ADVERTISEMENT.

THREE of the Four Divisions of the ENGLISH CYCLOPÆDIA having been completed, and the publication of the FOURTH DIVISION having commenced, the Proprietors desire to call attention to the character of the Cyclopædia, as a *complete* body of knowledge.

As separate works, the nature of the Cyclopædia of GEOGRAPHY, of BIOGRAPHY, of NATURAL HISTORY, and of ARTS AND SCIENCES, is sufficiently clear. But, taken as a whole, the connection of these great Divisions may require some very brief elucidation.

If the English Cyclopædia had been arranged in *two* Alphabets instead of in four, the one department might have been called *Literary*, the other *Scientific*.

The Cyclopædia of GEOGRAPHY, and the Cyclopædia of BIOGRAPHY, forming Ten Volumes, embrace together not only the Description of every Country, but its History in all ages. Under the Geographical name will be found a rapid view of a nation's progress. Under the Biographical names will be found all the great public events, and the religious, moral, and intellectual history of every State, as detailed in the lives of its eminent citizens.

The Cyclopædia of NATURAL HISTORY, and the Cyclopædia of ARTS AND SCIENCES, now in course of publication, and forming also Ten Volumes, present every feature of the Physical and Moral Sciences, and of the applications of Science to Productive Industry. This concluding Division also embraces all branches of miscellaneous information not strictly referable to these general heads.

The English Cyclopædia is founded upon the valuable Copyright of the Penny Cyclopædia, which has always remained in the hands of MR. KNIGHT. Every article in that celebrated work was an original contribution, furnished by many of the most eminent men of the time. The elaborate revisions, with the large additions, of the present work, have involved a new outlay for literary labour of not less than Seven Thousand Pounds, making the cost of literary production alone of these Twenty Volumes, not far short of Fifty Thousand Pounds.

THE

ENGLISH CYCLOPÆDIA.

A New Dictionary of Universal Knowledge.

CONDUCTED BY CHARLES KNIGHT.

ARTS AND SCIENCES.—VOLUME I.

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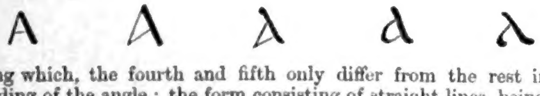
THE

ENGLISH CYCLOPÆDIA.

ARTS AND SCIENCES.

A, the first letter of the alphabet in the English, and many other languages. As a sound, its power in the English language is at least fourfold, as in the words *father*, *call*, *tame*, and *hat*. The first of these sounds is that which generally prevails in other languages. The modified pronunciation of the vowel in *tame* is partly due to the vowel *e* at the end of the word; in *call* and similar forms, the peculiarity arises from the letter *l*; so that the only true sounds of the vowel are perhaps the long sound in *father*, and the short one in *hat*. The printed forms of this letter, viz., the capital A, the small character a, and the italic *a*, are all derived from a common form, differing but slightly from the first of the three. In the old Greek and Latin alphabets, from which our own has descended, the following were the ordinary figures of this letter:—



among which, the fourth and fifth only differ from the rest in the rounding of the angle; the form consisting of straight lines being well adapted for writing on stone, metal, &c.; the rounded letter, on the other hand, being better suited for expeditious writing, with softer or more flexible materials. From this last our two small characters are easily deduced. For the explanation of the fact that this letter is allowed the first place in the series of letters, see ALPHABET.

A or AN, the indefinite article. Of the two, *an* is used before a vowel. Where the following word begins with a consonant, it being more troublesome to express the final *n*, this letter, from not being pronounced ceased to be written. Thus we say *an emperor*, but instead of *an king*, we find it more convenient to say *a king*. Sometimes a virtual consonant exists at the beginning of a word without being written, as in *union* and *once*, where the ear catches the initial sounds of *y* and *w*, *younion* and *wunce*. Before such words it is customary to drop the final letter of the article, at least in pronunciation, and there can be no good reason for not writing *a union*, *a once beloved monarch*. On the other hand, whenever *h* is mute, we should retain the *n* both in writing and speaking, thus, *a history*, but *an historical work*. That *an* and not *a* is the primitive form of the article, is proved by the Anglo-Saxon *an*, and the German *ein*; indeed, our own numeral *one* is only another and fuller form of the same word. In such phrases as *three shillings a pound*, the article evidently has this meaning. The double shape of our article has led to a corrupt mode of writing certain words, thus from *an eft* was deduced *a neft*, *a newt*; and the reverse seems to have taken place in the change of *a nadder* to *an adder*.

A, as a prefix in English words. 1. In such words as *afoot*, *aside*, *aboard*, we have simply, as Horne Tooke observes, corrupted abbreviations of *on fote*, *on syde*, *on borde*, &c. This *on* is an Anglo-Saxon preposition with the meaning of *in*. Thus, in the old translation of the New Testament we have *he fell on sleep*, for *asleep*. The same is the origin of the *a*, which so often precedes our verbal nouns in *ing*, as *he is gone a-walking*, *the house was so many years a-building*; and indeed it was only by the suppression of this *a* that our imperfect participles in *ing* came into use. A similar formation appears in the French *en sortant*, &c., and the Celtic languages generally form their imperfect participle, by prefixing a preposition of similar power to the infinitive, that is, to an abstract noun expressing the idea of the verb. 2. But an *a* also appears at times in the formation of the perfect participle. Thus *ago*, formerly *agone*, *ashamed*, *afeard*, now dishonoured as a vulgarism, are the perfect participles of the verbs *go*, *shame*, and *fear*, the latter of which meant in our old writers, to cause, not to feel fear. It was only as a reflective verb *I fear me*, that we have the idea of the Latin *vereor*, and our modern *I fear*. This non-accented *a* is but a variety of the *y*, so familiar in the old participles *yclept*, *yseen*, &c., and consequently it represents the *ge* of the German *ge-gangen*, &c., which is commonly allowed to be an old preposition signifying *thoroughly*. 3. In some verbs of Saxon origin, the prefixed *a* represents the inseparable preposition *on* of the Anglo-Saxon, a little word no way connected with the preposition *on* already noticed, for it corresponds to the German *ent* and Greek *ανα*. Thus *to awake*, that is, *to wake up*, is the Anglo-Saxon *on-wacan*; and *a-cknowledge* is closely related to the Anglo-Saxon *on-cnáwan*, and the Latin *a-gnosc-ere*, whose prefix is of similar origin, and no way related to the ordinary Latin preposition *ad*. 4. On the other hand, in some of our Norman words, such as *amount*, *avail*, and their compounds, so familiar in legal language, *par-amount*, *par-aval* (See Mr. Ludlow's paper, 'Philolog. Soc. Trans.' for 1854, p. 114), we have, as in the ordinary French preposition *à*, the representative of the Latin *ad*, *ad montem, up*; *ad vallem, down*. 5. Lastly, our obsolete or Lowland-Scotch compound prepositions *a-fore*, *a-yont*, *a-hint*, must be placed beside the current forms, *be-fore*, *be-yond*, *be-hind*, *ab-aft*, *ab-out*, *ab-ove*; forms which point to a disyllabic preposition *abe*. In the same way, the Homeric *ενι*, appears in kindred languages sometimes as *in* or *en*, sometimes as *ni* or *ne*, and as *i* alone, as in *i' the*, &c.

AB, the fifth month of the ancient Hebrew year, but now the eleventh (or, in intercalary years, the twelfth), in consequence of the transfer of the new year from spring to autumn.

On the 1st day of Ab a fast is held in commemoration of the death of Aaron. On the 9th a fast is observed in remembrance of the destruction of the Holy Temple by Nebuchadnezzar in 588 B.C., and of the destruction of the second Temple by Titus, A.D. 70. This fast is considered the most mournful of the whole year. On the 18th another fast is observed. All these fasts are postponed one day if they fall on the Saturday.

A little festival called Tub-ab, or the fifteenth Ab, is celebrated on the 15th day, to commemorate an ancient custom, according to which the young girls of each tribe came forth into the fields clothed in white, and exhibited themselves in dances before the young men, with the view of being selected by them in marriage.

The month of Ab may begin in some years as early as the 10th of July, in others as late as the 7th of August.

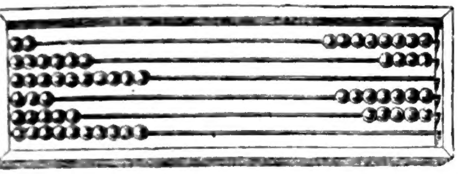
Ab is the name of the twelfth month of the Syrian year, coinciding with our August.

ABACISCUS, in architecture, is a diminution of the architectural term ABACUS, and is principally applied, when used at all, which is not often, to the tiles or squares of a tessellated pavement.

A'BACUS, a game among the Romans; so called from its being played on a board, somewhat in the manner of chess.

A'BACUS, in architecture, is the level tablet, whether square or oblong, which is almost always placed on the moulded or otherwise enriched capital of a column, to support the horizontal entablature. The architectural application of the term Abacus, which in the original is applied to any rectangular tile-like figure, arises from a story which Vitruvius tells of the manner in which the foliated capital called the Corinthian originated. The modifications in its form in the various orders of Greek and Roman architecture will be seen in the article COLUMN. In Gothic architecture, the abacus undergoes numerous changes and modifications, not merely in the several styles, but also in each style. To a great extent, it appears to have been treated in Gothic architecture according to the fancy of the individual architect: at any rate, it was not regulated by strict rules as in the classic orders. But it may be stated generally, that in the Romanesque, or what in England is commonly known as the Norman style, the abacus is usually square; in first pointed, or Early English gothic, it is nearly always round; and in the later styles more commonly octagonal. In French gothic however the square abacus was retained much longer than in the English.

ABACUS, an instrument employed to facilitate arithmetical calculations. The name may be given with propriety to any machine for reckoning with counters, beads, &c., in which one line is made to stand for units, another for tens, and so on. For teaching the first principles of arithmetic, a convenient abacus would be about three times as long as it is broad. It consists of a frame, traversed by stiff wires, on which beads or counters are strung so as to move easily. The beads on the first row are units, those on the next tens, and so on. There is an instrument sold in the toy-shops with twelve wires, and twelve beads on each wire, for teaching the multiplication-table; but it may be made still further useful in judicious hands.



The abacus can never be much used in this country, owing to our various division of weights and measures. We should need one abacus for pounds, shillings, and pence; another for avoirdupois weight; a third for troy weight; and so on. In China, however, where the whole system is decimal, that is, where every measure, weight, &c., is the tenth part of the next greater one, this instrument, called in Chinese shwanpan, is very much used, and with astonishing rapidity. It is said that while one man reads over rapidly a number of sums of money, another can add them so as to give the total as soon as the first has done reading. Their abacus differs from the one described above, in having only five beads on each wire, one of which is distinguished from the rest either in colour or size, and stands for five. There is one of these instruments in the East India Company's Museum. The Greeks and Romans used the same sort of abacus, at least in later times. The Russians are also much in the habit of performing calculations by strings of beads. A chequered board, such as we still sometimes see at the doors of public-houses, was formerly used in this country as an abacus, and a chess-board would now do very well for the purpose of instruction above-mentioned. The multiplication-table is sometimes called the Pythagorean abacus.

In 1839, Dr. Reid brought before the notice of the British Association a small apparatus, which he called a *Chemical Abacus*, and which he had found useful in introducing his pupils to a precise knowledge of the constitution of the more important chemical compounds. It consisted of a wooden frame with cross-wires and beads on the wires; each wire corresponded to a chemical element, and the beads to atoms; while the names of the elements were placed on the frame at the extremities of the wires. Dr. Daubeny suggested that the apparatus might be improved, by having the beads of different colours to correspond with the different elements.

The advocates of decimal coinage in England might strengthen their advocacy by a notice of the possible usefulness of the abacus as a reckoning apparatus under that system.

For mechanical aid of a more complex kind, in calculating and registering processes, see CALCULATING MACHINES. Examples of a special character are noticed under SLIDE RULE.

ABANDONMENT, a term used in marine insurances. Before a person, who insures a ship or goods, can demand from an insurer, or underwriter, the stipulated compensation for a total loss of such ship or goods, he must abandon or relinquish to the insurer, all his interest in any part of the property which may be saved.

ABATEMENT. This word is derived from the old French word *abater*, which signifies to beat down, prostrate, or destroy. But before entering upon an explanation of the present meaning of the term, it will be well to observe, for the information of those who may not be acquainted with the history of our law, that by far the greater number of the terms of art (as they may be called) peculiar to it, are derived either from the Norman-French, or the Latin. We shall therefore give a cursory view of the circumstances which led to their adoption.

When William I., commonly styled the Conqueror, became King of England, he filled all the posts of profit and honour with subjects from his Norman dominions—the civil places chiefly with ecclesiastics. Foreign priests having thus obtained all the seats of the judges and other officers of the superior courts of justice, it was found necessary to ordain that all proceedings in them should be carried on in the Norman tongue instead of the English, of which these new judges were for the most part altogether ignorant. This practice continued until Edward III. abolished the use of French, and substituted English as the language of such pleadings. At the same time that all arguments and judgments were spoken in French, the written parts of the proceedings, such as the writs and records, were engrossed in the Latin language, a practice which continued long after Edward III. had expelled the French tongue from our courts; for it was not until the reign of George II., that an Act of Parliament was passed, providing that writs and records should for the future be in English.

It will be evident that, under the circumstances described, the more ancient legal terms would, whenever that could conveniently be done, be translated into the French and Latin languages; and as, during the periods mentioned above, the laws of England experienced great alterations and received many additions, abundance of new terms were necessarily called for to express new notions, and were naturally drawn from the languages then in legal use. Many of the expressions thus translated, and those first invented, are employed at the present day with little or no alteration. Of this we have an example in the term which is the subject of this article.

The word *abatement* is used in its literal sense when we speak of abating or *beating down* a nuisance. Whatever unlawfully annoys or does damage to any person, is a nuisance, which he may abate, that is, beat down and remove: provided he commits no breach of the peace, and does no more injury to the thing than is necessary for effecting his purpose. If a new house or a wall be erected so near to an old house as to obstruct its ancient lights, this is a private nuisance, which the person injured may peaceably abate. If a gate or other obstruction be placed across a public road, this is a public nuisance, and any person may beat down and remove it. But a person thus taking the law into his own hands, must be careful, in every case, to do no more than is absolutely necessary to enable him to exercise or enjoy his own right.

Another signification of abatement is that of abating a civil action, or an indictment. Here it is taken figuratively, and signifies the beating down or overthrowing such action or indictment. This is effected in an action at law, by way of plea, stating some matter which renders it the duty of the court to put an end to the proceedings. Thus, it may be alleged that the plaintiff in such proceedings is an outlaw, or an attainted person, or otherwise incompetent to maintain an action; or that there are other persons still living who are equally liable with the defendant, and ought to be joined with him in the demand. But it is a rule that he who takes advantage of a flaw must, at the same time, show how it can be amended; and pleas in abatement must, therefore, not only point out the flaw, but disclose the remedy. Therefore, if a defendant pleads that another ought to be sued along with him, he must state where he can be found; for if he be not within the jurisdiction so as to be served with a writ, the plea is bad. Pleas in abatement have always been discouraged by the courts; and they are required to be verified by affidavit (4 & 5 Anne c. 16; 3 & 4 Will. IV. c. 45). But in consequence of the ample powers of amendment conferred by the Common Law Procedure Act, 1852, such pleas are now of rare occurrence.

A similar observation applies to pleas in abatement in criminal proceedings (14 & 15 Vict. c. 100). If an indictment assign to the defendant no Christian name or a wrong one, no surname or a wrong one, he may plead this matter in abatement; and so formerly, when an addition or description of the calling of a defendant was required, an error in or want of it was the subject of a plea. This addition or description is no longer necessary. (13 & 14 Vict. c. 100, s. 24.) Misnomer then is the only case in which a plea in abatement has been usual in practice; and, at the present day, such a plea is of no avail to a defendant, for the court has authority to amend the indictment, and then call upon the party to plead to the charge (Blackst. 'Comm.' Mr. Kerr's ed. vol. iii. p. 325; iv. 396). Again, if a plaintiff dies, or a female plaintiff marries, the proceedings are said to be abated; and if a defendant dies, the proceedings as to him are said to abate. Whenever the interest of the person who dies survives to those who represent him, the action or suit may be revived; and so when the subject matter of the proceeding is one for which the representatives of the deceased may be made liable, the action or suit may be revived and continued against them. ('Blackst. Comm.' Mr. Kerr's ed. vol. iii. pp. 463, 519.)

It is said to be "an abatement when a man dies seised of an estate of inheritance, and between the death and the entry of the heir, a stranger doth interpose himself and abate." ('Co. Litt.' 277 a.) This entry of a stranger on the lands is an abatement; the effect of which is that the true owner can only recover the seisin by entry [ENTRY]. If the abator died seised, the land descended to his heir, and the right of entry at common law was gone. The true owner must then have resorted to a particular form of action. Now, however, the right of entry subsists (3 & 4 Will. IV. c. 27), enabling the true owner to recover either by entry or the ordinary action of ejectment.

(Blackstone's *Commentaries*, Mr. Kerr's ed. vol. iii. p. 170.)

ABATEMENT OF LEGACIES. [LEGACY.]

ABATIS, a military term, signifying a work composed of felled trees, with the softer branches cut off, laid side by side with the ends from which the branches grow towards the enemy; thus forming an obstruction to his progress, and a breast-work for musketry to fire over. This species of defence is often used in fieldworks, where wood, not of too great size, is plentiful. Lines, flanked by bastions, are thus formed, either simply by laying down and fastening the trees, or, if when so placed they would be too high to fire over, by sinking them in a ditch whose section is an angle with its longest slope towards the enemy. They are sometimes formed against the counterscarp of a rampart, sometimes in the covered way, and may generally be used wherever an obstruction is to be raised to the enemy's progress, provided they can be flanked by a fire sufficient to prevent his destroying them at his leisure.

ABATTOIR. An abattoir is the French name for a slaughter-house. The existing French system was first adopted at Paris in 1817, and completed in 1818. There are three abattoirs on the north side of Paris, and two on the south side, not far from the barriers, and about two miles from the centre of the city. The cattle markets for the supply of Paris are several miles distant, and the cattle are driven from them round the exterior boulevards to the abattoirs, and consequently do not enter the city. At one of the abattoirs each butcher has his slaughter-house, a place for keeping the meat, an iron rack for fat, pans for melting it, and a place with convenience for giving cattle hay and water, and where they may be kept before being slaughtered. A fixed sum is charged for this accommodation, the charge for cattle being a franc and a half per head, and the blood, brains, and entrails. In some of the abattoirs, two or three butchers use the same slaughter-house. There are 240 slaughter-houses in all. The income of the establishment, arising from these fees, the sale of manure, &c., was above 48,000*l.* in 1842. An inspector is appointed at each abattoir, and means are taken to prevent unwholesome meat being sold. The manufactories of glue, gelatine, Prussian blue, hoof-oil, blood-manure, and other chemicals produced from offal, are conveniently placed near the abattoirs. Much of the fat is melted down at the abattoirs, and tripe is also prepared within the establishments. An excellent account of the abattoirs at Montmartre will be found in 'Household Words,' vol. ii. p. 556; and another in Head's 'Faggot of French Sticks.' There are slaughter-houses under public regulations in most of the Continental cities; and those of New York and Philadelphia, and some other of the cities of the American Union, are, it is said, placed on a similar footing.

The great cattle-market in Smithfield, for the supply of London, existed above five centuries, but the spot was originally a piece of waste ground beyond the city, instead of being, as at present, surrounded by a dense population. The cattle sold for the London market amount annually to about 240,000, the sheep to about 1,700,000, calves 28,000, and pigs 35,000. A large proportion of these are slaughtered within the limits of the metropolis. There are slaughtermen who kill for other butchers frequently above a hundred head of cattle, and perhaps five or six hundred sheep, every week; many butchers kill for themselves to a considerable extent, and there are few who have not accommodation for slaughtering and dressing a few sheep, either in the cellar underneath their shop, or in the rear of their premises. The slaughter-houses for sheep in Newgate Market, many of which are in cellars, and in Warwick Lane, are close to Newgate Street, and within a hundred and fifty yards of Ludgate Street, two of the great thoroughfares of London.

The inconveniences attending the system of having the cattle-market and the slaughter-houses in the midst of the metropolis were seriously felt; and, after a long opposition on the part of the city authorities, an Act of Parliament was passed in August 1851 for removing it to a spot of ground of about 15 acres, between the Caledonian Road and Maiden Lane, on the north of London. The execution was intrusted to the corporation of the city of London. It was undertaken and carried out in a liberal spirit. Considerable architectural merit is shown in the designs for the various buildings and the surrounding wall. Excellent accommodation has been provided for the animals, with a large supply of water for them and for cleansing the market, and facilities for the transaction of business, by the erection of banking-houses, hotels, &c. When completed, the old market in Smithfield was closed on September 11th, 1855, and the new one opened on September 13th. It provides space for about 35,000 sheep, 6600 oxen, 1425 calves, and 900 pigs; with lairage for 3000 oxen and 8000 sheep. There are two public slaughter-houses, at which 600 oxen can be killed weekly,—the only approach made in the metropolis to the abattoir system; but still the greater proportion of beasts and sheep are driven through the crowded streets of the metropolis to be killed at private slaughter-houses, many yet remaining in Warwick Lane and the vicinity of Newport Market. But strenuous attempts have been made to lessen the nuisance even in these. By the Towns Improvement Act (10 & 11 Vict. cap. 34, 1857), they have to be registered and licensed; even for those in which private butchers slaughter at home powers of inspection are given, and provision is made for the removal of offal and ordure. These regulations are not confined to the metropolis, but are extended to all towns; and the execution of the provisions of the Act were intrusted to Boards of Health, and are now, by the Local Government Act (21 & 22 Vict. cap. 98), transferred to the municipality or other governing body of the town or place; but as the adoption of this Act is optional, the supervision in many places remains with the Boards of Health, or has not been brought into operation. These Acts are confined to England and Wales; but in Edinburgh an abattoir has been provided that may be a model to municipalities who may concern themselves for public good, and many other towns have provided themselves with excellent abattoirs within the last few years. In these places, however, the use of the abattoir is not compulsory and private slaughter-houses continue to exist in most if not in all of them.

ABBÉ is the French term for Abbot. In France, before the Revolution, Abbé was the denomination of a very numerous body of persons, who had little or no connection with the Church, except the apparent one which they derived from this title, which frequently occurs in the literary and political history of that period. Many of them had not even received the tonsure, which is, in Roman Catholic countries, the first and indispensable mark of the clerical character. So far back as the end of the 17th century, we find Richelet, the lexicographer, complaining that there was scarcely a young man, tolerably well made, and who had acquired the air of an ecclesiastic, who did not, by an insufferable abuse, assume the style of Monsieur l'Abbé. Another author, Mercier, writing a century later, describes, with some asperity, the effeminate manners and dandyism of the same class of characters. The abbés occupied a very conspicuous place in French society, and discharged a variety of domestic functions. Many of the abbés however followed a more useful and creditable way of life. Some acted as private tutors in families, though these were seldom treated with much respect, and were consequently in general persons of very inferior qualifications. Others were professors of the university; and a great many employed themselves as men of letters, in which capacity their labours have given to the title of Abbé an honourable celebrity, and redeemed it from the universal contempt to which swarms of frivolous and intriguing sycophants would otherwise have reduced it.

ABBÉS COMMENDATAIRES, were such abbés as held abbeys in commendam,—that is, with the right of administering their revenues, or a part of them. There were, before the Revolution, between 200 and 300 abbeys in France, which the king had the privilege of conferring in commendam; and it was the expectation of obtaining one of these benefices which induced so many persons to take the title of Abbé. Before obtaining such preferment, they used to be called *Abbés de sainte espérance*, abbés of holy hope. After they were thus provided for, they were Abbés Commendataires. The papal bull, which ratified their appointment, commanded them in all cases to get themselves ordained priests within the year, or as soon as they should arrive at the canonical age (five-and-twenty) on pain of the benefice being declared vacant; but it was common to obtain dispensations for disregarding this condition, and most of them remained Secular Abbés. The Abbé Commendataire received the third part of the revenues of his abbey, and also enjoyed certain dignities and privileges which it is unnecessary to specify; but the actual government of the house was committed to the hands of a resident superior, the *prieur claustral,* who was in almost all respects quite independent of the sinecurist, his colleague.

ABBESS, the superior of a nunnery, or other female religious community. An abbess, in the Roman Catholic Church, possesses, in general, the same dignity and authority as an abbot, except that she cannot exercise the spiritual functions appertaining to the priesthood. According to a decree of the Council of Trent, an abbess, at the time of her election, ought to be at least forty years old, and to have made profession for eight years. It is forbidden that any person be elected to the dignity who has not been professed for five years, or is under thirty years of age.

ABBEY, a religious community presided over by an abbot or abbess. When the superior was denominated a prior, the establishment was called a priory; but there was latterly no real distinction between a priory and an abbey. The priories appear to have been all originally off-shoots from certain abbeys, to which they continued for some time to be regarded as subordinate. The wealthiest abbeys, in former times, were in Germany; and of all such foundations in the world, the most splendid and powerful was that of Fulda, or Fulden, situated near the town of the same name in Franconia. This monastery, which belonged to the order of St Benedict, was founded by St. Boniface, in the year 784. Every candidate for admission was required to prove his nobility. The monks elected their abbot from their own number; and that dignitary became, by right of his office, Arch-Chancellor to the Empress, and Prince Bishop of the diocese of Fulda. He claimed precedence over all the other abbots both of Germany and of France. One of the first effects of the Reformation both in England and in Germany was the destruction of the religious houses; although, even in the Protestant parts of the latter country, a few male and female monastic communities still subsist. In England their extinction was complete. The preface to Bishop Tanner's 'Notitia Monastica' may be consulted for the most accurate account that has been given of the number and revenues of the English monasteries at the time of the dissolution. From this statement, it appears that, by the Act of Parliament passed in 1535 for the suppression of all those having a less revenue than 200*l.* a-year, about 380 houses were dissolved; from whose possessions the crown derived a revenue of 32,000*l.*, besides plate and jewels to the value of about 100,000*l.* By an act passed in 1539, all the remaining monasteries were suppressed, to the number of 186; the revenues of these amounted to 100,000*l.* per annum. Besides the monasteries, 48 houses of the knights hospitallers of St. John were also confiscated to the crown. Other authorities make the wealth of the monastic establishments much greater than it would appear to have been from this account; and it is probable that the revenues of many of them, at the period of the dissolution, had been considerably diminished by the precautions which the abbots were led to take in anticipation of that event. Camden states the whole number of the religious houses that were suppressed at 645. In the earlier times of the French monarchy, the term abbey was applied to a duchy or earldom, as well as to a religious establishment; and the dukes and counts called themselves abbots, although remaining in all respects secular persons. They took this title in consequence of the possessions of certain abbeys having been conferred upon them by the crown.

ABBOT, the title of the superior of certain establishments of religious persons of the male sex, thence called Abbeys. The word *Abbot*, or *Abbat*, as it has been sometimes written, comes from *Abbatis*, the genitive of *Abbas*, which is the Greek and Latin form of the Syriac *Abba*, of which the original is the Hebrew *Ab*, father. It is, therefore, merely an epithet of respect and reverence, and appears to have been at first applied to any member of the clerical order, just as the French Père and the English Father, having the same signification, still are in the Catholic Church. In the earliest age of monastic institutions, however, the monks were not even priests; they were merely religious persons who retired from the world to live in common, and the abbot was that one of their number whom they chose to preside over the association. In regard to general ecclesiastical discipline, all these communities were at this time subject to the bishop of the diocese, and even to the pastor of the parochial district within the bounds of which they were established. At length it began to be usual for the Abbot, or, as he was called in the Greek Church, the Archimandrite, or Hegumenos (that is, the chief monk, or leader), to be in orders; and since the 6th century monks generally have been priests. In point of dignity an abbot is next to a bishop; but there have been many abbots in different countries who have claimed almost an equality in rank with the episcopal order. A minute account of the different descriptions of abbots may be found in Du Cange's 'Glossary,' and in Carpentier's Supplement to that work. In England, according to Coke, there used to be twenty-six abbots (Fuller says twenty-seven), and two priors who were Lords of Parliament. These, sometimes designated Sovereigns, or General Abbots, wore a mitre, not exactly the same as that of the bishops, carried the crozier in their right hand, while the bishops carried theirs in their left, and assumed the episcopal style of Lord. Some croziered abbots, again, were not mitred, and others who were mitred were not croziered. Abbots who presided over establishments that had sent out several branches were styled Cardinal-Abbots. There were likewise, in Germany, Prince-Abbots, as well as Prince-Bishops. In early times we read of Field-Abbots (in Latin, *Abbates Milites*) and Abbot-Counts (*Abba-Comites*, or *Abbi-Comites*). These were secular persons, upon whom the sovereign had bestowed certain abbeys, for which they were obliged to render military service as for common fiefs. A remnant of this practice appears to have subsisted in our own country long after it had been discontinued on the Continent. Thus, in Scotland, James Stuart, the natural son of James V., more celebrated as the Regent Murray, was, at the time of the Reformation, Prior of St. Andrew's, although a secular person. The secularisation of some of the German ecclesiastic dignities has since occasioned something like a renewal of the ancient usage. We have in the present century seen a prince of the House of Brunswick (the late Duke of York) at the same time Commander-in-Chief of the British army and Bishop of Osnaburg.

The efforts of the abbots to throw off the authority of their diocesans long disturbed the Church, and called forth severe denunciations from several of the early councils. Some abbeys, however, obtained special charters recognising their independence; a boon which, although acquired at first with the consent of the bishop, was usually defended against his successors with the most jealous punctiliousness. Many of the abbots lived in the enjoyment of great power and state. In ancient times they possessed nearly absolute authority in their monasteries. The external pomp and splendour with which an abbot was in many cases surrounded, corresponded to the extensive authority which he enjoyed within his abbey, and throughout its domains. St. Bernard is thought to refer to the celebrated Luger, abbot of St. Denis, in the beginning of the 12th century, when he speaks, in one of his writings, of having seen an abbot at the head of more than 600 horsemen, who served him as a cortège. Even in the unreformed parts of the Continent, however, and long before the French Revolution, the powers of the heads of monasteries, as well as those of other ecclesiastical persons, had been reduced to comparatively narrow limits; and the sovereignty both of abbots and bishops had been subjected in all material points to the authority of the civil magistrate.

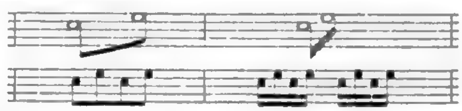
The title of Abbot has also been borne by the civil authorities in some places, especially among the Genoese, one of whose chief magistrates used to be called the Abbot of the People. Nor must we forget another application of the term which was once famous in our own and other countries. In many of the French towns there used, of old, to be annually elected from among the burgesses, by the magistrates, an Abbé de Liesse (in Latin *Abbas Lætitiæ*), that is, an Abbot of Joy, who acted for the year as a sort of master of the revels, presiding over and directing all their public shows. Among the retainers of some great families in England was an officer of a similar description, styled the Abbot of Misrule; and in Scotland the Abbot of Unreason was, before the Reformation, a personage who acted a principal part in the diversions of the populace, and one of those whom the zeal of the reforming divines was most eager in proscribing.

ABBREVIATION, a mathematical term, given to the process by which a fraction is reduced to lower terms. Thus, the division of the numerator and denominator of $\frac{48}{56}$ by 8, which reduces it to $\frac{6}{7}$, abbreviates the fraction.

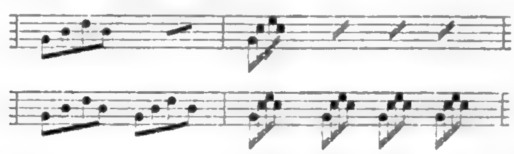
ABBREVIATION, in music, is a kind of stenography, or shorthand, which much diminishes the labour of the composer and copyist. It frequently happens, not only that the same note is reiterated, but that the same passage is repeated; and the necessity of writing at length such repetitions is avoided by the use of certain well-contrived and simple abbreviations. Those most commonly employed are:—I. One dash or more, through the stem of a minim or crochet, or under a semibreve, by which such note is converted into as many quavers, semiquavers, &c., as it is equal to in time. Ex.

are to be played thus,—

II. Two alternate notes, frequently repeated, are commonly abridged in the following manner,—



III. The groups of notes called arpeggios are thus contracted, the dash alone denoting repetition;—



IV. The word *simili* (the same) signifies that the group of notes is to be repeated. *Bis* (twice) written over a bar, or a passage, denotes repetition.

ABBREVIATIONS, the shortening of a word or phrase, made either by omitting some letters or words, or by substituting some arbitrary mark.

Abbreviations are of two kinds; first, those which are used in familiar speech, by which two words are made one, as can't for can not, won't for will not, &c., and those which are employed in writing only; our business is with the latter.

Before the invention of printing, every expedient to abridge the enormous labour of copying would be naturally adopted, and the principle, once introduced, was followed where the necessity which led to its first employment no longer existed. Latin inscriptions are not unfrequently quite unintelligible to the best scholar who has not given the subject his particular attention, and many are ambiguous even to the most skilful. The most usual Latin abbreviation is the initial letter instead of the whole word; whether a name, as M. for Marcus, P. for Publius; or a relation, as F. for filius, a son; or an officer, as C. for consul, Qu. for quæstor, &c.

The Rabbins carried this practice to a great extent; and although, in copying the Bible, they carefully abstained from abbreviations, their other writings are filled with them. They even carried their abbreviations into their common tongue, and when they had contracted a name or sentence, by taking the initials only, they made words of the unconnected letters by the interposition of vowels. Thus, for Rabbi Levi ben Gerson, they took the first letters, R.L.B.G.; and, by the interposition of vowels, made the word Ralbag.

In the middle ages the practice of abbreviating increased; and even in printing, where the employment of contractions was much less necessary, the old mode was by no means abandoned. Many writings became unintelligible; and in matters of law and government the difficulties thus created demanded the interposition of Government. An Act of Parliament was passed in the fourth year of George II., by which the use of abbreviations was altogether forbidden in legal documents; and although this was so far modified by another act, within a year or two, allowing the use of those of common occurrence, the old practice was never completely revived. A few only are still employed, chiefly in titles, coins, and commercial transactions; the most important of which follow:

TITLES.

A.A. Associate of Arts.
A.B. Bachelor of Arts.
A.E.R.A. Associated Engraver of the Royal Academy.
A.M. Master of Arts.
Abp. Archbishop.
A.R.A. Associate of the Royal Academy.
Bp. Bishop.

Bart. or Bt. Baronet.
B.A. Bachelor of Arts.
B.C.L. Bachelor of Civil Law.
B.D. Bachelor of Divinity.
Clk. Clerk, a Clergyman.
C.B. Companion of the Bath.
Dr. Doctor.
D.C.L. Doctor of Civil Law.
D.D. Doctor of Divinity.
Mus. D. Doctor of Music.
Esq. Esquire.
F.G.S. Fellow of the Geological Society.
F.L.S. Fellow of the Linnæan Society.
F.M. Field Marshal.
F.R.A.S. Fellow of the Royal Astronomical Society.
F.R.C.S. Fellow of the Royal College of Surgeons.
F.R.G.S. Fellow of the Royal Geographical Society.
F.R.S. Fellow of the Royal Society.
F.S.A. Fellow of the Society of Antiquaries.
G.C.B. Grand Cross of the Bath.
G.C.H. Grand Cross of Hanover.
H.E.I.C. Honourable East India Company.
H.R.H. His or Her Royal Highness.
J.P. Justice of Peace.
J.V.D. of Canon and Civil Law.
Kt. Knight.
K.B. Knight of the Bath.
K.C.B. Knight Commander of the Bath.
K.C.H. Knight Commander of Hanover.
K.G. Knight of the Garter.
K.H. Knight of Guelph of Hanover.
K.M. Knight of Malta.
K.P. Knight of St. Patrick.
K.T. Knight of the Thistle.
Lp. Lordship.
LL.D. or B. Doctor or Bachelor of Laws.
Mr. Mister.
Mrs. Mistress.
Messrs. Gentlemen.
M.A. Master of Arts.
M.D. Doctor of Physic.
M.P. Member of Parliament.
M.R.C.S. Member of the Royal College of Surgeons.
M.R.C.S.E. Member of Royal College of Surgeons, Edinburgh.
M.R.I.A. Member of the Royal Irish Academy.
M.R.S.L. Member of the Royal Society of Literature.
Q.C. Queen's Counsel.
R.A. Royal Academician.
Rt. Hon. Right Honourable.
R.E. Royal Engineers.
R.M. Royal Marines; in Ireland, Resident Magistrate.
R.N. Royal Navy.
S.C.L. Student of Civil Law.
S.S.C. Solicitors before Supreme Courts.
S.T.P. Professor of Divinity.
W.S. Writer to the Signet.

ON ENGLISH COINS.

A.C. Arch-Chancellor.
A.D. Arch-Duke.
A.T. Arch-Treasurer.
B. et L. D. Duke of Brunswick and Lunenberg.
D.G. By the Grace of God.
F.D. Defender of the Faith.
S.R.I. Holy Roman Empire.
M.B.F. et H. Great Britain, France, and Ireland.
R. Rex, King, or Regina, Queen.

COMMERCIAL.

Cr. Creditor.
Dr. Debtor.
Do. or ditto, the same.
No. Number.
f.o.b. free on board.
Fo. Folio.
4to. Quarto.
8vo. Octavo.
12mo. Duodecimo.
Ro. Right-hand page.
Vo. Left-hand page.
L.S.D, Pounds, Shillings, and Pence.
A.R.P. Acres, Roods, and Poles.
Cwt. Qr. Lb. Oz. Hundredweights, Quarters, Pounds, and Ounces.

MISCELLANEOUS.

A.B. Able Seaman.
A.D. the year of our Lord.
A.H. the year of the Hegira.
A.M. the year of the World.
A.M. before noon.
A.U.C. the year of the building of Rome.
B.C. before Christ.
cf. compare.
Cur. or Ct. the Current Month.
D.O.M. Deo Optimo Maximo; or, to God the greatest Best.
D.V. Deo Volente; or, if it please God.
e.g. for example.
H.M.S. Her Majesty's ship.
H.S.E. Hic situs est, or Hic sepultus est—He is buried here.
I.H.M.S. Jesu Hominis Moritur Salvator.
i.e. that is.
ib. in the same place.
id. the same.
L.S. the place of the Seal.
MS. Manuscript.
N.B. Observe.
N.S. New Style (after the year 1752).
O.S. Old Style (before 1752).
Nem. con. without contradiction.
Nem. dis. unanimous.
Per proc. by procuration for.
P.M. Afternoon.
P.S. Postscript.
Prox. the next or coming month.
q.e.d. quod erat demonstrandum, which was to be demonstrated.
R.I.P. Requiescat in Pace; or, may he rest in peace.
s.p. sine prole, without issue.
sp. g. specific gravity.
ss. a half.
T.O. Turn over.
ult. the last month.
viz. namely.
U.S. United States.
Xmas. Christmas.
Xtian, Christian.

ABDICATION (from the Latin *abdicatio*) is the act of renouncing and giving up an office by the voluntary act of the party who holds it. But the term is now applied to the giving up of the regal office; and in some countries a king can abdicate in the proper sense of that term, whenever he pleases. But the Sovereign of England cannot abdicate, except with the consent of the two Houses of Parliament, in any constitutional form; for a proper abdication would be a divesting himself of his regal powers by his own will, and such an abdication is inconsistent with the nature of his kingly office. It is, however, established by a precedent that he does abdicate, or that an abdication may be presumed, if he does acts which are inconsistent with and subversive of that system of government of which he forms a part. Thus it was resolved by both Houses, in 1688, "King James II. having endeavoured to subvert the constitution of the kingdom, by breaking the original contract between king and people; and by the advice of Jesuits and other wicked persons, having violated the fundamental laws, and having withdrawn himself out of the kingdom; has abdicated the government, and the throne is thereby vacant." The Houses, in this well-known instance, proceeded on the doctrine of an *original contract* between the king and the people, as the foundation of their declaration that James II. had abdicated the throne; and hence, Blackstone, in arguing upon this declaration, assumes that the powers of the King of England were originally delegated to him by the nation. ('Blackstone's Commentaries,' Mr. Kerr's ed., vol. i., p. 198.)

It appears, by the parliamentary debates at that period, that in the conference between the two Houses of Parliament, previous to the passing of the statute which settled the crown upon William III., it was disputed whether the word "abdicated," or "deserted," should be the term used, to denote in the Journals the conduct of James II. in quitting the country. It was then resolved that the word "abdicate" should be used, as including in it the mal-administration of his government. It has been said that, in coming to this resolution, the Houses gave a new meaning to the word.

Among the Romans the term *Abdicatio* signified generally a rejection or giving up of a thing, and a magistrate was said to abdicate who for any reason gave up his office before the term was expired.

ABDOMEN, DISEASES OF. The abdomen is one of the largest cavities of the body, and besides the peritoneum, with which it is everywhere lined, contains the greater part of the digestive organs, the urinary organs, and the internal organs of generation. [ABDOMEN, NAT. HIST. DIV.] Any one of these organs may become diseased, and as they are all more or less accessible by external examination, it is of great importance in cases of suspected abdominal disease, that this should be had recourse to.

There is no part of the human body so well adapted for this kind of examination as the abdomen. Its walls are soft and yielding; some of its most important organs lie immediately beneath the surface; though they cannot be seen they can be felt; and several of their morbid conditions can therefore be ascertained with clearness and certainty.

Not only are some of the diseases of the abdominal viscera visible to the naked eye, but they are even strikingly expressed; for they either cause a permanent change in the configuration of the abdomen, or they produce a temporary alteration of its natural movements, or they occasion both effects.

Both in the male and in the female it often happens that diseases not to be ascertained, or at any rate exceedingly apt to be overlooked, or mistaken, if the region of the part affected be covered with its ordinary clothing, become manifest the moment the part in question is uncovered; or if not, are rendered obvious by other modes of inspection to which the removal of the clothing is indispensable.

The external examination of the abdomen, or the exploration of it, as it is technically termed, is comprised in simple inspection, manual examination, and percussion.

1. The simple inspection of the abdomen often affords valuable information. The mere alteration of its form is sometimes of itself sufficient to determine the seat and the nature of the disease. In each case of diseased organs the change is different; in each it is peculiar, and even characteristic. The abdomen may be affected with spasm, as in the disease called colic, or with inflammation, as in the disease called enteritis. Life may depend on the promptitude with which the true nature of the affection is detected. One set of remedies is required for one of these diseases, and a totally different set for the other. Remedies essential to the preservation of life, if the disease be inflammation, may be destructive of life, if the disease be merely spasm; and if under the notion that the disease is spasm, the remedies proper for inflammation be not employed, death may be the consequence of the error in less than twenty-four hours. In both affections the pain may be the same, and several other symptoms may be similar, but the form of the abdomen may be alone sufficient to determine the true nature of the malady; for, if it be inflammation, the abdomen will be rounded, enlarged, and distended; while if it be spasm, it will be drawn in and contracted. There are affections which place life in the most imminent danger, especially in children, in which it is difficult, if not impossible, to determine, from the symptoms alone, whether the seat of the disease be in the brain, or in the inner coat of the intestines. Suppose it be in the brain, one set of remedies are required, which must be applied to the head; suppose it be in the intestines, a different sort of remedies is required, which must be applied to the belly. An index is sometimes afforded to the real seat of the disease, by the mere form of the abdomen; while its size, combined with its form, oftener affords a still more certain guide; and so does any deviation from its natural movements.

2. Manual examination affords still more correct and complete information relative to the condition of the abdominal organs. The size, the tension, the temperature, the sensibility of the abdomen, the presence or absence of unnatural tumours or morbid growths within its cavity, the presence or absence of fluids, the nature and extent of the contents of the intestinal canal, may be ascertained with considerable precision by touch combined with pressure. Increase of temperature on the surface of the body is a most important sign of internal disease. Increase of temperature arises from a preternatural increase in the action of the arteries, and denotes inflammation of the part affected. All acutely inflamed organs are hotter than in their natural state, and if the inflammation be intense, the neighbourhood of the inflamed part gives to the hand of the examiner the sensation of pungent heat,

which is always a sign not only of disease, but of exceedingly severe disease.

Diminished temperature, which arises from diminished action in the arteries, and an overloaded state of the veins, is no less important as a sign of disease. It always denotes a most dangerous condition of the system, the danger being in proportion to the coldness. It is the concomitant of the worst forms of fever which are ever witnessed in this country; fever with a cold skin being incomparably more alarming than fever with even a pungently hot skin. In the cholera, the first, the most sure, and the most alarming sign of the invasion of the malady, is coldness of the system, and especially of the abdomen, the main seat of the malady; and it is uniformly found that there is no one sign which affords a better criterion of the extent of the danger, in any case, than the degree of coldness of the system in general, and of the abdomen in particular.

3. That mode of external examination of the body termed percussion —namely, the mode of eliciting sounds from the surface, the nature of the sound produced affording a knowledge of the condition of the parts beneath—has opened to the modern practitioner a new source of information, the careful and skilful employment of which has afforded practical results of far greater precision and importance than could possibly have been anticipated. This mode of examination has been applied principally, and with the most valuable results, to the detection of the diseases of the chest; but its application is just as necessary to diseases of the abdomen. The size of the liver, the part of the intestinal tube distended with air, and a variety of other particulars, may be obtained by the aid of percussion.

An account of the various diseases to which the abdominal viscera are subject, and their treatment, will be found in this work, either under the head of the diseases of the various organs, or the special terms by which such diseases are designated. [KIDNEYS, DISEASES OF; LIVER, DISEASES OF; ENTERITIS; PERITONITIS; DROPSY.]

ABDUCTION (from the Latin word *abductio*, which is from the verb *abducere*, to lead or carry off) is an unlawful taking away of the person of another, whether of child, wife, ward, heiress, or women generally.

Abduction of Child. [KIDNAPPING.]

Abduction of Wife may be either by open violence, or by fraud and persuasion. The law in both cases supposes force and constraint, the wife being unable to give a valid consent. The remedy of the husband in such a case is an action, by which he may recover, not the possession of his wife, but damages for taking her away; and by statute 3 Edward I. c. 13, the offender shall be imprisoned for two years, and fined at the pleasure of the king, that is, of the court. The husband is also entitled to recover damages against such as persuade and entice the wife to live separate from him without sufficient cause.

Abduction of Ward. A guardian is said to be entitled to an action if his ward be taken from him, but it is added that, for the damages recovered in such action, he must account to his ward when the ward comes of age. But it is very doubtful if such an action will now lie. It was grounded originally on the interest which the guardian, according to feudal notions, had in his ward's marriage; but since the abolition, in the reign of Charles II., of all the feudal tenures except socage, the ward's marriage has been of no value to the lord or guardian. An action would lie for loss of services, if the ward really rendered any to the guardian.

It may be added, that all questions between guardians and wards are now in general inquired into and determined by the Court of Chancery.

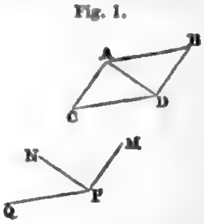
Abduction of Heiress. By 9 George IV. c. 31, when any woman shall have any interest in any estate real or personal, or shall be heiress presumptive or next of kin to any one having such interest, any person who from motives of lucre shall take or detain her against her will for the purpose of her being married or defiled, and all counsellors, aiders, and abettors of such offences are declared guilty of felony, and punishable by transportation for life, or not less than seven years, or imprisonment with or without hard labour. The taking of any unmarried girl under sixteen out of the possession of a parent or guardian is declared a misdemeanour, and is punishable by fine and imprisonment. The marriage, when obtained by means of force, may be set aside on that ground. In this case, as in many others, fraud is legally considered as equivalent to force; and, consequently, in a case where both the abduction and marriage were voluntary in fact, they were held in law to be forcible, the consent to both having been obtained by fraud.

Abduction of Women generally. The forcible abduction and marriage of women is a felony. Here, and in the case of stealing an heiress, the usual rule that a wife shall not give evidence for or against her husband is departed from, for in such case the woman can with no propriety be reckoned a wife where a main ingredient, her consent, was wanting to the contract of marriage; besides which, there is another rule of law, that "a man shall not take advantage of his own wrong," which would obviously be done here, if he who carries off a woman could, by forcibly marrying her, prevent her from being evidence against him, when she was perhaps the only witness to the fact.

ABERRATION (OF LIGHT), an astronomical phenomenon, being an apparent alteration in the place of a star, arising from the combined motion of the spectator, and the light which brings the impression of the star to his eye. We should however premise, in order that the reader may not form too large a notion of aberration, that it is never so much as 21", that is, the apparent place of the star differs from its real place less than the *ninetieth* part of the apparent diameter of the sun. It is no wonder, therefore, that practical astronomy was considerably advanced before this discovery was made. If our sense of vision were perfect, or if light moved no faster than a rain-drop we should have *terrestrial aberration*, that is, objects would change their relative places when we begin to move, and if we went as fast as a ray of light moved, the utmost confusion would be the consequence. When we ride in a carriage into which the rain is beating, we mistake the direction of the rain: for the cause of which phenomenon, see MOTION. But as light moves with a velocity which imagination cannot conceive, about 192,000 miles in a second, its motion is so great compared with any we can give to ourselves, that its passage from any one terrestrial object to another may be considered as instantaneous. The motion of a spectator on the earth, which goes round the sun at the average rate of about nineteen miles in one second, though less than the ten thousandth part of that of light, is nevertheless sufficient to cause a small variation in the place of the star, perceptible by the aid of good astronomical instruments.

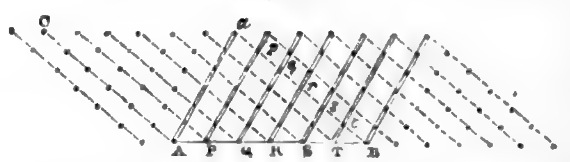
We know [MOTION] that if a body A be struck in two different directions at the same instant, with impulses which would separately carry it through AB and AC in one second of time, the result of the combined impulses is that it moves in one second through AD, the diagonal of the parallelogram, whose sides are AB, AC. Again, if the spectator and the object at which he is looking are both in motion, the appearances presented by the motion will be preserved, if we render the spectator stationary, provided we give to the object a velocity equal and contrary to that which the spectator *had*, in addition to its own. Hence, if the spectator move from P to Q in one second, while in the same time the object moves from A to C, and if AB be equal to PQ, the spectator, who does not perceive his own motion, will imagine that the object moves through AD in one second, he himself remaining at P. Hence, if rays of light move parallel to AC, and he can distinguish them, they will appear to him to move parallel to AD. Though he cannot see the light itself, he will mistake the direction of the object from which it comes; and if asked to point it out, will place his finger in the direction PN instead of PM. The following illustration will place this in a clearer light.

Fig. 1.



Let us suppose the rays to move so slowly, that a spectator can be furnished with a tube long enough for light to take some perceptible time in passing from one end of it to the other. This will do for our purpose, since, though by such a supposition the aberration will be very much increased, yet the effect, and the reason of it, will be of the same kind as if light were supposed to have its real velocity. The star being at an immense distance, the rays which reach the spectator in different parts of the second may be called parallel, without sensible error. Thus, while in one second the spectator moves from A to B, he receives rays of light in the direction indicated by the dotted lines. The question now is, in what direction must he hold the tube, so as to see the star through it? If he were at rest, that direction would evidently be AC.

Fig. 2.



Let AB be the line described by the spectator in one second, during which time let a ray of light move from a to B, or from C to A. Join Aa, and let Aa be the length and direction of the tube. Divide the second into any number of equal parts, say six, and carry the tube into the various positions which it will successively occupy. Consider a ray of light as a succession of little particles moving one after another in a straight line. Then when the eye has come to P, the particle a will have come to p; when the eye is at Q, the particle will be at q, and so on. We have then so placed the tube, that its motion will not interfere with that of the ray, which moves as freely in the moving tube as it would do if there were no tube. To the spectator, who does not perceive his own motion, the tube is stationary, and the ray of light appears to come down it; therefore Aa will be the direction in which he sees the star, instead of AC. The angle CAa, contained between the real and apparent directions, is what is called the *aberration*. Here aA is the diagonal of the parallelogram BaCA, in which aC is equal and opposite to AB, as before noticed. To apply this, we must remark,—

1. That the above figure is much distorted, since AB is not the ten thousandth of aB; whence the aberration will be very small.

2. That the aberration is in the plane passing through AB, the line of the earth's course for the moment, and through the real direction

A C of the star; whence, as the earth changes the direction of its motion in going round the sun, the direction of the aberration will also change.

3. That we have committed an error in supposing the lines A C and B a to be parallel, since they meet at the star; which error, on account of the star's enormous distance, will be imperceptible.

4. That A B is not properly the spectator's motion round the sun only, but compounded of that and his motion round the earth's axis; the latter, however, being at most not one-third of a mile in a second while the former is nineteen miles per second, the maximum effect of the diurnal aberration amounts to only a fraction of a second of space.

5. The real direction A C of the light may be considered as the same at every part of the earth's orbit, on account of the distance of the star.

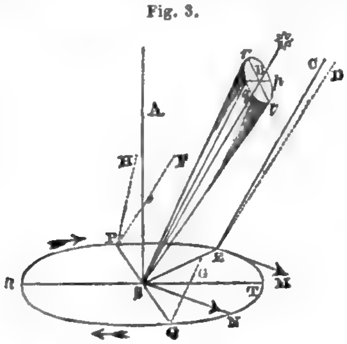
6. The aberration always throws the star apparently nearer to the earth's course, that is, A a is always within the angle C A B.

7. The aberration is greater or less according as the angle C A B is nearer to, or further from, a right angle, and is greatest when C A B is a right angle. This result may readily be proved by those who understand trigonometry, if they recollect that A B and a A are given, being the velocity of the earth and the *apparent* velocity of light, and that

$$\sin \mathrm{A}a\mathrm{B}, \text{ or } \sin \mathrm{CA}a = \frac{\mathrm{AB}}{a\mathrm{A}} \sin a\mathrm{BA} = \frac{\mathrm{AB}}{a\mathrm{A}} \sin \mathrm{CAB}.$$

Let us suppose, which will be exact enough for our purpose, that the earth moves in a circle (the ecliptic), of which the sun is in the centre. The line S A, perpendicular to the plane of the ecliptic, looks towards the *pole* of the ecliptic. Let S B be the direction of a star, P S Q perpendicular in the plane of the ecliptic to S B, and R S T perpendicular to P S Q in the same plane. When the earth is at E, it is moving in the direction E M, perpendicular to S E, and the star, from its great distance, is in the direction E C parallel to S B. Hence the aberration takes place in the plane C E M, that is, the star is a little lowered towards E M, and appears in the direction E D. Let the needle S N move round the circle with the earth, so as always to indicate the direction in which the earth is moving, that is, S N is always parallel to E M, and perpendicular to S E. The plane B S N being parallel to the plane C E M, is the plane in which aberration would appear to take place if the spectator were at S, and S was moving; but as the spectator does not perceive his own motion, let us suppose him placed at S, and the same aberration to take place in the plane B S N, which really does take place in C E M. By what has been said, the aberration is greatest when the needle points to Q or P, that is, when the earth is at T or R; and least, when the needle points to T or R, that is, when the earth is at P or Q; because the angle B S N is a right angle when N is at P or Q, and differs most from a right angle when N is at T or R. Hence the aberration increases as the earth moves from P to T, diminishes from T to Q, increases from Q to R, and decreases again from R to P. The line in which the star appears, moves round S B in the course of a year, and describes a cone, while the star appears to describe a small oval or ellipse about B, the greater axis of which is parallel to P Q, and the lesser to R T; such as $p\ r\ q\ t$, in which p is the apparent place when the earth is at P, and so on. This deviation is completed in the course of a year.

Fig. 3.



When the star itself is in the pole of the ecliptic, or is seen in the direction S A, the angle A S N, is always a right angle, the aberration is always of the same magnitude, and the apparent path of the star is a circle. As we take stars in which S B is more inclined to the ecliptic, the oval becomes flattened in proportion to its length, so that when the star is in the ecliptic, it appears to vibrate backwards and forwards in a straight line, going and returning once in each year.

If the star be on the solstitial colure, the points P and Q will be the equinoxes, and R and M the solstices. The aberration will consequently be greatest at the solstices, and least at the equinoxes. We shall refer to this case presently.

The stars appear to us to lie on a large sphere, of which we are at the centre. [SPHERE.] We may represent the phenomenon on a common globe, by drawing a small ellipse or oval round the star, the major axis of which is parallel to the ecliptic, and the figure of which is more or less flattened, as the star is nearer to, or further from, the ecliptic. The major axis will always be an arc of 41", and the minor axis will be 41" multiplied by the *sine* of B S M or the star's latitude.

Previously to entering upon the quantity of aberration, we shall give some account of the discovery, which is one of the most remarkable in the history of science. The arguments for the motion of the earth, though tolerably conclusive, were yet principally derived from the great simplicity of this hypothesis in comparison with others, since all the phenomena then observed could be equally well explained upon the supposition, that the other planets moved round the sun, at the same time that the sun moved round the earth. It remained, therefore, to find some *experimentum crucis*, some phenomenon, which admitted of no *other* explanation except what could be derived from the earth's motion. The first idea which suggested itself to astronomers was, that if the earth really moved, the stars would appear to change their places; though they did not count much upon this, since they knew that the distance of the stars might be so great, that the whole diameter of the earth's orbit would be too small a change of position to cause any perceptible change of place. [PARALLAX.]

However, the great improvements effected in practical astronomy towards the close of the 17th century, enabled astronomers to detect certain small changes in the apparent places of the stars, which had hitherto escaped observation, but which could not be satisfactorily explained by the parallax depending on the annual motion of the earth. Hooke, indeed, from observations of γ *Draconis*, made with a zenith sector of his own construction, was led to assign a parallax of sensible magnitude to that star, but the result at which he arrived was not generally admitted by astronomers. About the same time Picard remarked that the apparent place of the pole star was subject to a variation of which he could give no satisfactory account. Flamsteed, who independently detected the same phenomenon, attributed it to the effects of annual parallax, but Cassini showed that the direction in which the displacement occurred, was not in accordance with the effect which would result from the annual motion of the earth.* It may be mentioned also that Römer, a contemporary of Flamsteed, remarked certain changes in the declinations of the stars which, according to his pupil Horrebow ('Basis Astronomiæ,' p. 66) he was unable to explain either by parallax or refraction.

In the year 1725, Bradley, Savilian Professor of Astronomy at Oxford, and afterwards Astronomer Royal, and Molyneux, the son of Locke's well-known friend of that name, resolved to verify Hooke's observations of γ *Draconis*. This star had been selected by Hooke for his researches on annual parallax, because it passed very near the zenith of Gresham College, London, the place where his observations were made, and therefore would not be sensibly affected by refraction. The star manifestly offered the same facility of investigation to Bradley and Molyneux, whose observations were originally made at Kew. The instrument with which their observations were made was also a zenith sector, which, indeed, at that time was the most correct instrument for measuring very small angles [ZENITH SECTOR]; and a very large one, having a telescope 24 feet long, made by Graham, one of the most celebrated artists this country has produced, was erected at the place just mentioned, under the direction of Molyneux. Before proceeding further let us consider what would be the effect produced on the apparent place of γ *Draconis* by the aberration of light. This star happens to be situate within about 16° of the pole of the ecliptic; it will, therefore, in accordance with the preceding account of aberration, appear to describe nearly a small circle about the place it would have if the earth had no motion, which is called its *mean place*. In the maps of the stars, published by the Useful Knowledge Society, the little circle, which represents γ *Draconis*, will do well enough to give an idea of the path which it describes every year. By measuring the star's zenith distance when on the meridian, its *polar* distance was also measured, since the zenith and pole are both points of the meridian, distant from one another by the *colatitude* of the place [COMPLEMENT]; in other words, by adding the difference between 90° and the latitude of Kew to the meridional zenith distance of the star at that place, we obtain its polar distance. In *fig.* 4, S represents the mean place of the star and $v\ s\ a\ w$ the small ellipse, nearly a circle, described by the star in one year. The reader must imagine this circle placed in the heavens, and the line P S bent over his head, so that Z is his zenith and P the pole. We must now show how to find the points of the ellipse $v\ s\ a\ w$, answering to the four principal periods of the year —namely, the solstices and equinoxes. Referring back to *fig.* 3, in which we finally placed the spectator at S, the sun will appear to describe the circle which the earth really describes; that is, as the earth moves from Q to R, the sun will appear to move from P to T. Hence, when the earth is at Q, the aberration, throwing the apparent place of the star towards S R, 90° *before* the earth, throws it also towards a line 90° *behind* the sun's *apparent* place. Let E, *fig.* 5, be

* The displacement remarked by Flamsteed was evidently due to aberration. This has recently been established beyond doubt by Dr. Peters, who, by a discussion of Flamsteed's observations of the pole star, found the maximum value of aberration to be 20"·676, with a probable error of 1"·11. The close agreement of this result with the mean of the most trustworthy values of the same element hitherto obtained, furnishes a favourable proof of the accuracy of Flamsteed's observations.

the earth, W V S A the apparent course of the sun or the ecliptic, E P the axis of the earth, A M V N the equator; whence, if the sun move in the direction indicated by the arrows, V is the vernal equinox, S the summer solstice, A the autumnal equinox, and W the winter solstice.

Fig. 4.

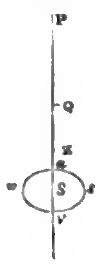
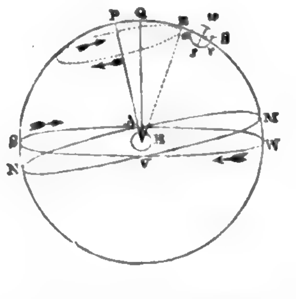


Fig. 5.



The circle which bounds the whole figure is the *solstitial colure*, and as the star γ *Draconis* is very nearly on that colure, we will suppose it to be at S. Let Z be the spectator's zenith; that is, let him be on such a part of the earth that the plumb-line falls in the direction Z E, the point Z will, by the motion of the earth, be carried round the dotted circle. The meridian is the moving circle passing through P and Z, and as the figure stands, the real star and the pole of the ecliptic are on the meridian. First, let the time be the vernal equinox, or let the sun appear at V; then the point W being 90° behind V, the star will appear to be thrown towards W, and its apparent place is *v*. Similarly, *s*, *a*, and *w* are the apparent places corresponding to S, A, and W, the dotted part of the ellipse being supposed to be bent over on the other side of the sphere. *Fig.* 4 is taken from *fig.* 5, and is the course of the star, as it will appear to the spectator at E, S Q P being bent, so that Z is over his head, and P behind him. Let us now suppose him in the situation of Bradley, with an instrument capable only of measuring changes in the polar distance, the time being the winter solstice. As the star appears to move from *w* to *v*, which takes place between this and the vernal equinox, the polar distance will increase from day to day; after the vernal equinox it will decrease, and continue to do so until the autumnal equinox; after which, it will increase again till the winter solstice. This is precisely the phenomenon observed by Bradley, who clearly perceived that it could not be attributable to the annual parallax of the star. To illustrate this, let us suppose that when the earth is at Q (*fig.* 3), we look at the star in the direction Q G, and when it is at P we look at it in the direction P F. Draw P H parallel to Q G: the spectator, who imagines himself at rest, will, if he observes the star at these two epochs, see the difference of position corresponding to the angle H P F, at least if the distance of the star be not so great as to render that angle imperceptible to his instruments. This however will take place in the plane passing through the star and P Q, whereas, the effect observed by Bradley took place in a direction perpendicular to that plane.

The displacement of γ *Draconis*, observed by Bradley at Kew, was confirmed by subsequent observations which he made at Wanstead, in Essex, with an instrument of similar construction. The question now occurred, to what was the phenomenon attributable? At first he suspected that it arose from some irregularity in the instrument, or deviation of the plumb line, and afterwards from some *nutation*, or conical motion of the earth's axis. These, however, he found would not account for the observed displacement of the star. "At last, when he despaired of being able to account for the phenomenon which he had observed, a satisfactory explanation occurred to him all at once when he was not in search of it. (Thomson, 'History of the Royal Society,' p. 346.) He accompanied a pleasure-party in a sail upon the river Thames. The boat in which they were was provided with a mast which had a vane at the top of it. It blew a moderate wind, and the party sailed up and down the river for a considerable time. Dr. Bradley remarked, that every time the boat put about, the vane at the top of the boat's mast shifted a little, as if there had been a slight change in the direction of the wind. He observed this three or four times without speaking; at last he mentioned it to the sailors, and expressed his surprise that the wind should shift so regularly every time they put about. The sailors told him that the wind had not shifted, but that the apparent change was owing to the change in the direction of the boat, and assured him that the same thing invariably happened in all cases." * While pondering on the circumstance, it occurred to him that the velocity of light, combined with the motion of the earth in its orbit, must produce a similar minute change in the apparent places of the stars, and thus he was led to his great discovery of aberration.

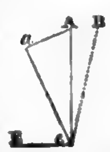
The greatest aberration, as we have observed, is parallel to the ecliptic, and is the greatest semi-diameter of the apparent annual ellipse of a star. This ought to be the same for all stars, if the rays which come from them move with the same velocity. Hitherto it has not been discovered that the greatest aberrations of different stars differ by more than may reasonably be imputed to instrumental errors; we must therefore conclude that, as far as we know, the light of every star moves with the same velocity.

Bradley, in the early period of his researches, fixed the maximum value of aberration at 20"·25, but ultimately he adopted 20"·0 as the most probable value. Delambre, from observations of the eclipses of Jupiter's satellites, determined it to be 20"·255. Bessel, by a discussion of Bradley's observations ('Fundamenta Astronomiæ,' 1818) found the maximum value to be 20"·7080, but in the 'Tabulæ Regiomontanæ' (1830), he has adopted Delambre's result. In recent times various astronomers have investigated the value of the constant of aberration, and have obtained results which generally fluctuate between these two extremes. In the Introduction to the 'British Association Catalogue of Stars' (1844), Mr. Bailey has compared together all the most trustworthy determinations, and hence deduces 20"·4192 as the most probable value. The result generally adopted by astronomers in the present day is due to M. Struve, Director of the Imperial Observatory of Pulkowa, who has found the maximum aberration to amount to 20"·445 by a discussion of observations recently made at that observatory with a transit instrument placed in the prime vertical. [TRANSIT INSTRUMENT.] This result agrees very nearly with that obtained about the same time by Dr. Peters, who, from observations made at the Pulkowa observatory with a vertical circle by Ertel [CIRCLE], determined the maximum value of aberration to be 20"·481.

The aberration of light has furnished astronomers with what has been always regarded a desideratum since the establishment of the true system of the universe by Copernicus—an incontrovertible proof of the annual motion of the earth. In recent times, M. Foucault, an eminent French physicist, has given two distinct demonstrations of the diurnal motion, founded on the doctrine of rotation. [GYROSCOPE; PENDULUM.]

It is well known that solar light is composed of several colours, which admit of separation from one another. The light of the stars is also compounded of several colours; for though different tinges predominate in different stars, no one gives a perfectly pure colour. The phenomenon of aberration proves that these different lights move with the same velocity; for two lights, moving with different velocities from the same star, would give different quantities of aberration; that is, would make differently coloured images of the star in different places, that image being nearest to the real place of the star, the colour of which moves with the greatest velocity. But as no indication of such an appearance is observable in the very best telescopes, we are, therefore, bound to conclude, that all the different coloured light of which white light is composed, moves with the same velocity. For the determination of the velocity of light from the aberration, see LIGHT.

We have hitherto considered only the case of a star which has no motion of its own; let us now take that of a planet, comet, or the moon, which moves while the earth moves. Let the planet move from A to *a*, and the earth from E to *e*, in the time which it takes the light to move from the planet to the earth. Then, by what has been said, the earth at *e* receives the ray A*e*, which is imagined to be in the direction B*e*; and if the planet had remained fixed at A, A*e*B would have been the aberration, or the angle contained between its true and its apparent direction. But in the meanwhile the planet has moved to *a*, and if light were transmitted instantaneously would appear in the direction *e a*. Hence *a e* B is the aberration; that is, to the former angle, the planet's motion round *e*, during the passage of the light, must be added or subtracted, according as the earth and planet move in the contrary or same directions. The greatest aberration of Mercury is nearly one minute; that of the moon, only two-thirds of a second. To the sun, which has no motion of its own, the rule for a star in the ecliptic may be applied; recollecting, however, that as a line drawn from the sun to the earth is always at right angles, or very nearly so, to the direction of the earth's motion, the aberration is always at its greatest value, or nearly so, and is nearly 20¼".



In the preceding account we have omitted two circumstances, which would only have perplexed the reader. Firstly, every star changes its place on account of the precession of the equinoxes. [PRECESSION.] This was known to Bradley, who was therefore obliged to allow for this change, before he could pretend to assign that arising from any other phenomenon; secondly, the motion of the earth not being perfectly circular, but slightly elliptical, the quantity of aberration must be a little modified on that account. The effect of this will be seen in the article REDUCTION.

ABERRATION, in Optics. The most perfect mirror, or lens, which could be made, would be one in which all the rays which come from one point should be reflected or refracted to another point. Owing to the practical difficulties in the way of forming such a mirror or lens, the spherical form is adopted, of which it can only be said, that instead of returning to a point all the rays coming from a point, it condenses so many of them near a particular point, that an apparent image is formed at that point. The point near which most rays are collected is called the focus, and the distance at which a ray cuts any line passing through the focus is called its aberration with respect to that line. For a discussion of this subject, see LENS. Again, when light is refracted through any transparent medium, its different colours have

* The original authority for this account is said to be Dr. Robison ('Natural Philosophy,' vol. iv. p. 629), who probably received it from Bradley himself.

different foci; for the cause and phenomena of which see ACHROMATIC. The aberrations arising from these two causes are generally known by the names of *spherical aberration* and *chromatic aberration*.

ABETTOR. The etymology of this word is somewhat uncertain; it may be derived from the Saxon *betan*, to push forward, or incite. An abettor is an instigator or setter on—one that procures another to commit a crime. If an abettor, or, as he is then usually termed, aider and abettor, be present at the time of committing the crime, he is treated as a principal; if absent, he becomes an accessary before the fact. [ACCESSARY.]

ABEYANCE is a legal term, derived from the French *bayer*, which, says Richelet, means to "look at anything with mouth wide open." Coke ('Co. Litt.' 342, b.) explains the term thus, "*En abeiance*, that is, in expectation, of the French *bayer*, to expect. For when a parson dieth, we say that the freehold is in abeyance, because a successor is in expectation to take it; and here note the necessity of the true interpretation of words. If tenant *pur terme d'autre vie* dieth, the freehold is said to be in abeyance until the occupant entereth. If a man makes a lease for life, the remainder to the right heirs of J. S., the fee-simple is in abeyance until J. S. dieth. And so in the case of the parson, the fee and right is in abeyance, that is, in expectation, in remembrance, entendment or consideration of law, *in consideratione sive intelligentia legis;* because it is not in any man living."

The expression that the freehold or the inheritance of an estate is in abeyance, therefore, means that there is no person in whom the freehold or inheritance is vested at the moment, and that the freehold or inheritance is waiting or expecting for an owner who is to be ascertained. This doctrine of the suspense of the freehold or inheritance is repugnant to the general principles of the tenure of land in England. By the old law, it was necessary that some person should always be in existence as the representative of the freehold, for the discharge of the feudal duties, and to answer the actions which might be brought for the fief; and thus the maxim arose that the freehold could never be in abeyance. The case of glebe lands belonging to parsons, and of lands held by bishops and other corporations sole were scarcely exceptions, for the *corporation* always existed, although the individual parson or bishop was not yet named.

Titles of honour are also sometimes said to be in abeyance, which occurs when the persons next in inheritance to the last possessor are several females or co-parceners. In this case, the title is not extinct, but is said to be in abeyance; and may be called out of abeyance at any time by the crown. Several instances of the exercise of this prerogative are on record both in ancient and modern times.

(*Camoys's Case*, 5 Bing. *N. C.* 754; *Coke upon Littleton*, 165; Cruise, *Digest*, vol. i. pp. 52, 55; *Report of Committee of House of Lords*, *Sess.* 1858.)

ABIB, the first month of the Hebrew year, now more generally known by the Chaldee name Nisan. [NISAN.]

ABIETINE (Formula unknown), a neutral resin, extracted from Canada balsam and Strasbourg turpentine. It is inodorous and tasteless; soluble in alcohol, concentrated acetic acid, ether, and naphtha, but insoluble in water. It fuses on being heated, and assumes the form of a crystalline mass on cooling. Caustic potash has no action upon it. (See 'Journ. de Pharm.,' xvi. 436.)

ABJURATION OF THE REALM signifies a sworn banishment, or the taking of an oath to renounce and depart from the realm for ever. By the common law of England, if a person guilty of any felony, excepting sacrilege, fled to a parish church or churchyard for sanctuary, he might, within forty days afterwards, go clothed in sackcloth before the coroner, confess the full particulars of his guilt, and take an oath to abjure the kingdom for ever, and not to return without the king's licence. Upon making his confession and taking this oath, he became attainted of the felony; he had forty days from the day of his appearance before the coroner to prepare for his departure, and the coroner assigned him such port as he chose for his embarkation, to which he was bound to repair immediately with a cross in his hand, and to embark with all convenient speed. If he did not go immediately out of the kingdom, or if he afterwards returned into England without licence, he might suffer death as a felon, unless he happened to be a clerk, in which case he was allowed the benefit of clergy. This practice, which has obvious marks of a religious origin, was by several regulations in the reign of Henry VIII., in a great measure discontinued, and at length, by statute 21 James I. c. 28, the privilege of sanctuary was entirely abolished. In the reign of Queen Elizabeth, however, Roman Catholics and Protestant Dissenters convicted of having refused to attend the divine service of the Church of England, might be required to *abjure the realm*, and if they refused to swear, or to depart, or returned without licence after their departure, they were to be adjudged felons, and to suffer death without benefit of clergy. The punishment inflicted by stat. 35 Eliz. c. 2, was thus more severe than that imposed for a return after adjuration at the common law, for in the latter case the felon had the benefit of clergy; in the former, it was expressly taken away; but the circumstances which called for the act must not be forgotten. Protestant Dissenters were exempted from this statute by the Toleration Act, 1 Wm. III. c. 18; but Popish recusants convict continued liable to be called upon to abjure the realm for their recusancy, until the statute 31 Geo. III., c. 32 (1791), relieved them from that and many other penal restrictions, upon their taking the oaths of allegiance and abjuration.

ABJURATION, OATH OF, is an oath which asserts the title of the present royal family to the crown of England. It was first imposed by 13 & 14 Will. III., c. 6; altered by 1 Anne, st. 1. c. 22, and amended again by 1 Geo. I., stat. 2, c. 13. The person taking the oath recognised the right of the king under the Act of Settlement, engaged to support him to the utmost of the juror's power, promised to disclose all traitorous conspiracies against him, and disclaimed any right to the crown of England by the descendants of the Pretender. The juror next declared that he rejected the opinion that princes excommunicated by the Pope might be deposed and murdered; that he did not believe that the Pope of Rome or any other foreign prince, prelate, or person, had or ought to have jurisdiction, directly or indirectly, within the realm. Persons required to take the oath of abjuration were generally obliged to take at the same time the oaths of allegiance and supremacy. All these oaths have now been simplified and reduced to one form by the statute 21 & 22 Vict., c. 48. The form of oath to be taken by a Roman Catholic is given in 10 Geo. IV., c. 7 (the Roman Catholic Relief Act). The first part of the oath is similar in substance to the form required by 6 Geo. III. c. 53. The taker disclaims, disavows, and solemnly abjures any intention to subvert the present Church Establishment as settled by law within the realm; and solemnly swears that he will never exercise any privilege to which he is or may become entitled to disturb or weaken the Protestant religion or Protestant government in the United Kingdom; and solemnly, in the presence of God, professes, testifies, and declares that he makes this declaration, and every part thereof, in the plain and ordinary sense of the words of the oath, without any evasion, equivocation, or mental reservation whatever.

The word *abjuratio* does not occur in classical Latin writers, and the verb *abjurare*, which often occurs, signifies to deny a thing falsely upon oath.

ABLATIVE CASE, a term borrowed from the grammatical system of the Latin language, and occasionally employed in teaching our own. In the English Language there are many little words, such as *with, in, to, at*, &c., which are called *prepositions*, because they are *preposed* or prefixed to the words with which they are connected. The name however is an unfortunate one, as they are sometimes found *postponed* or placed after such words, especially in the older specimens of our language. We say *with which* or *wherewith, in which* or *wherein, from which* or *wherefrom.* So, in the Latin language, a certain set of little words, with the force of prepositions, were tacked on to the end of their nouns: thus, while the three letters, *reg*, meant *king* (whence our word *reg-al*), *reg-is* meant *of* or *from a king*—*reg-i, with, in*, or *near a king*—*reg-em, to a king.* Thus the three little words, *is, i, em*, were equivalent to prepositions. It pleased the grammarians however, who are fond of multiplying names, to call these words *reg-is, reg-i*, &c., by the name of *cases.* The meaning of the endings of these words was not always definite enough. Thus with the case in *i* for instance, it was found necessary to mark the relation of place more precisely by the addition of other words, as *in, in*—*pro, before*—*cum, with.* Thus they would have, *in regi, in the king; pro regi, before the king; cum regi, with the king.* Now, as *in, pro, cum*, were much more definite than the termination *i*, it became unnecessary to make the *i* distinctly heard. It was no longer necessary to the meaning, and might therefore be slurred over: hence the pronunciation was reduced to *in rege* (the last *e* very faintly pronounced), *pro rege, cum rege.* But we have so far dealt only with those cases where the so-called ablative grew out of a case in *i*, commonly called the dative. There was, however, another case-ending, of different form and very different power, which in the end got similarly corrupted. This, in old Latin, had a final *d*, as *Gnaivod patre prognatus*, afterwards *Cnaeo*, &c., *sprung from a father Cnaeus.* In Sanscrit this *d* is represented by a *t*, as *mat, from me, tvat, from thee.* Bopp indeed (V. G. § 340) regards the original suffix of the Sanscrit as *tas*, afterwards reduced to a *t*, and further holds that this *tas* corresponds on the one hand to the Homeric θεν of εμεθεν, σεθεν, and on the other to the Latin *tus*, as seen in *caelitus, from heaven.* Be this as it may, it seems pretty certain that in the so-called ablative of the Latin there are blended what were originally two distinct cases; first, a true ablative, once ending in *d* with the sense of *from*, so as to justify the use of the case after prepositions of removal, as *ex rege, ab rege, de rege*, as well as *Corintho fugit, he fled from Corinth;* secondly, what was more properly a dative, or rather locative, answering to the question *where*, as in the examples already given with the prepositions of rest, *cum, with, pro, before, in, in.* The fact that two independent cases have slipped into an identity of form is not rare in language. We have an example of such confusion in one of our own pronouns, as in *he gave him a book*, where *him* is a dative, corresponding to the German *ihm;* and *he gave him to the constable*, where *him* is an accusative, corresponding to the German *ihn.*

ABLUTION, literally *a washing away*—a religious ceremony, consisting in bathing the body, or a part of it, in water, which has been practised more or less extensively by the disciples of almost every form of faith. Among outward types, none can be conceived more natural or appropriate as a sign or attempted representation of mental purity. The custom, particularly in the warm climates where it was first introduced, had also the further advantage of being highly conducive to health; and this circumstance no doubt contributed powerfully to recommend it to the authors of many of the religions by which it was sanctioned and enjoined. Ablutions, or *lustrations*, as they are more commonly called, even constituted a part of the Mosaic ceremonial, and were practised among the Jews on various occasions both by the priests and by the people. They occupy an important place in the Brahminical and other religions of India, where the waters of the Ganges are considered as having so purifying a power, that even if a votary, who cannot go to that river, shall call upon it to cleanse him, in prayer, while bathing in another stream, he will be freed from any sin or pollution he may have contracted. But the religion by which ablutions have been enjoined most punctiliously, and in the greatest number, is the Mohammedan. According to the precepts of the most rigid doctors of that faith, it may almost be said that scarcely the most ordinary or trifling action can be rightly performed without being either preceded or followed by an entire or partial lustration. The rules laid down upon the subject by these writers are minute and tedious, to a degree scarcely to be believed. The simple ceremony of Christian baptism may be regarded as an adoption of this natural type by the Author of our faith. Although, however, that is the only instance in which dipping in or sprinkling with water has been enjoined under the dispensation of the New Testament, the early Christians appear to have been also in the habit of undergoing ablution with water before partaking of the communion. The sprinkling with holy water, in use in the Roman Catholic church, may be considered as a species of ablution; and as a liturgical term it is applied in that church to the wine and water used by the priest to cleanse his fingers, and the chalice, after having administered the sacrament. In the Greek church, ablution sometimes means the wine and water given to the communicant, the better to be enabled to swallow the holy wafer.

ABORTION. [INFANTICIDE.]

ABRAHAM MEN. To 'sham Abraham' is a well-known cant expression, which has reference to the practices of a large class of vagabonds and cheats who were once common in this country. An Abraham Man was an impostor who personated a 'Tom of Bedlam,'—an unhappy being who was turned out of a lunatic asylum to subsist upon casual alms, incurable but harmless, without a home, but still maintained by public sympathy. This class of persons was so numerous at a period when there was very insufficient provision for the cure or mitigation of the greatest of human calamities, that the charity of the kind-hearted inhabitants of the small towns and villages was largely taxed for their support; and the appeal thus made to the feelings by a poor creature, fantastically clothed in tawdry rags, and singing snatches of old songs, was so irresistible, that it became a profitable trade to imitate such an unfortunate being. In Decker's 'English Villainies,' written more than two centuries ago, there are many curious particulars of the habits of this class of impostors; these details, in great part, agree with the rich description which Shakspere has given in his 'Lear,' (Act. ii. scene 3.) of a pretended 'Poor Tom,' who has put on

> "The basest and most poorest shape,
> That ever penury, in contempt of man,
> Brought near to beast."

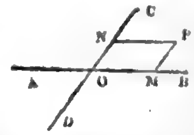
ABSCESS, (from a Latin word, *Abscedo*, implying separation,) is so called, because parts which were in contact have become separated. An abscess consists of a collection of the matter termed pus, in some tissue, or organ of the body. Purulent matter, or pus, is formed out of the lymph separated from the blood during the process of inflammation. The production of pus during the progress of inflammation is called suppuration. [INFLAMMATION.]

The purulent matter constituting an abscess, properly so called, is always confined within a definite space: the means by which it is confined vary. Sometimes the purulent matter is effused into the substance of an organ; in this case some portion of that part of the blood which is called *fibrin*, or coagulable lymph, is effused with it; this fibrin coagulates into a firm solid membrane, encloses the pus, and so prevents its diffusion. Sometimes the effused fibrin, or coagulable lymph, becomes organised; in this case it forms a new membrane, which is called an *adventitious* membrane, and the pus is completely enclosed in this new membrane as in a bag, or shut sac or *cyst*: an abscess of this kind is called an *encysted* abscess, and the internal surface of this cyst is always endowed with the properties both of absorption and of secretion; for large collections of matter, enclosed in bags of this kind, occasionally disappear without any external opening; and on the other hand, when such a bag has been completely emptied of its contents, it is sometimes rapidly refilled with pus. When an opening is formed in an abscess, and purulent matter continues to be discharged from it, it loses the name of abscess, and takes that of ulcer.

Purulent matter is poured out from the blood in other modes, and forms other collections of pus; but these latter collections are never called abscesses. Sometimes, for example, the pus, as it is secreted from the blood, is diffused through the substance of the inflamed organ. This is the case especially with the lung during the progress of inflammation. This diffusion of purulent matter through the substance of an inflamed organ is termed INFILTRATION and, instead of containing an abscess, the organ is said to have pus infiltrated through it. This is also seen in phlegmonous erysipelas.

There are few tissues of the body, and still fewer organs, in which abscesses may not form. They are found in the brain, the lungs, the heart, the liver, the spleen, the uterus, the ovaria, the cellular membrane, and the joints. In some of these organs the disease is highly dangerous, in others certainly fatal, in others comparatively unimportant. [INFLAMMATION.]

ABSCISSA, or LINEA ABSCISSA, a line cut off, is a mathematical term, used as follows: If any two right lines A B, C D, be given, meeting in O, the position of any point, P, in the plane of those lines, is known when we know, first, within which of the four angles, B O C, C O A, A O D, D O B, it lies, and, secondly, what is its distance from each line, measured on a line parallel to the other; or, in other words, what are the sides of the parallelogram O M P N. Either of these sides being called the *abscissa*, the other is called the *ordinate;* both are called *co-ordinates;* the straight lines, A B and C D, are called the *axes*, and O is called the *origin*. It is customary to denote the lengths of the abscissa and ordinate by the letters x and y respectively. Thus O M being the abscissa of the point P, P M is its ordinate. All points in the line P M have the same abscissa; all those in P N the same ordinate. [CO-ORDINATES.]



ABSENTEE. This is the first subject, in alphabetical order, that comes under our notice in the science of political economy. In the whole compass of that science there is no subject which presents more difficulties in the way of popular explanation, if we view it purely as a scientific question. An absentee, as the term is now used, is a person who derives his income from one country, but resides in another country where he expends that income. The common voice of mankind says that this is an evil and an injustice. It points to lands imperfectly cultivated, to labourers inadequately employed, to ruined cottages, to uneducated children, and it proclaims that these things would not be if the proprietor resided upon his estates. He does not choose to reside upon his estates; he would rather derive less from his estates, having the liberty to spend the revenue as he pleases. There is no law to prevent him but the great law of moral obligation, which he may obey or not. The public inconveniences of a positive law to bind his person to his property would far outweigh its public good. But the common sense of mankind is right; and the day of retribution comes when neglect goes forward into general destitution. Then the capital which has been abstracted from its fertilising local influence, is forcibly driven back, to prevent misery becoming utter ruin. Such results have been shown in large districts of Ireland. The political economists of every class cannot shut their eyes to these facts; but some say that these facts lie beyond the boundaries of their science; they belong to the moralist to explain. They consent only to look at the absentee in his abstract capacity of a capitalist; they admit that it would be better for his own local connections and dependants that he should not be an absentee; but they are prepared to prove that it is a matter of indifference to the country in general; that the wealth of the country is neither increased nor diminished whether he spend his rents in Dublin or in London—in London or in Rome. Even in this point of view these economists have few supporters. Popular opinion, without pointing to the extreme moral evils of a non-resident landed proprietary, maintains that the amount of revenue which the landlord spends in a foreign country is so much clear loss to the country from which he derives his property, and so much encouragement withdrawn from its industry; and that he ought therefore to be compelled to stay at home, instead of draining his native land for the support of foreign rivals. Some political economists reply, that this is a popular delusion, and that, in point of fact, the revenue spent by the landlord in a foreign country has precisely the same effect upon the industry of his own country as if his consumption took place at home. The truth perhaps lies between these counter opinions. The argument of the economists runs thus: all consumers residing in their own country, and landlords amongst the number, purchase many articles of foreign production which have been exchanged for the productions of their own country. In purchasing such foreign productions they stimulate native industry; in taking from foreigners what they produce cheaper and better than we can, and in sending them in exchange what we can produce cheaper and better than they can, we develop a wider field of industry for our native productions, and obtain a larger store of commodities for our home necessities. The consumption of an English resident in a foreign state, they go on to say, produces, in principle, the same indirect effects upon English industry, as his partial or entire consumption of foreign goods in England. His consumption of foreign goods abroad is equivalent to an importation of foreign goods into England; and that consumption, it is said, produces a correspondent exportation of English goods to the foreigner. For why? There must be an export of English goods to some country to the amount of the foreign goods which he consumes, otherwise his remittances could not be made to him. For example, England owes half a year's rent to the resident at Brussels; he draws a bill upon England, which a banker discounts, and sells to a merchant at Antwerp, who wants the bill to pay for goods which Antwerp owes to England; and so, say the economists, England keeps the rent after all; and it stimulates industry as much as if it had been spent in England at first. It does little, they say, to stimulate industry in either case, for it is equally unproductive consumption. It has been a notion amongst a class of political economists, which is fast yielding to sounder notions, that all expenditure is unproductive unless it be incurred directly in the aid of further production. The truth is becoming apparent, that it is impossible to limit productive expenditure by such narrow laws—to say that the man who spends *100l.* in clothes is an unproductive consumer, whilst the tailor who spends *50l.* in cloth and labour for the clothes is a productive consumer. The one could not exist without the other. The one has enabled the other to make a profit upon the clothes, and part of that profit may become accumulation as certainly as if the buyer of clothes had been satisfied with half his wardrobe [CAPITAL]; and this shows the fallacy that lies at the bottom of the absentee argument. The absentee withdraws the local profit of those who have a natural claim to supply his wants. It may be true, that the foreigner requires some additional goods from England in consequence of the domiciliation of the English absentee; but does he require as large an amount of English goods as the total sum which the Englishman expends? Unquestionably not. There are large differences between the exchanges of commerce and the smaller exchanges of domestic life. The profit of the foreign retailers, of the foreign domestic servants, of the foreign landlord of the absentee's house, remain at any rate to the foreign country, and are so much abstracted from the absentee's country. By abstracting the profit of these smaller transactions, the surplus that becomes accumulation remains in the shape of new capital to the foreign country. New capital in a country is created by the slow aggregation of minute individual profit. Profit is like the nitrogenous substances in the food of men. Individuals may exist feebly and miserably without profit from their labour—that is, their labour may replace what they consume, and leave no surplus—as individuals may drag on existence upon the innutritious root which imperfectly replaces their ordinary exhaustion, and leaves nothing for development or extraordinary exertion. But the wealth of nations cannot be sustained without surplus produce—without profit; as the health of communities cannot be sustained without the food which builds up the body as well as keeps alive the animal heat. Rent is really profit under another name. It is, in most cases, the largest portion of the surplus produce of the soil. It is that surplus which constitutes a natural fund for social improvement. The absentee who withdraws that fund from its local appropriation to make it the source of new profit to a foreign country, even if it be only the profit of supplying his domestic necessities, and not the profit of commercial exchange, to a certain extent must take away what he ought to contribute to the accumulation of his own district and his own country.

(The arguments which deny the injurious effects of absenteeism, merely regarded as a question of political economy, may be seen in Mr. M'Culloch's evidence before the Select Committee on the 'State of Ireland, 1825, Fourth Report,' and his evidence before the Committee on the 'State of the Poor in Ireland, 1830.' The contrary argument may be found in 'Lectures on Political Economy,' by J. A. Lawson, LL.B., Lecture V. 1843.)

ABSINTHINE (Formula, $C_{32}\ H_{22}\ O_{10}$), the bitter principle of the *Artemisia absinthium*. To prepare it, the dried leaves of wormwood are extracted with alcohol of 80 per cent., the extract evaporated to a syrupy consistence and treated with ether; the supernatant ethereal layer must be decanted, and the treatment of the residue with ether repeated until the ethereal extract no longer tastes bitter. This ethereal solution, evaporated on the water bath, leaves a residue composed of absinthine and a resinous body, which latter may be dissolved out by very dilute ammonia. The residual absinthine must be digested with dilute hydrochloric acid, washed with water, and then dissolved in alcohol; to the alcoholic solution acetate of lead must be added until the liquid becomes milky. After filtration, the excess of lead must be removed by sulphuretted hydrogen, and the alcoholic solution, slightly diluted with water, allowed to evaporate spontaneously in a warm place. Yellow resinous drops of absinthine gradually separate, and these finally solidify to a confusedly crystalline mass.

Absinthine has a slight odour of wormwood, and an exceedingly bitter taste. It is very slightly soluble in water, more so in ether, and very soluble in alcohol, and also in concentrated acetic acid. Ammonia dissolves it in very small quantity only, but potash somewhat more freely. It possesses a decidedly acid reaction.

ABSOLUTION, a religious ceremony in use in different Christian communities, by which the priest declares an individual, on repentance and submission to the requisite penance, to be absolved either from his sin, or from the ecclesiastical punishment or deprivation to which it had rendered him liable. It is contended by many theological writers, that down to the twelfth century the priest in this act only used the words "May God, or may Christ, absolve thee;" thus refraining from claiming any authority to remit the sin himself. Since then, however, the formula used in the Roman Catholic church has been *Ego te absolvo a peccatis tuis* (I absolve thee from thy sins), accompanied with the sign of the cross. The Council of Trent has expressly condemned the doctrine that the priest has not power of himself to absolve from the guilt of sin. (Session xiv. Canon 4.) The Church of England employs in the Order for the Visitation of the Sick, words nearly the same with those employed in the Roman Catholic communion, "I absolve thee from all thy sins." It is, however, maintained by the highest authorities that the absolution thus bestowed is only declaratory, while that pronounced by the Roman Catholic priest is professed to be absolute, and to proceed solely from himself. Hooker, 'Ecclesiastical Polity,' B. VI. § 12; who winds up his comparison of the doctrine of his own church with that of the Church of Rome, by saying, "Wherefore the further we wade, the better we see it still appear, that the priest doth never in absolution, no not so much as by way of service and ministry, really either forgive the act, take away the uncleanness, or remove the punishment of sin: but if the party penitent come contrite, he hath by their own grant absolution before absolution; if not contrite, although the priest should ten thousand times absolve him, all were in vain." (*Ibid.* B. VI. § 13.) In the Greek church the formula is merely declaratory; that is to say, it is of the nature of a prayer to heaven that the sins of the penitent person may not be visited with their due punishment. It is so also in the Protestant Church of Scotland; and there the term absolution is commonly used to denote simply the declaration of the Kirk-Session or other judicatory, expressed by the mouth of its president, that the party is released from the ecclesiastical interdict to which his delinquency had subjected him.

In the early church there were held to be five kinds of absolution: by baptism; by the eucharist; declaratory, by word of mouth and doctrine; precatory, by imposition of hands and prayer; judicial, by relaxation of church censures.

The Absolution as it now stands in the order for Morning and Evening Prayer was first inserted in the Second Book of Edward VI. On a subsequent revision the word *minister* was changed into *priest*. The other two absolutions are coeval with the reformed Prayer Book.

ABSORPTION (from *absorbeo*, to *suck up*) is the process by which rays of heat are made to disappear. The surfaces of different bodies vary greatly in absorbing power, and even in the same body the power varies with the state of the surface as to colour, roughness, &c. The subject will be considered in its proper place under HEAT.

ABSORPTION OF LIGHT is that process which takes place when light enters an imperfectly transparent medium, in virtue of which a portion of the light is continually stifled, or spent in producing some physical effect, while the remainder is either directly transmitted, or emerges after one or more internal reflections.

A body absorbing all the light incident upon it would appear black, and would be wholly invisible; though, in point of fact, the blackest body actually existing reflects some light from its surface; while a body absorbing none, but reflecting light of all kinds indifferently from a multitude of irregularly placed surfaces, would appear white like snow. In general, the different component parts of white light are absorbed with unequal energy, and thus the light which escapes absorption is coloured, as not containing the colours of the spectrum in the proper proportion to form white light. In the great majority of cases the colours of natural bodies are occasioned in this way.

When light of any one kind enters a homogeneous medium, its intensity decreases in geometric progression as the length of its path within the medium increases in arithmetic in progression. This readily follows from the fact that in any given case the quantity of light lost by absorption is a given fraction of the quantity originally incident. (See Herschel on Light, 'Encyclopædia Metropolitana,' art. *Absorption*.) Accordingly, in being transmitted directly across a stratum of the medium of thickness t, the intensity is reduced in the ratio of 1 to r^t, where r is a fraction less than 1, or at most equal to 1. The quantity r varies from one medium to another, and for the same medium from light of one refrangibility to light of another. If $r = 1$ for light of all kinds, the medium is colourless and transparent, like water, which for ordinary purposes may be regarded as such. If r were less than 1, but the same for light of all kinds, the medium, in a stratum of sufficient thickness, would cease to transmit light, without becoming coloured in smaller thicknesses; but no such media are known to exist. When r is less than 1, it always varies more or less with the kind of light, and therefore the transmitted light is coloured.

If $a, a', a'' \ldots$ denote the original intensities of the various kinds of light of which white light is made up, $r, r', r'' \ldots$ the different values of the fraction r for those kinds of light, the intensities after transmission will be reduced to $a\,r^t, a'r'^t, a''\,r''^t \ldots$ The relative proportions of these latter will determine the tint of the transmitted light. It is to be remarked, that this tint will change, not only with a change in the absorbing medium, but even while the medium remains the same, with a change in the thickness t. While the total quantity of light transmitted continually decreases as the thickness of the stratum looked through is increased, the colour generally becomes purer and purer, those colours for which r is least becoming more and more predominant. Sometimes however the change of tint with an increase on thickness is very remarkable. Thus, solutions of the chrome salts in general are green in small thickness, and passing through a sort of neutral tint, become red when the thickness is sufficiently increased. The reason of this is easily explained according to the principles just laid down. The green, and a comparatively small quantity of red, are the colours which chiefly escape absorption at an early stage; but as the absorption goes on, the red, being absorbed less rapidly than the green (r being less for a portion of the red than for the green), becomes at length the predominant colour.

The mode of absorption of light by a coloured substance is often eminently characteristic of the substance, but can be judged of only very imperfectly by the tint of the transmitted light. It is easily determined by analysing the transmitted light by means of a prism.

When a body is not homogeneous in structure, but (like chalk or paper) is filled with surfaces capable of reflecting light, a considerable portion of the whole reflected light ordinarily proceeds from a greater or less depth beneath the outer surface. If the material of which the body is composed be one capable of absorbing light, the light reflected from the interior suffers absorption both in penetrating into the body and in getting out again. Accordingly, those colours which the material is least disposed to absorb are found predominating in the reflected light. It is thus that absorption operates in the case of pigments, the petals of flowers, dyed clothes, &c., which exhibit more or less lively colours by reflected light, though in these cases the light reflected strictly at the outer surface is colourless. The tint of the reflected light has a general agreement with that of the light transmitted through sufficiently thin stratum of the coloured material.

Metals may for most purposes be regarded as absolutely opaque; yet even they can sometimes be rendered so thin as to transmit light. Thus, gold-leaf transmits a green or bluish-green light; and the coloration of the light shows that the transmission does not take place merely through the minute holes with which gold-leaf is filled, but actually through the metal. There are good reasons for believing that the strong reflecting power of metals is intimately connected with their intense absorbing power. Thus gold, which absorbs the more refrangible colours with most energy, reflects them also in greatest abundance, so that it is yellow by reflected, while it is bluish-green by transmitted light. Some intensely coloured substances (murexide and platinocyanide of magnesium are good examples) absorb the colours of *a part* of the spectrum almost as intensely as metals, while for other parts they are comparatively transparent, and reflect the colours for which they have an intense absorbing power with an energy comparable with metals: while other colours are reflected only as they would be by vitreous substances. Hence the *regularly* reflected light is brilliantly coloured; but the predominant colour is that of the light *most intensely* absorbed. This is just the reverse of what takes place in the case of the light reflected from the petals of flowers, &c., where the coloration is due, not to reflection, but to absorption, and the colour is that due to the light for which the absorbing power of the colouring substance is *least*. (See a paper by M. Haidinger in the Proceedings of the Academy at Vienna. 'Sitzungsberichte,' Bd. 8, S. 97. See also 'Phil. Mag.,' S. 4, vol. vi., pp. 284 and 393.)

When a doubly refracting crystal is coloured, it often happens that the two pencils which, in any given direction within the crystal, are capable of being transmitted independently of each other, are very differently absorbed. Thus a plate of tourmaline cut parallel to the axis stops more or less completely light polarised parallel to the axis, constituting the ordinary ray, and lets through light polarised perpendicularly to the axis, constituting the extraordinary ray. In some specimens, with plates of a suitable thickness, the stoppage and transmission respectively are tolerably perfect, which makes such a plate very valuable in experiments on polarisation. That the effect is really one of absorption may be shown by using, instead of a plate bounded by parallel surfaces, a thin wedge tapering to a mere line, and viewing it separately by light polarised parallel and perpendicularly to the axis. It is found that quite close to the edge the crystal is colourless and transparent for both pencils; but that as the distance from the edge increases, the ordinary pencil becomes rapidly more and more absorbed, while the absorption of the extraordinary comes on but slowly. As usual in absorption, the different colours are unequally absorbed; and not only so, but the colours which are most absorbed are different for the ordinary and extraordinary rays, so that the crystal is commonly differently coloured with regard to the two pencils, which may be observed at the same moment, but separately, by viewing the crystal through a double-image prism. The mode of absorption changes, not only in a given direction within the crystal in passing from the ordinary to the extraordinary ray, but also in passing from one direction to another. Dr. Wollaston appears to have first observed ('Phil. Trans.,' 1804, p. 428) that the light transmitted along the axis of a crystal of tourmaline had a colour different from that of the light transmitted perpendicularly to the axis. Several uniaxal crystals (such as smoky quartz, &c.) agree with tourmaline in the general character of the absorption which takes place in them. The colour, and generally the mode of absorption, of the ordinary ray is alike in all directions; that of the extraordinary varies from that of the ordinary, which it has in the direction of the axis, to that most different from the ordinary, which it has in any direction perpendicular to the axis. Many biaxal crystals have a similar property, but the variation of the colour with the direction is more complicated, and in particular some very curious appearances are observed about the optic axes. (See a paper by Sir David Brewster, 'Phil. Trans.,' 1819, p. 11.) M. Haidinger has shown that in biaxal crystals (or at least in those which are symmetrical with respect to three rectangular planes) there are *three* fundamental modes of absorption, symmetrically related to the principal axes, seen each in *any* direction perpendicular to the axis in question by light polarised perpendicular to that axis.

M. de Senarmont has recently shown ('Annales de Chimie,' S. 3, tom. xli. p. 319) that the power of double absorption may be conferred on naturally colourless crystals by a small amount of foreign impurity. A very remarkable example is afforded by nitrate of strontia coloured red by crystallising out of an infusion of logwood.

ABSTINENCE, from *abstineo*, to abstain. The term abstinence signifies a total, or an excessive privation of food. The constituent matter of the body is in a state of continual change—the old particles are constantly taken up and carried out of the system, while new particles are as regularly deposited in their room to repair the loss. The source of these new particles is the aliment or food; but a second office is performed by the aliment scarcely less important than that of furnishing new matter for the renovation of the system. All the organs of the body are excited to the performance of their functions by certain external agents, which are called stimulants; such as air, water, heat, and so on; but of these stimulants the aliment is among the most indispensable and the most powerful. Upon the quantity and quality of the aliment depend the quantity and quality of the blood, and upon the quantity and quality of the blood depends in a great measure the energy of all the functions of all the organs. Any material change in the diet must necessarily produce a powerful impression on the system. Life can be maintained but for a short period under the total privation of food, while the excessive privation of it produces effects upon the system which have not been often observed with accuracy, but which are remarkably uniform, and highly curious and instructive. Opportunities occasionally occur of noting these effects with correctness and completeness, when, for example, the passage to the stomach is closed up by disease; or when, owing to an unsound state of mind, the individual refuses to take nourishment.

During the first two or three days after the total abstinence from food, in a person previously in sound health, the suffering from hunger is generally severe. The thirst is also at times distressing, but thirst is not constantly attendant. The pulse during this period remains natural and so does the temperature of the body. All the evacuations are scanty, and take place at distant intervals. After the first two or three days the wasting of the body becomes visible, the fresh colour characteristic of health disappears, and the features and the limbs, instead of being plump and round, are sunk and collapsed. The loss of weight, which increases rapidly, is appreciable, and the progress of the emaciation is striking. The physical debility increases in exact proportion with the emaciation: and the mind becomes weak, confused, wandering, irritable, and at length almost deprived of reason. All this time there is little or no pain from hunger or thirst, or these uneasy sensations return only at intervals, and are seldom acute and never lasting. The pulse at this stage may be a little quickened; it is certainly easily excited; and in like manner the heat, which seldom sinks below the natural standard, is readily parted with,—so that a slight change of the temperature of a room is felt acutely, and produces very uneasy sensations, a fact which demonstrates to the physician the feebleness with which the functions are carried on, no less clearly than the physical debility itself. The most remarkable and curious phenomena which next supervene, are those connected with the intellectual faculties. The loss of power to perceive accurately, and to connect the trains of thought, is followed by decided delirium, which is at first of a low muttering character, similar to that which takes place in the last stage of typhus fever; but this sometimes passes rapidly into furious and even maniacal delirium, requiring coercion, just as a violent paroxysm of madness itself. Generally the delirium is preceded by a state of painful watchfulness and restlessness, it being impossible to procure sleep or quiet; and, finally, the skin becomes intensely hot, the pulse extremely rapid, the emaciation frightful, the debility so great that scarcely the slightest movement can be performed, and at length the individual sinks exhausted, commonly into a state of stupor amounting to that complete and profound insensibility which is technically called coma.

This history of the progressive changes which take place in the system on the total abstraction of food, is illustrated in the most perfect manner, by two cases which fell under the notice of physicians capable of accurately observing and duly appreciating each successive event. Many wonderful stories are on record, of the truth of which there is no sufficient evidence; but the cases to which we refer were observed and recorded by men whose veracity is beyond question, and who were endowed with more than ordinary discrimination and judgment. The record on this account is invaluable, while in itself it is highly curious and instructive.

For the first case we are indebted to Dr. Currie, of Liverpool. In August, 1795, a gentleman of Yorkshire, aged sixty-six, applied to this physician for his assistance, on account of an obstruction in his swallowing food, with which he had been afflicted for ten or twelve months. At first the complaint was slight; it occurred only when he attempted to swallow dry and hard substances; it afterwards extended to solids of every kind; and, at the time he was first seen by his physician, although he was still able to pass down liquids, the quantity he could swallow was not sufficient for his nutrition, and he was considerably reduced. On the introduction of a bougie into the gullet, it passed about two inches easily, but then met with an obstruction which, by a moderate pressure, was overcome. It then passed easily seven or eight inches more, but at the lower part of the tube, towards its termination in the cardia, it met with a firm resistance, which no patience or skill could surmount. This obstruction proceeded from a schirrous tumour, which, gradually increasing at first, diminished the passage, and at length closed it wholly.

On the evening of the 17th of October, a sudden increase of the obstruction came on, and from this time he was able to swallow only a table-spoonful of liquid at a time, and at long intervals. It was with difficulty that he got down seven or eight spoonsful of strong soup in the day, and this quantity gradually diminished. On the thirteenth day from this sudden increase of the obstruction, the passage appeared to be wholly closed.

The patient himself, to the last, was far from despairing of his recovery; and the affectionate friends around him, though they could not but see the issue of the case, yet desired that his life might be prolonged to the uttermost. The following plan was, therefore, adopted with this view. Every morning a clyster was administered, consisting of eight ounces of strong broth, made chiefly of the membranous parts of beef, these being considered the most nutritious, into which were rubbed two yolks of egg, and to which were added forty drops of laudanum. This was repeated in the afternoon, and again in the evening, previously to which, in the evening, he was placed up to the neck in a tepid bath, of which one-fourth was milk, and the rest water; the whole quantity amounting to twenty-four gallons. The temperature was fixed at 96°, to accommodate his sensations, and the time of immersion was gradually prolonged from forty-five minutes to an hour.

After a few days it was found that the retention of the rectum improved, so that the clysters were enlarged to ten ounces of broth, and three yolks of eggs each; to which were added eight ounces of white wine, and the laudanum, which was added to the evening clyster, was gradually increased from sixty to two hundred and fifty drops. Thus the whole of his nutriment for twenty-four hours consisted of thirty ounces of broth, twenty-four ounces of wine, nine yolks of eggs, and from 250 to 380 drops of laudanum, and administered by clyster; with what liquid might be supposed to be taken up in the bath by the absorbents of the surface of the body.

When in tolerable health, at the commencement of his complaint, this gentleman, who was a tall man, and naturally corpulent, weighed 240 lbs. Before the obstruction had become complete, imperfect nutrition had reduced him to the weight of 179 lbs. In twenty days, from the period of the sudden increase of the obstruction, he was reduced to 154 lbs.; on the twenty-fourth day he had lost 5 lbs. more; and at the period when his delirium commenced, that is on the thirty-second day from the night that he ceased to swallow, he weighed 138 lbs., having lost upwards of 100 lbs. of his original weight. He lived four days longer, that is, thirty-six days from the period when the obstruction was supposed to be complete; but during these last four days, no nutriment, in any form or of any kind, was administered; for the rectum no longer retained the clysters, and the administration of the bath appeared, under these circumstances, to be wholly useless.

For a month after the total obstruction of the passage the temperature and the pulse were natural; but on the thirty-second day the pulse became small and frequent; on the following day the eyes lost their common direction, the axis of each being turned towards the nose; he complained that he sometimes saw double, but the sensibility of the retina was increased rather than impaired; for, on the admission of the light of the window, he screamed out, though he had before been accustomed to this light. On the next day there was considerable incoherence of mind; this incoherence passed rapidly into delirium, during the prevalence of which there was a perpetual and indistinct muttering, with great restlessness and agitation; the skin and the extremities were sometimes of a burning heat, and sometimes clammy and cold; the pulse became feeble and irregular; the respiration, which hitherto had been singularly undisturbed, became laborious; and in ninety-six hours after the clysters and all other means of nutrition had been abandoned, he ceased to breathe.

During the whole of this melancholy progress to inevitable death, this unfortunate gentleman complained very little of hunger: occasionally he expressed a wish that he could swallow, but not often nor anxiously; and, when questioned on the subject of his appetite, he always declared that he had no hunger which occasioned any uneasiness. The clysters evidently relieved the sense of hunger, and the opium they contained seemed to have a powerful share in producing this relief. It occasioned quiet and rest after each clyster, and allayed every kind of desire or appetite. Neither was he much disturbed with thirst. This sensation was, indeed, troublesome during the first days of his abstinence; but it abated, and, as he declared, was always removed by the tepid bath, in which he had the most grateful sensations. His spirits were uncommonly even, and his intellect perfectly sound. He occupied himself a good deal in his private concerns; and, as usual, interested himself in public affairs. In order to husband his strength he was confined a good deal to bed; but, till the last few days of his life, he dressed and undressed himself daily, and walked, not only about his room, but through the house. His nights were quiet; his sleep sound, and apparently refreshing. Just before his delirium set in he had very lively dreams, which were all of a pleasant nature; and, in the last conversation he had with his physician, he told him he had had a very gay evening with two Yorkshire baronets whom he named; that they had pushed the bottle about freely; that many jokes had passed, at the recollection of which he laughed heartily, a thing uncommon with him; but it was observable that he was unable, longer than a moment or two, to distinguish this scene which had passed in sleep from a real occurrence; and this state of mind lapsed into delirium from which he never recovered. At this period he was so weak as to be scarcely able to turn himself in bed, to which he had been entirely confined several days, previously to his death.

The second case, which is no less interesting, occurred to Dr. Willan. It was that of a young man of studious and melancholic turn of mind, who being affected with indigestion, undertook voluntarily to live without food. He drank nothing but water flavoured with a little orange juice. He was seen by Dr. Willan on the sixty-first day of his fast: at that time he was emaciated to a most astonishing degree; the muscles of his face were entirely shrunk; his cheek bones stood prominent and distinct, affording a most ghastly appearance; the abdomen was concave from the collapsed state of the intestines; the limbs were reduced to the greatest possible degree of tenuity, and the processes of their bones were easily distinguishable. His whole appearance suggested the idea of a skeleton prepared by drying the muscles upon it in their natural situations. His mind had become imbecile.

Unfortunately the treatment adopted was injudicious, the quantity of food allowed him being much too large; yet, for the first few days, he appeared to improve, regaining flesh and strength, and acquiring firmness and even cheerfulness of mind; but on the night of the fifth day he was sleepless and restless; on the morning of the sixth, he began to lose his recollection, and before midnight he was quite frantic and unmanageable; at the same time his pulse was increased in frequency, with considerable heat of the skin, and tremors. During the following day he continued raving, and talking very incoherently, as he had done during the preceding night. He remained nearly in the same state, scarcely ever sleeping, and taking very little nourishment, his pulse becoming daily smaller and feebler, and beating at length 120 strokes in a minute, and his emaciation still increasing, until the eleventh day from the period that he began to take food and medicine, and the seventy-second from the commencement of his abstinence, on which day he died, quite exhausted.

There is no authentic case on record in which the duration of the abstinence was as long as this, and both these cases taken together, afford an excellent history of the disorder of the functions, and the exhaustion of the powers of life on the total and continued abstraction of food. The mind in the first case was naturally firm and strong; in the second it was supported by an enthusiasm amounting to insanity. When the mind is feeble, and especially when it is under the influence of fear, anxiety, despondency, or any other depressing cause, the duration of life is greatly abridged. It is instructive to observe the absence of severe suffering from hunger and thirst; the absence of all acrimony of the fluids; the absence of all violence and turbulence of mind until delirium set in, the precursor of death.

From the powerful influence of abstinence on the system, it is obviously capable of becoming a most energetic remedy in various diseases. When the mass of the fluids and solids of the body is too abundant, abstinence is capable of reducing them to almost any extent that can be required; and if the abstinence be judiciously commenced and conducted, not only is it unattended with any diminution of the strength or injury to the health, but it contributes to the improvement of both. Numerous instances are on record which place this fact beyond question. The case of Cornaro the Venetian nobleman, and that of the Essex miller, which afford evidence of this more complete than it would be easy to invent, are universally known. The body, whatever be its bulk or weight, provided the health be in other respects sound, may be reduced to almost any degree of thinness, and kept at that point by an appropriate regulation of diet and exercise. The physician, at his pleasure, can make no one fat, but he can make any one as thin as he chooses, frequently improving at the same time the health and vigour both of body and mind. Seldom is he called upon to put this art into practice, and seldomer than he ought does he insist upon carrying it into practice; but it is something to know that the resources of his art place this in his power.

In all acute diseases, such as the various forms of fever and inflammation, abstinence is a most powerful remedy, not only because the abstraction of nutriment diminishes the mass of the fluids and solids (since the process of absorption goes on though the supply of new matter is stopped), but also because it withdraws one of the main stimulants of the system, and consequently subdues the increased actions which accompany, and which for the most part constitute, acute diseases.

In some chronic maladies, especially in that large class which depend on what is termed plethora, that is, too great a quantity of solids and fluids, particularly in the plethoric state of the blood-vessels of the brain, predisposing to and producing apoplexy, in some morbid affections of the stomach itself, in some derangements of the liver, and in several diseases of the heart, abstinence is an invaluable remedy. In other chronic diseases it is injurious, as in diseases of debility, in diseases which depend on irritation in contradistinction to those which depend on inflammation, and in various nervous maladies.

Abstinence is not equally borne by all persons, nor at all times by the same person. By the corpulent and plethoric it may be endured longer, and carried farther, than by the thin and the spare; in the middle or mature age, it is less injurious than in infancy, youth, or extreme old age. A degree and duration of it, which are highly beneficial in a fever or an inflammation, would be fatal in the state of health.

It is curious, and it is highly important to bear in mind, that abstinence and excess produce symptoms so nearly alike, that it often requires the utmost care and sagacity on the part of the physician to distinguish the one case from the other; and as the one requires opposite remedies from the other, a mistake may be fatal, and must be injurious. A man, addicted to drunkenness, was cast into prison for theft, and reduced, at once, to a diet of bread and water. After the first week, a disorder of the intellectual faculties took place; his countenance became pale and expressive of languor, his flesh wasted, and his strength declined; his nights were sleepless; shortly afterwards there was delirium, which was mild at first, but subsequently furious. These symptoms might have been easily mistaken for those which denote inflammation of the brain; but the true nature of the affection was discriminated, and brandy was administered. Immediately the affection of the brain disappeared, and the flesh and strength returned.

Some time ago an alarming epidemic broke out in the Milbank Penitentiary, London. The prisoners confined in this prison were suddenly put upon a diet, from which animal food was almost entirely excluded. An ox's head, the meat of which weighs eight pounds, was made into soup for one hundred people, which allows one ounce and a quarter of meat to each person. The prisoners were at the same time subjected to a low degree of temperature, to considerable exertion, and were confined within the walls of a prison, situated in the midst of a marsh, which is below the level of the adjoining river. The consequences were, first, loss of colour, of flesh, and of strength; next, this simple debility of constitution was succeeded by various forms of disease—scurvy, dysentery, diarrhœa, low fever; and, lastly, affections of the brain and nervous system—namely, headache, vertigo, delirium, convulsions, apoplexy, and even mania. When bleeding was tried, the patients fainted after losing five, four, or even fewer ounces of blood. Abstinence will sometimes produce a train of symptoms exactly similar to those of the disease which it is employed to remove. Persistence in the abstinence will aggravate the malady, which will baffle every mode of treatment as long as the abstinence is persevered in; but which will disappear with surprising rapidity on the administration of a generous diet. This is especially the case with those affections of simple irritation which assume the appearance of inflammation, and which are attended with headache, noise in the ears, giddiness, restlessness, sleeplessness, and delirium. A professional man was seized with fever; rigid abstinence was enforced, not only during the continuance of the fever, but also during the stage of convalescence. Delirium, which had been present in the height of the fever, recurred in the convalescence. A physician of eminence in maniacal cases was consulted, who recommended him to be removed to a private asylum. Before this advice was carried into effect, another physician saw him: a different treatment and regimen, with a gradual increase of nourishment, were adopted; the patient was well in a few days, and within a fortnight returned to his professional avocations.

It is the common belief that abstinence is conducive to longevity, and many stories are on record which are conceived to establish the truth of this opinion. It is stated, for example, that the primitive Christians of the east, who retired from persecution into the deserts of Arabia and Egypt, lived healthfully and cheerfully on twelve ounces of bread per day, with mere water; that, with this diet, St. Anthony lived 105 years; James the Hermit, 104; Arsenius, tutor of the Emperor Arcadius, 120; St. Epiphanius, 115; Simeon the Stylite, 112; and Romauld, 120: to which are added many others. But we should remark that the evidence for these instances of longevity is not very satisfactory. [FOOD, in NAT. HIST. DIV.]

ABSTRACT. [VENDORS AND PURCHASERS.]

ABSTRACTION is an act of the mind, by which it considers a certain attribute of an object, or several objects, by itself, and without regarding any other attributes which the object or objects may happen to possess. Thus, if we see ink, pitch, ebony, and a negro, we see that these objects have in common the attribute of blackness; and this quality we can in thought *draw off* or *abstract* from the various other attributes which they respectively possess; and consider it separately and independently of anything else. In like manner we can consider any attribute of a single object, such as of the sun or moon, without attending to its other attributes; thus we may contemplate the magnitude of the sun without attending to its heat, light, &c.; so we may contemplate the light of the moon, without attending to its magnitude, the inequalities of its surface, &c. All names of classes, inasmuch as the individual members can never be identical, are formed by a process of abstraction. Thus, when we think of a ship or a house, we pay no attention to the materials, colour, shape, size, construction, convenience, or beauty of the ship or house, but we give the one name to any dwelling of man built by regular artificers, and the other to any vessel with a deck and masts made to sail on the sea. Any object which possesses these attributes we call a ship or a house; though there cannot be any ship or house which possesses *only* those attributes, and is not also of a certain colour, size, shape, &c.; but these incidental qualities we leave out of our consideration in referring any object to the class of houses or ships.

From these remarks it is evident that abstraction, being a merely arbitrary act of the mind, by which a certain attribute is considered apart from any other attributes with which it may happen to be associated, does not represent to us images or notions to which there is anything corresponding in the nature of things; there is nowhere an abstract man or tree which has no colour, dimensions, or other incidents not entering into the abstract notion signified by those general terms. Whenever we recognise in any object those peculiarities which we consider as characteristic of a certain class, we refer it to that class, without taking any heed of the *other* attributes with which they may happen to be combined. Thus, if in some unexplored part of the world there should be discovered a race of animals resembling some known variety of the human race in every particular except the colour of the skin or the hair, they would be doubtless called men, although there is no such thing as an abstract man whose skin or hair is devoid of colour.

The circumstance of there not being any sensible object, or any conception of our mind, which we can image to ourselves without its attributes, has given rise to considerable perplexity on the subject of abstraction. For instance, when we think of a horse, we represent to ourselves an animal of certain colour, shape, and size; though we should equally give the name of horse to an animal of different colour, shape, and size. So, when we think of a plane triangle, although a triangle is any plane figure bounded by three straight lines, yet we cannot help representing to ourselves a triangle which is either right-angled, or acute-angled, or obtuse-angled, or equilateral or scalene. The truth is, that the process by which the mind abstracts is, that it conceives or represents to itself the object of thought as an individual of its class, together with certain particular attributes which must belong to all individuals; and it considers apart from the rest only that attribute which is required for the matter in hand. Thus, if it is a question whether a newly-discovered skeleton is that of an animal belonging to the class of elephants or of deer, the comparative anatomist calls to his mind an elephant or deer, such as actually exists, but *considers* only the structure of his bones; and, if there is a close agreement in this respect, he pronounces the skeleton to have belonged to one of those classes. So, likewise, when a mathematician, by means of a figure described on paper, proves that the square of the hypotenuse equals the sum of the squares of the other sides of a right-angled triangle, although the image in his mind is that of a triangle of a definite size, yet he considers only the relation of the sides and angles, without paying any attention to the length of the lines.

This process, by which the mind *generalises* a particular notion, by considering only a part of it, might be illustrated by many examples of changes in the meaning of words. Thus, there stood formerly on the bank of the Thames, in London, a palace called Bridewell; this, in the reign of Elizabeth, was converted into a penitentiary, or prison for hard labour; whence the term *bridewell* has been extended, and is now sometimes used as a general name for such penitentiaries. So the name *palace* has been extended to all sumptuous houses, having originally been confined to that on the *Palatine* hill, at Rome. It has been remarked that, although brute animals have, like men, the faculty of reasoning or drawing conclusions from premises, yet they have not, like men, the faculty of abstraction. Nevertheless, it is plain that some animals go through a process of which the effects exactly correspond with that of abstraction in men; for example, they can count, and are aware of the recurrence of certain numbers; and a dog who has once been beaten with a stick, or pelted with a stone, will run away from all sticks or stones, of whatsoever size, shape, or colour. That they cannot found, on abstraction, the admirable gift of language, the most important distinction between men and beasts, is owing apparently not to the absence of the power of forming general notions, nor yet to the inability of making articulate sounds, as we may perceive in the instance of the parrot. [NOMINALISTS.]

ABSURDUM, REDUCTIO AD, is that species of argument which proves, not the thing asserted, but the absurdity of everything which contradicts it. It is much used in geometry, in order to demonstrate the converse of a proposition already proved. One of two things must be true; either the proposition asserted, or something which contradicts it. If the opposing party deny the proposition, he must affirm that which is contradictory. Let his counter-proposition be taken for granted; then, if by the legitimate use of it some absurdity can be deduced, it is evident that his contradiction is wrong, and the original proposition right. As an instance of this method of proceeding, let us suppose it has been proved, and is not denied, that whenever A is B then C is D. We may then affirm that when C is not D, A is not B. For if A were B, C would be D; but C is not D, therefore A is not B. The full form of the *Reductio ad Absurdum*, in this case, is as follows:—You grant that if A were B, C would be D; but you refuse to admit the consequence that, when C is not D, A is not B; that is, you say that C may not be D, and yet A may be B. Let this, then, be as you say, that is, let C not be D, and yet let A be B. But in supposing that A is B, the admitted proposition obliges you to say that C is D. But you have supposed that C is not D: you therefore say at the same time that C is D, and that C is not D, which is absurd. Consequently, if it be true that whenever A is B then C is D, it follows that when C is not D, A is not B.

The *Reductio ad Absurdum* has been objected to as not equally conclusive with direct demonstration. For this there is no foundation; though it must be admitted that direct demonstrations are more pleasing and more elegant. But it is obvious that, if everything which contradicts a proposition be false, the proposition itself must be true. The student of logic must distinguish between that which is only *contradictory*, and that which is *contrary* to a proposition. Thus, to the proposition that "all squares are equal," it is contradictory that "*some* squares are not equal," and contrary, that "*no* squares are equal." The contrary is the most complete contradictory, and affirms that the proposition is true in no one instance. It is not correct to say that, if a proposition be false, its contrary is true; for example, it is false that all squares are equal, and equally false that no squares are equal. But of a proposition and its contradictory one must be true; thus either all squares are equal or some squares are not equal. Hence, whatever disproves a proposition proves something contradictory, and whatever disproves everything contradictory proves the proposition. The *Reductio ad Absurdum* is, therefore, as conclusive as direct demonstration.

The *Reductio ad Absurdum*, in Euclid, is wholly unnecessary to all who can see that *contra-positive* propositions are identically the same. The following forms are contra-positive:

Every A is B
Every not-B is not-A.

Thus (Euclid I. 4) two sides equal to two sides understood, proves that equal angles give equal areas: that is, unequal areas give unequal angles. He then has to prove I. 6, which he does by *Reductio ad Absurdum*. His form is, equal base angles give equal opposite sides: its equivalent contra-positive is, unequal sides give unequal opposite angles. From the unequal sides it may immediately be shown, as in Euclid, that two triangles having two pairs of sides equal, each to each, have unequal areas, and therefore unequal angles. Thus it is shown that the angles opposite unequal sides are unequal: which is but saying that the sides opposite equal angles are equal. Had logic been cultivated concurrently with geometry, the *Reductio ad Absurdum* would long ago have disappeared, in nearly all the cases in which it is now used.

ABUTMENT, in building, is that which receives the end of, and gives support to, anything having a tendency to thrust outwards in a horizontal direction. The piers against which an arch that is less than a semi-circle rests are abutments; while the supports of an arch of any other figure, which springs at right angles to the horizon, are imposts. The piers of the arches of Southwark and Vauxhall bridges are abutments or abutment-piers; whereas those of London, Blackfriars, and Waterloo bridges, and of the old Westminster bridge, are imposts or impost-piers. Nevertheless, the piers at the extremities of a bridge, of whatever form its arch or arches may be, are always termed its abutments; that is, abutments of the bridge itself.

ABUTMENT, in machinery, is a term applied to a fixed point from which resistance or re-action is obtained. In an ordinary steam-engine, for example, each end of the cylinder acts alternately as an abutment. The steam, being unable to expand itself in the direction of the fixed obstacle, that is, the end of the cylinder, expends the whole of its elastic force in the opposite direction, against the movable obstacle or piston. In like manner the breech of a gun forms an abutment for the expansive force of the ignited powder; although in this case, the abutment not being absolutely a fixed point, its recoil occasions some loss of power. Even a rotatory steam-engine, with a continuous circular action, must have an abutment to render the force of the steam effective. Springs, whether used to impel machinery, as in the case of a watch, or to measure or control force, as in the various contrivances noticed under SPRING-BALANCE, must have their abutments or points of resistance; as also must all mechanical combinations in which power is transmitted by means of screws, of which it is sufficient to cite as an example the nut in the fixed head of an ordinary screw-press. In all these cases an analogy may be traced with the use of the term abutment in architecture. With a similar meaning the name is applied in carpentry to a joint in which two pieces of timber meet so that the fibres of one piece run in a direction oblique or perpendicular to the joint, and those of the other parallel with it.

ABUTTALS, from the French *abutter*, to limit or bound, are the buttings and boundings of lands to the east, west, north, and south, showing by what other lands, highways, hedges, rivers, &c., such lands are in those several directions bounded.

The boundaries and abuttals of corporation and church lands, and of parishes, are usually preserved by an annual procession.

ABYSSINIAN CHRISTIANS. The discovery of a body of Christians in so remote a country excited, in no small degree, the attention of Europe in the 15th century, which was again revived by Salt's last mission, in 1810. From the 'Tareek Negushti,' or 'Chronicle of the Abyssinian Kings,' combined with the evidence of the ecclesiastical writers, we learn that Christianity was introduced into Abyssinia in the time of Constantine, by Frumentius, or Fremonatos, as the chronicles call him. Frumentius, after residing some years in the country, was raised by Athanasius the patriarch of Alexandria, to the dignity of bishop. He arrived in Abyssinia, perhaps about the year A.D. 330, and probably in the reign of the King Aizanas, whose name still exists in the inscription of Axum. It is, however, not certain to which king of the Abyssinian chronicles we ought to apply the names of Aizanas and his brother Saizanas, both of which occur in the inscription, and also in a letter of the Emperor Constantine, addressed to them A.D. 356. When the Greek merchant Cosmas visited Abyssinia, A.D. 525, it was completely a Christian country, and well provided both with ministers and churches. Of the Abyssinian churches, which probably belong to the earlier periods of their conversion, or at least are eight or nine hundred years old, there are still some remains. The most remarkable is Abuhasubha, hewn out of the solid rock, which at this place is soft and easily worked. The Portuguese, Alvariz, describes ten such churches as these, of which he has given a plan, and one of them is probably the same as that which Mr. Pearce visited at Jummada Mariam. (Salt, p. 302.) The great church at Axum is comparatively modern, though parts of it, such as the steps, clearly belong to a prior edifice. Mr. Salt describes the well-built remains of a church or monastery near Yahee, which he assigns to the 6th century of the Christian era.

The monastic, and also the solitary life, spread into Abyssinia from the deserts of the Thebais, and when the Portuguese Jesuits entered the country they found it full of such devotees; many of them seemed, however, to be monks only as far as celibacy was concerned, for they cultivated the ground and lived in villages.

With the Christian religion, the Abyssinians received the Holy Scriptures, which they now possess in the ancient Ethiopic version, made, according to Ludolf, from the Greek Septuagint, though nothing is known of the date of this version. As to the New Testament (says Ludolf), no entire copy has been yet brought to Europe. Mr. Bruce brought with him from Abyssinia a complete copy of the Scriptures in the Ethiopic language, and also a set of the Abyssinian Chronicles. The Abyssinians divide the Scriptures, which they have entire, differently from what we do, making four principal parts of the Old Testament, and mixing what we call the Canonical with the Apocryphal books. The New Testament is also divided into four parts, to which they add the Book of Revelation as a supplement. The old written language is of the Semitic stock, and is written from left to right, but the language is not now spoken; there are two languages now in use, the Tigré and the Amharic. For other information respecting the Abyssinian liturgies, and the religious opinions of the Abyssinians, we refer to Ludolf, Book iii. chaps. 4, 5. Ludolf denies the existence of the Book of Enoch, because he had only seen a spurious copy. A knave who got possession of an Ethiopic book, wrote the name of Enoch upon it, and sold it to Peiresc for a considerable sum of money, and this was the book that Ludolf saw. Bruce brought home three copies of the book of Enoch; one of which he gave to the Bodleian Library at Oxford. This book was originally written in Greek, but the original is lost—all but one large fragment. In the epistle of Jude reference is made to the prophecies of Enoch; and Mr. Bruce says, "the quotation is word for word the same in the second chapter of the book." This, however, will not prove the genuineness of the prophecies of Enoch, as Mr. Bruce has very well argued. An English translation of the book of Enoch was published by Dr. Lawrence, Oxford, 8vo. 1822.

The High Priest (or sole bishop) of Abyssinia is called *Abuna*, which signifies Our Father; and as Frumentius, the first bishop, received his appointment from the Patriarch of Alexandria, this dignitary has, probably, always been a foreigner. The king is the head of the Church. Polygamy, though not allowed by the ecclesiastical canon, is common enough in practice; and Mr. Salt mentions an instance of one gentleman who had five wives at once. The king, of course, marries as many as he pleases: the clergy, also, who are not monks, may marry, but only once. A second marriage renders them unworthy of their sacred office, according to the ancient canons. Circumcision, according to Bruce, is practised in Abyssinia, and baptism of infants and agapæ or love-feasts have been in use ever since the introduction of Christianity. The creed of the Abyssinian Church is what is called the Monophyiste; *i. e.*, admitting the divinity of our Saviour, but acknowledging in him only one nature.

It would appear, from what we know of the Abyssinian Church, that its priests, at present, are not well informed, nor are the people in general well acquainted with the principles of the Christian religion, though they may be Christians in name; yet some of their ceremonies are conducted with great decency, and very much resemble those of the Church of England. When Salt was at Chelicut, Lent was strictly observed for fifty-two days, and no flesh was eaten during this period, though fish and various dishes were always plentiful on the table: the people always fasted till sunset. A feast followed this severe and protracted fast, in which they all seemed anxious to make up for lost time, by over eating and drinking. The Sacrament is also administered in Abyssinia, in a very decorous manner; and red wine made of a grape which is common in some parts of the country, is used on the occasion. Formerly (says Mr. Salt) if a man married more than one wife, he was excluded from participating in this rite, but wealth and power have induced the Church to relax its severity in this respect. Marriage itself in Tigré, appears a mere civil institution: the woman keeps her name, and the parties can separate whenever they agree to do so. In this case the woman has her dowry back, which is not forfeited unless she is manifestly guilty of adultery. The higher classes are subject to no rule, but what may be considered as imposed by the relatives of the male and female. The priests are forbidden to marry after ordination. The Abyssinians bury their dead immediately after washing and fumigating the body with incense: while the bearers are putting it in the ground, the priests recite a form of prayer. Other strange ceremonies that follow are described by Salt.

(Ludolf's *History of Ethiopia*; Bruce, vol. ii. p. 422; Salt's *Abyssinia*; Rüppell; Gobat, *Journal of a Three Years' Residence in Abyssinia*; and Professor Lee's *Brief History of the Church of Abyssinia*, prefixed to that work.)

ACADEMY. A house and garden in one of the suburbs of Athens, inclosed by a wall, and having the grounds laid out in walks shaded by trees, was the original Academy. It is commonly stated to have been so called from its original possessor Academus, or Ecademus, who is said to have established here a school of gymnastic exercises. Other etymologies of the term, however, have also been given. About the middle of the 5th century before the commencement of our era, the groves of Academus fell into the possession of Cimon, the Athenian general; and it was he who first adorned the place with statues and fountains, and added other improvements, so as to convert it into a retreat uniting to the charms of natural scenery many of the luxuries of art. At his death he left the garden to the public; and it became a favourite resort of the lovers of philosophy and solitary meditation. Hither Socrates was wont occasionally to repair to converse with his disciples. But it was his illustrious pupil, Plato, who first gave celebrity to the Academy as the seat of philosophy, by establishing here the school over which he presided for nearly half a century. Hence the Platonic philosophy is frequently called Academism, or the philosophy of the Academy; and its followers, Academics, or Academists. Plato died about the year 348 before the Christian era. About the year B.C. 296, one of his successors, Arcesilaus, introduced certain changes into the original doctrines of the school; and he is on this account considered the founder of a second, or Middle, as distinguished from the Old academy. There was also in this sense a third academy, called the New, of which the founder was Carneades, who flourished about a century after Arcesilaus. Some writers even reckon a fourth Platonic academy, founded soon after the time of Carneades, by Philo (not the celebrated Platonic Jew), and Charmidas or Charmadas; and a fifth, designated the Antiochian, from its founder, Antiochus, who had been a disciple of Philo. With regard to the academy of Plato, we may further notice that it was situated in the suburb, lying N.W. of Athens, called Ceramicus, that is, literally, the Place of Tiles; and it has been remarked, as a curious coincidence, that the principal public garden of that city should thus have apparently had the same origin with the Tuileries of the modern capital of France, a name which also indicates that the site was anciently that of a tile-work. Cicero had a country seat on the Neapolitan coast, to which, as one of his favourite retreats for philosophical study and converse, he gave, in memory of the famous Athenian school, the name of Academia. It was here he wrote his Academic Questions. Its remains are still pointed out near Pozzuoli, under the name of the Bagni de' Tritoli.

After the restoration of letters in the 15th century, the term Academy was revived in Italy, but with a signification somewhat different from what it had borne in ancient times. It was used to imply, not a school in which philosophy was taught by a master to his pupils, but an association of individuals formed for the cultivation of learning and science, and usually constituted and endowed by the head of the state in which it was established. What was now called an academy, in fact, more nearly resembled what was anciently denominated a Museum,—the name given, for example, to the famous association of the learned, founded by the first Ptolemy, at Alexandria, which so long subsisted in that city. The Emperor Charlemagne is also recorded, towards the close of the 8th century, to have established in his palace at Paris a society of this description. Charlemagne was also the founder of the University of Paris, and several other schools and seminaries of instruction; but although the Greek term Academia has often, at least in more recent times, been applied to such institutions, they are altogether distinct in their nature from what is properly called an academy.

On the other hand, many of those associations of the learned, which, in all material respects, resemble the academies that arose in Italy with the revival of letters, are, nevertheless, not known by that name. They are called not academies, but Societies, Associations, Museums, Lyceums, Athenæums, Institutes, &c. Of such associations, British and foreign, which have issued, and many of which continue to issue their printed Transactions, Journals, or various works, the Catalogue of the British Museum contains a list of about 1250. Among the more celebrated, and one of the earliest, was the Academy 'della Crusca,' that is, literally, *of the bran*, or *chaff*, in allusion to the object of its institution, the purifying of the national tongue, and the sifting, as it were, of its flour from the bran. It was established at Florence in 1582, principally by the exertions of the poet Antonio Francesco Grazzini, who is much celebrated for the purity of his style. The Dictionary of the Academia della Crusca, first published under the title of 'Vocabolario degli Academici della Crusca,' at Venice, in 1 vol. fol., in 1612; but augmented, in 1729-1738, to 6 vols. fol., is considered as the standard authority for the Italian language; and the writers from whose works it has been collected, or whom it recognises as classics, such as Boccaccio, Machiavel, &c., are hence frequently denominated *Autori Cruscanti*. The Academia della Crusca is now incorporated with two still older societies, the Academia degli Apatici (or *Academy of the Impartials*), and the Academia Fiorentina, originally the Academia degli Umidi, founded in 1549 by Cosmo I. The united institutions bear the name of the Royal Florentine Academy. Another very famous old Florentine academy is that entitled Del Cimento, that is, the *Academy of Experiment*. It was instituted for the cultivation of physical science, by the Cardinal Leopold de' Medici, brother of the Grand Duke Ferdinand II., in 1657. Among its first members were Borelli, Viviani, &c. A collection of experiments on the pressure of the air, the compressibility of water, on heat, sound, projectiles, light, and other subjects belonging to natural philosophy, was published in Italian by the Academy del Cimento in 1667, of which Muschenbroeck afterwards gave to the world a Latin translation, with valuable notes. Many of the Italian academies are remarkable for the fantastic names by which they are designated; and in 1725 there were nearly 600 of them. The Royal Academy of Sciences and Belles Lettres of Naples was founded in 1779; it has published its Transactions, which contain many valuable papers on mathematical subjects, since 1788. The Herculanean Academy of Naples, was founded in 1755; the first volume of its Transactions appeared in 1775, under the title of 'Antichità di Ercolano,' and it has been followed by several others. The Academy of Etruscan Antiquities at Cortona, founded in 1726, and that at Florence, founded in 1807, have both published valuable Transactions. There are also academies at Padua, Milan, Siena, Verona, and Genoa, by all of which some volumes of Transactions have been printed. The Academy of Bologna was originally founded in 1690, by the afterwards distinguished astronomer Eustachio Manfredi, then only sixteen. The associates called their institution the Academia degli Inquieti, and took for their motto the words *Mens agitat*. In 1714 this academy was united to the University or Institute of Bologna, since which event it has been called the Academy of the Institute, or the Clementine Academy (from Clement XI., the then Pope). Its Transactions have been published under the title of 'Commentarii,' since 1731. To this list we may add the Royal Academy of Turin, in Piedmont, which was originally a private association founded about the middle of the last century, by the young Lagrange, then, although not yet twenty years of age, holding the office of Professor of Mathematics in the Royal Artillery School of that city. The first volume of its Transactions was published in Latin, in 1759, and surprised the scientific world by some papers of great originality, to which the name of Lagrange was appended. The Turin Transactions, which continued for some years to be enriched by the contributions of this eminent mathematician, were published in Latin, till 1784, since which time they have appeared in French.

The Académie Française was instituted in 1635 by Cardinal Richelieu, for an object of the same nature with that proposed by the Academia della Crusca,—the purification, regulation, and general improvement of the national tongue. This society, in imitation of its Italian model, published in 1694 the first edition of a French Dictionary, known by the name of the Dictionary of the Academy, to which it afterwards made many additions in successive reprints. This work however has scarcely perhaps attained the same authority with that of the Della Cruscan academicians; partly owing, no doubt, to the comparative immaturity of the French language when it was thus attempted to restrain its further growth. The original number of the members of the Académie Française was forty, from whom were elected a director and a chancellor every three months, as well as a secretary, who held his office for life. This constitution it continued to retain till the year 1793, when it was abolished, with most of the other establishments which had subsisted under the ancient government. Two years after it was restored as part of the Institute. The next of the French academies, in point of antiquity, is the 'Académie Royale des Inscriptions et Belles Lettres.' It was established in 1663, in the reign of Louis XIV., by Colbert, and consisted originally of a few members selected from the Académie Française. In 1701 this academy was placed, by an edict of the king, upon a new and more extended foundation; and from this date it published every year a volume of memoirs, many of great value, till it was suppressed at the Revolution. It consisted, at the period of its suppression, of ten honorary members, ten pensionaries, and twenty associates, exclusive of several corresponding members. The 'Académie Royale des Sciences' was originally established by Colbert in 1666, but was entirely remodelled in 1699. By the new constitution its researches were confined to the department of the physical sciences. The Académie des Sciences first began to publish its Transactions in 1666, and from 1699 a volume appeared regularly every year till the academy was suppressed in 1793. These three academies, together with the Académie Royale de Peinture et de Sculpture, which had been rather a school of painting than an association of cultivators of the art, were restored by the Directory in 1795, and united into what was called the National Institute. The French Institute has, since its establishment, ranked as the very first of the scientific associations of Europe, the most illustrious of whose philosophers have usually been comprehended in the list of its members.

The Royal Academy of Spain, founded at Madrid, in 1714, principally by the exertions of the Duke of Escalona, was constituted on the model of the Academia della Crusca and the Académie Française, and has for its object the improvement and purification of the Spanish language, of which it has published a Dictionary, under the title of

'Diccionario de la Lengua Castellana,' six vols. fol., 1726-1739. The Royal Academy of Spanish History was commenced as a private association at Madrid in 1730, but was taken under the royal protection, and incorporated by Philip V. in 1738. It consists of twenty-four members. The first volume of its Transactions was published in 1796, under the title of 'Memorias de la Real Academia de la Historia.' It has also printed some ancient manuscripts, and given new editions of some historical works. There are also an Academy of History and Geography at Valladolid, and a Literary Academy at Seville, both founded in 1753.

The principal Portuguese academy is the Academy of Science, Agriculture, Arts, Commerce, and general Economy, founded by Queen Maria in 1779. It has published several volumes of Transactions in different sets. There is also a Geographical Academy at Lisbon, established in 1799.

Of Austrian Academies, the most ancient is the 'Academia Naturæ Curiosorum,' established at Vienna in 1652. In 1687, during the reign of the Emperor Leopold I., it assumed the name of the Academia Cæsareo-Leopoldina. Its Transactions were at first published in separate treatises, but since 1684 they have appeared in volumes, under the title of 'Ephemerides et Acta Academiæ Cæsareæ Naturæ Curiosorum.' A history of this academy was published by Büchner, Halle, in 1756. The Academy of Arts and Sciences of Vienna was founded in 1705. In 1754 was established in the same city an Academy for the cultivation of the Oriental Languages.

The Royal Academy of Science and Belles Lettres of Berlin has long been one of the most eminent among the learned societies of Europe. It was established in 1700, by Frederick I., who appointed the celebrated Leibnitz its first president. The first volume of its Transactions appeared in 1710, under the title of 'Miscellanea Berolinensia,' and other volumes followed at intervals of three or four years, till the accession of Frederick the Great in 1740, who, in 1744, took it under his special protection, and proceeded to give it a new organisation, with the view of extending its usefulness, and raising it to a higher rank than it had hitherto enjoyed. A history of this academy was published in 1752. In 1754, was established by the Elector of Mainz, the Electoral Academy at Erfurt, for the promotion of the useful sciences. Its Transactions were originally published in Latin, under the title of 'Acta Academiæ Electoralis Moguntinæ Scientiarum Utilium;' but they have of late appeared in German.

Of other German Academies the principal are—the Academy of Sciences, otherwise called the Royal Society, of Göttingen, established in 1733; the Electoral Academy of Science and Bavarian History at Munich, first established in 1760, but greatly enlarged since the erection of Bavaria into a kingdom, and which has published its Transactions, since 1763, in German, under the title of 'Abhandlungen der Baierischen Akademie;' that of Mannheim, founded in 1755, by the Elector Charles Theodore, and now divided into three classes—historical, physical, and meteorological; the Transactions of the two former of which have been published, under the title of 'Acta Academiæ Theodoro-Palatinæ'—those of the last, under that of 'Ephemerides Societatis Meteorologicæ Palatinæ;' and the Academy of Suabian History, established at Tübingen, in Würtemberg.

The Royal Academy of Sciences, of Stockholm, was originally a private association, founded by Linnæus, and a few of his friends, in 1739, and was not incorporated by the Crown till two years afterwards. Its Transactions appear in quarterly parts, which form an octavo volume a year. The first forty volumes, from 1739 to 1779, are called the 'Old Transactions;' those which have appeared since, the 'New.' They are written in Swedish, but have also been translated into German. Stockholm also possesses an Academy of the Belles Lettres, founded in 1753; and an institution denominated the Literary Academy of Sweden, founded in 1786. The object of the latter is the cultivation and improvement of the national language. There is an Academy for the investigation of Northern Antiquities, at Upsal, which has published some valuable volumes of Memoirs. The Royal Academy of Sciences of Copenhagen was founded by the Count of Holstein in 1742, and incorporated the following year. Its Transactions appear in Danish; but they have been partly translated into Latin.

The Imperial Academy of St. Petersburg, like most of the valuable institutions of Russia, originated in the bold and contriving mind of Peter the Great. That monarch however did not live to carry into effect the scheme which he had arranged, and which is said to have been suggested to him by his inspection of the academies of France, when in that country in 1717, and to have been matured by consultations with Christian Wolff and Leibnitz. But immediately after his death, in 1725, his successor, Catherine I., proceeded to execute the intentions of her deceased husband; and the Academy was forthwith established, and held its first sitting in December of that year. Some of the most distinguished foreign mathematicians and philosophers of the day were wisely selected by the empress to grace the new foundation, and induced by liberal salaries to accept places in it under the title of professors. Among them were Wolff, Nicolas and Daniel Bernoulli, Bulfinger, &c. In its earlier days this institution underwent various fluctuations in reputation and efficiency, according as it happened to be patronised or neglected by the reigning sovereign; but since the accession, in 1741, of the Empress Elizabeth, who placed it upon a broader and more independent basis, it has generally maintained a high character. Its annual revenue is considerable; and one important service which it has thus been enabled to render, has been the exploration of various portions of the Russian empire, by means of the travellers Pallas, Stolberg, Klaproth, and others, whom it has sent out for that purpose. Its Transactions, down to the year 1747 inclusive, forming 14 volumes, are in Latin, and are entitled 'Commentarii Academiæ Scientiæ Imperialis Petropolitanæ.' Twenty volumes more, down to 1777, likewise in Latin, are entitled 'Novi Commentarii.' Since 1777 they take the name of 'Acta,' and are partly in Latin and partly in French. Of the whole number of mathematical papers which appeared in these Transactions down to the year 1783, in which he died, the celebrated Euler is computed to have written fully one half; and he left behind him about a hundred additional memoirs, which have appeared in the volumes printed since that period. These papers of Euler's contributed, more than any other publications of the time, to the simplification and improvement of the modern analysis. The Imperial Academy possesses a library of some extent, which contains a considerable number of oriental manuscripts, as well as valuable collections of medals and of specimens of natural history. In 1783, an institution, on the model of the Académie Française, having for its object the improvement of the Russian language, was founded at St. Petersburg, and was soon after united with the Imperial Academy.

Among the other European academies, may be mentioned the Medical Academy of Geneva, founded in 1715; the Académie des Sciences et des Belles Lettres of Brussels, which has published its Transactions, under the title of 'Mémoires,' since the year 1777; and the institution of the same name at Flushing, whose Transactions have also appeared. In the British dominions there are no associations for the cultivation of science or learning, which have this name, except the Royal Irish Academy, founded in 1782, and which has published its Transactions since 1787. In the United States of North America, as in England, such institutions are, for the most part, called *Societies*, but a few are styled Academies, such as those at Boston and Philadelphia, and have published their Transactions.

Academy is also the name usually given, both in this country and on the Continent, to an institution established for the cultivation and promotion of the fine arts, that is, of painting, sculpture, architecture, and music. Such institutions commonly partake both of the character of academies, in the sense already explained, and of schools or colleges, consisting, on the one hand, of an association of amateurs and distinguished proficients, professing to have in view the diffusion of a taste for the arts among the public generally, by publications, exhibitions, or any other means which may be made available for that end; and, on the other, of an establishment of teachers or professors, for the instruction of youth in the practice of some one or more of the branches in question. The latter object is effected by lectures, by prescribed tasks, and by the distribution of prizes and honours. Societies of painters, for the promotion and protection of their art, are of very ancient date. The Royal Academy of London originated in an association of painters, who obtained a charter, in 1765, under the title of the Incorporated Society of Artists of Great Britain. This society, however, was soon after broken up by disputes among its members; and in 1768, the Royal Academy of Arts was incorporated in its stead. It consists of forty artists bearing the title of academicians, of twenty associates, of two academician engravers, of five associate engravers, and of three or four individuals of distinction, under the name of honorary members, but who also hold certain nominal offices. From the academicians are selected the professors of painting, of sculpture, of architecture, and of perspective; and there is also a professor of anatomy, who is commonly a member of the medical profession. Nine of the academicians are likewise appointed annually to officiate in setting the models, and otherwise superintending the progress of the students. The sovereign is the patron of this institution; but its funds are, we believe, entirely derived from the money paid by the public for admission to the exhibition, which takes place every year, in the months of May, June, and July. A branch of the English Royal Academy was established some years ago at Rome. The Edinburgh Royal Academy of Painting was founded in 1754. A similar institution has also been established in Dublin, under the title of the Royal Hibernian Academy. An Academy of Ancient Music was established in London so early as the year 1710; but a disagreement among its members occasioned its dissolution after it had existed above twenty years. Some time after this the Royal Academy of Music was instituted, with Handel at its head, and for ten years, during which the operas of that great composer were performed under its superintendence in the Haymarket Theatre, enjoyed splendid success. But discord here also came at length, to divide and disperse the professors of harmony; and in the year 1729, the institution was broken up. A new Royal Academy of Music, which holds its meetings in Hanover-square, was established in 1822. The French Opera, it may be added, is styled the Académie de Musique.

ACA'NTHUS (in Architecture). The name by which the leaf used in the enrichment of the Corinthian capital is known. It is thus called because of its general resemblance to the leaves of a species of the acanthus plant; or rather because of a pretty traditional story which the Roman author Vitruvius tells of the fancied origin of the Corinthian capital, in which the leaves are said to be imitated from those of the acanthus. The same leaf, however, is commonly used in architectural and sculptural enrichments generally; in the enrichment of modillions, of mouldings, and of vases, as well as of foliated capitals; and we gather from Virgil, that the acanthus was by the ancients also employed as an ornament in embroidery. In the first book of the '*Æneid*,' verse 649, and again at 711, a veil or vest is said to be interwoven or embroidered with the crocus-coloured or saffron acanthus.

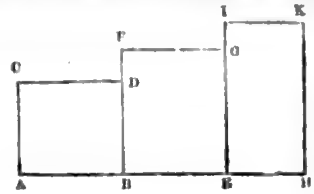
Pliny the elder, in his 'Natural History,' describes the acanthus in such a manner that it can only be recognised in the brank-ursine; and his nephew, in speaking of the successful cultivation of the same plant as an ornament to his garden, leaves little doubt that the brank-ursine is identical with the common architectural and sculptural acanthus. It is stated, however, that the brank-ursine (*Acanthus mollis*) does not grow in Greece, and it has been suggested that the plant from which the Greek architectural ornament was taken was the *Acanthus spinosa*, which grows there, and is still called the ἄκανθα.

This ornament, in the ancient Greek and Roman models, is very characteristic of the styles of architectural enrichment of those nations; in the Roman it is full, and somewhat luxuriant, and in the Greek more restrained, but simple and graceful.

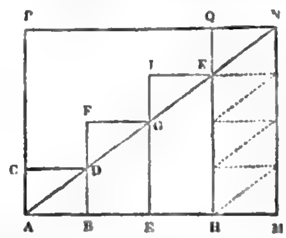
Roman. Greek.

ACCELERATED MOTION, ACCELERATING FORCE, ACCELERATION. When the velocity of a moving body is continually increased, so that the lengths described in successive equal portions of time are greater and greater, the motion is said to be accelerated, which is the same thing as saying that the velocity continually increases. [VELOCITY.] We see instances of this in the fall of a stone to the earth, in the motion of a comet or planet as it approaches the sun, and also in the ebb of the tide. As it is certain that matter, if left to itself, would neither accelerate nor retard any motion impressed upon it, we must look for the cause of acceleration in something external to matter. This cause is called the *accelerating force.* [See INERTIA; FORCE; CAUSE: to the remarks in the last of which articles we particularly refer the reader, both now and whenever the word cause is mentioned.] At present, the only accelerating force which we shall consider is the action of the earth, producing what is called *weight*, when not allowed to produce motion.

It is observed, that when a body falls to the ground from a height above it, the motion is *uniformly* accelerated; that is, whatever velocity it moves with at the end of the first second, it has half as much again at the end of a second and a half; twice as much at the end of two seconds; and so on. At least this is so nearly true, that any small departure from it may be attributed entirely to the resistance of the air, which we know from experience must produce some such effect. And this is the same with every body, whatever may be the substance of which it is composed, as is proved by the well-known experiment of the guinea and the feather, which fall to the bottom of an exhausted receiver in the same time. The velocity thus acquired in one second is called the measure of the accelerating force. On the earth it is about 32 feet 2 inches per second. If we could take the same body to the surface of another planet, and if we found that it there acquired 40 feet of velocity in the first second, we should say that the accelerating force of the earth was to that of the planet in the proportion of $32\frac{1}{6}$ to 40. By saying that the velocity is $32\frac{1}{6}$ feet at the end of the first second, we do not mean that the body falls through $32\frac{1}{6}$ feet in that second, but only that if the cause of acceleration were suddenly to cease at the end of one second, the body would continue moving at that rate. In truth, it falls through only half that length, or $16\frac{1}{12}$, in the first second. It may be proved mathematically, that if a body, setting out from a state of rest, have its velocity uniformly accelerated, it will, at the end of any time, have gone only half the length which it would have gone through had it moved, from the beginning of the time, with the velocity which it has acquired at the end of it. Thus, if a body have been falling from a state of rest during ten seconds (the resistance of the air having been removed), it will then have a velocity of $32\frac{1}{6} \times 10$ or $321\frac{2}{3}$ feet per second. Had it moved through the whole ten seconds with this velocity, it would have passed over $321\frac{2}{3} \times 10$ or $3216\frac{2}{3}$ feet. It really has described only the half, or $1608\frac{1}{3}$ feet. We may give an idea of the way in which this proposition is established, as follows:—The area of a rectangle [RECTANGLE]—that is, the number of *square feet* it contains, is found by multiplying together the numbers of *linear feet* in the sides. Thus, if A B be 4 feet, and A C 5 feet, the number of square feet in the area is 4×5, or 20. Again, the number of feet described by a body moving with a uniform velocity, for a certain number of seconds, is found by multiplying the number of seconds by the number of feet per second or the velocity. If, then, A B contain as many feet as there are seconds, and A C as many feet as the body moves through per second; so many feet as the body describes in its motion, so many square feet will there be in A B D C. That is, if we let A B *represent* the time of motion, and A C the velocity, the area A B D C will *represent* the length described in the time A B, with the velocity A C.



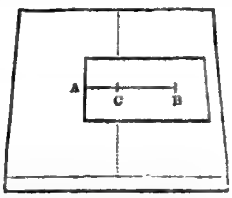
Not that A B D C is the length described, or A B the time of describing it; but A B contains a foot for every second of the time, and A B D C contains a square foot for every foot of length described. Similarly, if at the end of the time just considered, the body suddenly receive an accession of velocity D F, making its whole velocity B F per second; and if with this increased velocity it move for a time which contains as many seconds as B E contains feet, the length described in this second portion of time will contain as many feet as B E G F contains square feet; and the whole length described in both portions of time will be represented by the sum of the areas A B D C and B E G F. And similarly for another accession of velocity G I, and an additional time represented by E H. Now, let a body move for the time represented by A M; at the beginning of this time let it be at rest; and by the end let it have acquired the velocity M N: so that had it moved from the beginning with this velocity, it would have described the length represented by A M N P. Instead of supposing the velocity to be perpetually increasing, let us divide the time A M into a number of equal parts—say four, A B, B E, E H, H M—and let one-fourth of the velocity be communicated at



the beginning of each of these times, so that the body sets off from A, with the velocity A C, which continues through the time represented by A B, and causes it to describe the length represented by A B D C. We know from geometry that B D, E G, and H K, are respectively one-fourth, one-half, and three-quarters of M N, which is also evident to the eye, and may be further proved by drawing the figure correctly, which we recommend to such of our readers as do not understand geometry. Hence, G E or B F is the velocity with which the body starts at the end of the time A B; E I at the end of A E; and H Q at the end of A H. Consequently, the whole length described is a foot for every square foot contained in A B D C, E B F G, E I K H, and H Q N M, put together. But this is not a uniformly accelerated velocity, for the body first moves through the time A B, with the velocity A C, and then suddenly receives the accession of velocity D F. But if, instead of dividing A M into four parts, we had divided it into four thousand parts, and supposed the body to receive one four-thousandth part of the velocity M N at the beginning of each of the parts of time, we should be so much nearer the idea of a uniformly accelerated velocity as this, that instead of moving through one-fourth of its time without acquiring more velocity, the body would only have moved one four-thousandth part of the time unaccelerated. And the figure is the same with the exception of there being more rectangles on A M, and of less width. Still nearer should we be to the idea of a perfectly uniform acceleration if we divided A M into four million of parts, and so on. Here we observe—1, that the triangle A N M is the half of A P N M; 2, that the sum of the little rectangles A C D B, B F G E, &c., is always greater than the triangle A N M, by the sum of the little triangles A C D, D F G, &c.; 3, that the sum of the last-named little triangles is only the half of the last rectangle H Q N M, as is evident from the inspection of the dotted part of the figure. But by dividing A M into a sufficient number of parts, we can make the last rectangle H Q N M as small as we please, consequently we can make the sum of the little triangles as small as we please; that is, we can make the sum of the rectangles A C D B, &c., as near as we please to the triangle A N M. But the more parts we divide A M into, the more nearly is the motion of the body uniformly accelerated; that is, the more nearly the motion is uniformly accelerated, the more nearly is A N M the representation of the space described. Hence we must infer (and there are in mathematics accurate methods of demonstrating it), that if the acceleration were *really* uniform, A N M would really have a square foot for every foot of length described by the body; that is, since A N M is half of A P N M, and the latter contains a square foot for every foot of length which *would have been* described if M N *had been* the velocity from the beginning, we must infer that the length described by a uniformly accelerated motion from a state of rest, is half that which would have been described, if the body had had its last velocity from the beginning.

If the body begin with some velocity, instead of being at rest, the space which it would have described from that velocity must be added to that which, by the last rule, it describes by the acceleration. Suppose that it sets out with a velocity of 10 feet per second, and moves for 3 seconds uniformly accelerated in such a manner as to gain 6 feet of velocity per second. Hence it will gain 18 feet of velocity, which, had it had at the beginning, would have moved it through 18×3 or 54 feet of length, and the half of this is 27 feet. This is what it would have described had it had no velocity at the beginning; but it has 10 feet of velocity per second, which, in 3 seconds, would move it through 30 feet. Hence 30 feet and 27 feet, or 57 feet, is the length really moved through in the 3 seconds.

Similarly we can calculate the effects of a uniform *retardation* of velocity. This we can imagine to take place in the following way. While the body moves uniformly from left to right of the paper, let the paper itself move with a uniformly accelerated velocity from right to left of the table. Let the body at the beginning of the motion be at the left edge of the paper, and let that edge of the paper be placed on the middle line of the table. Let the body begin to move on the



paper uniformly 10 inches per second, and let the paper, which at the beginning is at rest, be uniformly accelerated towards the left, so as to acquire 2 inches of velocity in every second. At the end of 3 seconds, the body will be at B, 30 inches from A, but the paper itself will then have acquired the velocity of 6 inches per second, and will have moved through the half of 18 inches or 9 inches; that is, A C will be 9 inches. Hence the distance of the body from the middle line will be C B, or 21 inches. Relatively to the paper, the velocity of the body is uniform, but relatively to the table, it has a uniformly retarded velocity. At the end of the fourth second, it will have advanced 40 inches on the paper, and the paper itself will have receded 16 inches, giving 24 inches for C B. At the end of the fifth second, A B will be 50 inches, A C 25 inches, and C B 25 inches. At the end of the sixth second, A B will be 60 inches, A C 36 inches, and B C 24 inches, so that the body, with respect to the table, stops in the sixth second, and then begins to move back again. We can easily find when this takes place, for, since the velocity on the paper is 10 inches per second, and that of the paper gains 2 inches in every second, at the end of the fifth second the body will cease to move forward on the table. At the end of 10 seconds it will have returned to the middle line again, and afterwards will begin to move away from the middle line towards the left. At the end of the twelfth second, it will have advanced 120 inches on the paper, and the paper will have receded 144 inches, so that the body will be 24 inches on the left of the middle line.

The general algebraical formulæ which represent these results are as follow. Let a be the velocity with which the body begins to move, t the number of seconds elapsed from the beginning of the motion, g the velocity acquired or lost during each second. Then the space described in a uniformly accelerated motion from rest is $\frac{1}{2}gt^2$; when the initial velocity is a, the space described in an accelerated motion is $at + \frac{1}{2}gt^2$, and in a retarded motion the body will have moved through $at - \frac{1}{2}gt^2$ in the direction of its initial velocity if at be greater than $\frac{1}{2}gt^2$, or will have come back and passed its first position on the other side by $\frac{1}{2}gt^2 - at$, if at be less than $\frac{1}{2}gt^2$. In the last case it continues to move in the direction of its initial velocity for $\frac{a}{g}$ seconds and proceeds in that direction through the space $\frac{1}{2}\frac{a^2}{g}$

For further explanation as to velocities which are accelerated or retarded, but not uniformly, see VELOCITY.

ACCELERATION AND RETARDATION OF TIDES are certain deviations of the times of consecutive high-water at any place from those which would be observed if the tides occurred after the lapse of a mean interval. The interval between the culmination of the moon, or the occurrence of her principal phases, and the nearest time of high-water, is also called the retardation of the tide.

The tides are caused by the attractions exercised by both the sun and moon on the waters of the earth; but the effect produced by the moon exceeds that which is produced by the sun, and the difference is such, that the phenomena of the tides depend principally on the former. The mean interval between two consecutive returns of the moon, above and below the pole, to the meridian of any place, is 24h. 50m. 28·32s.; and since, neglecting all causes of irregularity, two lunar high-tides occur in that time, the mean interval between two consecutive lunar tides should be 12h. 25m. 14·16s.; while the mean interval between two consecutive solar tides should be 12h. Hence, if at the time of a conjunction or opposition of the sun and moon, the high tides which are produced by the actions of the luminaries separately were coincident, the next lunar tide would be retarded with respect to the next solar tide, by 25m. 14·16s., that is, by the excess of half a lunar day above half a solar day. These retardations continuing daily, the lunar high-water would coincide, at the time of quadrature, with the solar low-water, and thus produce the neap or diminished tides; after which, the like retardation continuing, the solar and lunar high-waters would again become coincident at the times of syzygy, and so on. The observed daily retardation of the lunar high-tides varies however according to the position of the moon with respect to the sun, to the moon's declination, and to the distance of that luminary from the earth. At Brest, when the sun and moon are in conjunction or in opposition, at the summer or winter solstice, the retardation is equal to 40m. 51·69s., and at the time of the equinoxes 37m. 38·15s. Again, when the sun and moon are in quadrature at either solstice, the retardation is 1h. 7m. 27·49s., and at the time of the equinoxes 1h. 23m. 16·34s.

If the earth were a solid of revolution, and were covered by the sea, the high tides produced by the sun and moon separately would, at any place, occur at the instants when those celestial bodies are on the meridian of the place; but such is not the fact in the actual condition of the earth; and local circumstances produce, at different ports, great differences in the intervals between the culmination of the sun or moon at the time of high-water, even on the days when the luminaries are in conjunction or opposition. The interval between the instant that the sun passes the meridian of a place and the occurrence of the solar high-tide, is found to be greater than the interval between the transit of the moon and the occurrence of the lunar high-tide; and this acceleration, as it is called, of the lunar tide, is with much probability ascribed by Dr. Young to a difference in the resistances experienced by the waters on account of the different velocities which are communicated to them by the separate actions of the sun and moon.

It should be observed however that at Ipswich the time of high-water is nearly coincident with the time at which the moon passes the meridian of that port; and both at Glasgow and Greenock, the high-tide generally precedes the transit (Mr. Mackie's 'Report,' at the seventh meeting of the British Association); but such phenomena are of rare occurrence, and at almost every place the high-tide occurs some time after the moon has culminated.

From a series of observations continued during sixteen years, at Brest, La Place, taking the excesses of the height of the evening tide above that of the morning for the day of syzygy, for the day preceding it, and for four days following it, has ascertained that at the syzygies which occur about the vernal and autumnal equinox the highest tides at that port take place 1·48013 days after the instant of the conjunction or opposition; and at the syzygies which occur about the summer and winter solstices they take place 1·54684 days after conjunction or opposition. Again, taking the excesses of the height of the morning tide above that of the evening for six days, as above, he ascertained that at the quadratures which occur about the equinoxes the highest tides take place 1·50964 days after the instant of quadrature, and at the solsticial quadratures 1·51269 days after such instant.

Mr. Airy ('Tides and Waves,' Encycl. Metrop.) observes that these retardations cannot be accounted for by delays in the transmission of the tide-waves, since no cause for such delay can be imagined to exist in the Southern Ocean, where the waves are formed; and it is known that the time of high-water at Brest is only fifteen hours later than at the Cape of Good Hope: he conceives, therefore, that the retardation must be ascribed to friction. By taking the means of the daily retardations of the morning and evening tides at Brest, La Place found that at the equinoctial syzygies such mean retardation was equal to 37m. 38s.; at the solsticial syzygies, 40m. 52s; at the equinoctial quadratures, 83m. 16s.; and at the solsticial quadratures, 67m. 27s.

From a series of observed heights of the tides, Sir John Lubbock has determined that the highest tides occur at London 2·013 days after the conjunction or opposition of the sun and moon; and at Liverpool, 1·68 days. ('Phil. Trans.' 1831, 1835.) Also, from the observed heights, Dr. Whewell has found that the highest tides occur at Bristol 1·667 days after the syzygies; and at Dundee 1·639 days. ('Phil. Trans.' 1838, 1839.) On the supposition that the mean retardation of the tide at London at the times of syzygy is 2·459 days, Mr. Airy has computed the moon's true hour-angle west of the meridian, at the time of high-water, for every half hour's difference in the time of her transit; and from the table it appears, that when the moon passes the meridian of London at noon (that is, at the time of conjunction), that angle, in time, is 1h. 57m. 17s.; when it passes at 3 P.M., the angle is 1h. 10m. 45s.; at 6 P.M., or at quadrature, 0h. 41m. 17s.; and at 9 P.M., 1h. 55m. 29s. The hour angle is the greatest at $10\frac{1}{2}$ P.M., when it is equal to 2h. 9m. 55s.; and at $11\frac{1}{2}$ P.M., or nearly at the time of opposition, it is 2h. 3m. 9s.: all these times are found to agree very nearly with the results of observation. From such results it is ascertained that, on the days following the times of syzygy and quadrature, the intervals between the time of the moon's transit and the instant of high-water are nearly equal; but from conjunction to the first quarter, and from opposition to the third quarter, the intervals are less than on the days of syzygy and quadrature, or the time of high-water is accelerated; while from the time of the first quarter to that of full moon, and from the third quarter to the new moon, the interval is greater, or the time of high-water is retarded. The time first mentioned (1h. 57m. 17s.) is that which is called the Establishment, at London; but Dr. Whewell recommends that the mean of the times (1h. 25m. 35s.), which he calls the mean, or correct, establishment, should be used in preference, because it differs less, on any day, from the vulgar establishment.

From Dr. Whewell's paper in the 'Philosophical Transactions' for 1836, we find that at Liverpool, when the moon passes the meridian at 30m. P.M., her hour-angle at the time of high-water is 11h. 18m. 16s.; when the hour of transit is 6¼ P.M., the hour-angle is 10h. 40m. 52s.; and when it is 11¼ P.M., the angle is 11h. 33m. 36s. The mean, or correct establishment, at that port, is 11h. 6m.

The acceleration and retardation of the times of high-water must evidently depend on the distance of the moon from the earth, and they are presumed to be proportional to the difference between the actual and the mean horizontal parallax of the luminary: this is called the parallax inequality of the tides; and La Place has determined, for the lunar tides, that the ratio of the daily variations, when the moon is in apogee and in perigee, is nearly as 2227 to 2899. He estimates the variation at 9m. 26·4s. for a change equal to one minute in the moon's apparent semidiameter at the times of conjunction and opposition, and at one-third of that quantity at the times of quadrature. Corresponding variations, but less in amount, take place with respect to the solar tides.

ACCENT (in Mathematics). To avoid the confusion arising from the use of many letters in an algebraical problem, and on other accounts, it is customary to signify different magnitudes of the same kind, or magnitudes similarly connected with the question, by the same letter, distinguishing these magnitudes from one another by accents. It is, therefore, to be understood that the same letter with two different accents may stand for magnitudes as different in value as those represented by different letters. The convenience of the accent may be illustrated as follows:—If a men can do b things in c days, and e men can do f things in g days, we have the following equation:—

$$a\, f\, c = e\, b\, g.$$

Now, instead of using e, f, and g, in the second part of the question, let us use the letters which stood for the corresponding quantities in the first part, with accents; that is, let a' men do b' things in c' days. The equation then becomes

$$a\, b'\, c = a'\, b\, c'.$$

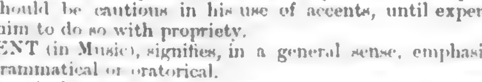
In this new form of the equation some things are evident to the eye, to ascertain which, had the first equation been used, we must have had recourse to the question itself. For instance, that if a'', b'', c'' express men, things, and days, as above, $a\,b''\,c = a''\,b\,c''$, only placing two accents now where there was one before. In many investigations, the judicious use of accents gives a symmetry to the processes and expressions which could scarcely be otherwise obtained.

For the unmathematical reader, we may illustrate the use of accents in the following way:—Let us suppose a bookcase to consist of four rows of shelves, each divided into six compartments. If we call the six compartments in the lowest range A, B, C, D, E, and F, respectively, we might let the compartment directly over A be called G, and so on; but it would be much simpler and more easy of recollection to call this compartment A′, the one over *it* in the third row A″, and so on. Thus each letter would indicate a certain vertical line of compartments, while the accent would point out in which horizontal line the one designated is to be found. This is precisely the mathematical use of the accent. All quantities of the same kind, or which the problem places in similar positions, are designated, with regard to this question, by the same letter.

The accented letter a' is read *a accented*, or *a dashed*; a'' is read *a twice accented*, or *a twice dashed*, or, more conveniently, though without much attention to idiom, *a two dash*, &c. When accents become too many to be used with convenience, the *Roman* figures are substituted for them. Thus a^{iv} would be used for a'''': at Cambridge, of late years, the i and v are an accent, and two accents joined at the base, which is very expressive. The Roman figures prevent a^{iv} from being taken for a^4, or a multiplied three times by itself. The young algebraist should be cautious in his use of accents, until experience has taught him to do so with propriety.

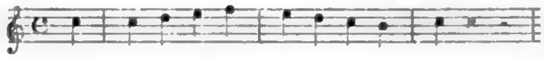
ACCENT (in Music), signifies, in a general sense, emphasis, and is either grammatical or oratorical.

Grammatical accent is the emphasis, always slight, given to notes which are in the accented parts of a bar. If the first, fifth, and ninth notes of the following series are accented, the whole will be divided into bars of common or equal time:



If an emphasis be given to the first, fourth, and seventh notes, the series will divide into bars of triple time—thus:

Again, an entirely different effect will be produced by throwing the accent on the second, sixth, and tenth notes of the same series:



So important is this accentuation, that the above examples give really different tunes, although the notes are the same.

Oratorical accent is expression—is the accent dictated by feeling—and not confined to any particular part of the bar. It is often required, though the composer may not have marked it by any sign, but left it to the knowledge and taste of the performer to discover and enforce. Commonly, however, the terms *rinforzato* (strengthened), and *sforzato* (violently forced), are used for the purpose, though these participles are too often thought synonymous. An acute angle (>) is also employed to indicate such emphasis.

The accented parts of a bar are such as naturally require some emphasis. In common time, the bar of which is divided into four parts, the first and third are accented, the second and fourth unaccented. In triple time of three crotchets, the accent is on the first; the second and third are usually unaccented; but a slight accent is sometimes given to the third or last note. In three-quaver time the accent is on the first quaver only. In six-quaver time, it is on the first and fourth quavers. Nine-quaver and twelve-quaver times, which are only multiples of the two former, and are seldom used, follow the same rule as those. The extremes, however, of slowness and quickness in times, though not altering their names, change the number of accented parts. [CLEF; TIME.]

ACCENT. When a child begins to read, he is apt to pronounce all the syllables of a word in the same key, with the same loudness and clearness, dwelling the same time upon each, and pausing the same time between each pair. He soon, however, learns that, in nearly every word there is one syllable at least which must be distinguished from the rest by a more impressive utterance, as in the examples *respéct, respéctful, respéctable.* If the word is a long one, it requires a second accent, as *respèctabílity, mànufáctory, immórtalìse.* On the other hand, when short words come together, one or two are often devoid of accent, as in the phrase *ón the tóp of a híll.* When it is stated that the accented syllable is pronounced more impressively than the rest, it is not meant that all accented syllables are to be equally impressive. In the examples given above, the first accent in *mánufáctory* seems to be weaker than that on the third syllable; so the last accent in *immórtalíse,* and that attached to the prepositon *on*, among the six monosyllables, *ón the tóp of a híll,* are comparatively very faint. The consideration of accent often determines whether or not we pronounce the initial *h* [See A or AN]; and, consequently, whether the article *an* or *a* is to be used before such a word. Upon accent depends the melody of verse, at least in modern languages. Of the ancient, particularly the Greek accent, it is better to abstain from speaking, because the opinions of people on the subject of Greek accent are both unsettled and contradictory. We may remark, however, that it is the practice of the modern Greeks, in a very great number of instances, to put the chief stress on that syllable which, in our printed Greek books, has the accentual mark (′) on it; but, in doing this, they frequently and unavoidably neglect the stress on those syllables which we are accustomed to pronounce most emphatically. It is said that the principle of Greek versification is *quantity*, or, as it is defined, the mere duration of a sound. Possibly, on a closer examination of the question, it would be found, that what the ancients meant by *quantity*, was not very different from what we mean by *accent*. A writer in the 'Transactions of the Philological Society for 1855' (pp. 119—145), has put forward arguments to show, that to accentuate the writings of Homer, Æschylus, Thucydides, as is the present practice, is simply an anachronism, inasmuch as the accentual marks were introduced at a much later period for the very purpose of denoting the changes of pronunciation, when the distinctive vowels *ω* and *η* were no longer trustworthy guides. It does not accord with the nature of the present work to enter into details; but we may be permitted to say, that the challenge to scholars contained in the paper has not yet been accepted. To return to the safer ground of our own language, the reader of our older writers, Shakspere and Milton, for instance, should know that the accents of words from time to time are changed, and even variable at the same time. Thus, the verb which we call *tríumph*, was with Milton generally *triúmph;* the noun and the verb being commonly distinguished by him in the same way as *próduce* the noun and *prodúce* the verb are at the present day. What we call *spirit*, was with him more commonly *spirite*, or almost *sprite;* and *áspect, prócess,* were *aspéct, procéss.* Even in our time, *advertisement* has become *advértisement.* In these changes, the usual tendency in our language is, and has been, to throw the accent farther back from the end of the word. Such a tendency is, perhaps, inherent in all languages, and seems to arise solely from an endeavour to save labour by rapidity of utterance.

The symbols employed to denote accents are three, the acute (ʹ), the grave (ˋ), and the circumflex (ˆ). We have hitherto spoken only of the first. The second in the ancient languages is said to denote the opposite to the acute, or, perhaps, the absence of it; while the circumflex, we are told, marks a compound of the two, first a rising and then a falling of the voice in the articulation of the same syllable.

These three little marks, as employed the orthography of the French language, have a signification altogether different. As the French, like all other languages, is deficient in the number of characters used to mark the vowel sounds, it has been found convenient to employ the three symbols given above. Thus, the sounds of *e*, *é*, *è*, *ê*, in the mouth of a Frenchman, differ not so much in point of *accent* as in the real articulation.

Emphasis differs from *accent*, and is properly used with reference to some one word, or part of a sentence, to which a speaker wishes to draw attention by giving it a more marked pronunciation. [EMPHASIS.]

ACCEPTANCE. [BILL OF EXCHANGE.]

ACCESSARY (from the low Latin *accessorius* or *accessorium*), is, in law, one who is guilty of an offence which is a felony, not as chief actor, but as a participator without being present at the time of the actual committing of the offence, as by command, advice, instigation, procurement, or concealment, &c.

A man may be accessary either before the fact, or after it.

An *Accessary before the Fact* is defined by Lord Hale to be one who, "being absent at the time of the crime committed, doth yet procure, counsel, or command another to commit a crime." The offender's *absence* is necessary to constitute him an accessary, as otherwise he would be a principal; and he must have procured the commission of the crime, either by direct communication with the actual perpetrator, or by conveying his advice or command through some indirect channel. But the mere concealment of a felony intended to be committed, without actual instigation, will not make a man an accessary; as that is only a misprision of felony. It is an established rule, that where a man commands another to commit an unlawful act, he is accessary not merely to the act commanded, but to all the consequences that may ensue upon it, except such as could not in any reasonable probability be anticipated or feared: as, for instance, if he commands another violently to beat a third person and he beats him so that he dies, the person giving the command is guilty as accessary to the murder consequent upon the act, notwithstanding that it may never have been his intention that a crime of so deep a dye should be committed. But a man will not be guilty as accessary before the fact if he command another to kill A, and he kills B, because the particular crime he contemplated has never been completed. It is otherwise where the directions have been substantially pursued, although the crime may not have been committed precisely in the manner in which it was commanded to be done, as where a murder is effected by means of stabbing instead of poisoning.

An *Accessary after the Fact* is one who, knowing a man to have committed a felony, receives, harbours, or assists him. In general, any assistance given to a felon to hinder his being apprehended, tried, or suffering punishment, as by affording him the means to escape the pursuit of justice, will constitute the assister an accessary after the fact; but it is not so if the assistance given have no such tendency, as when clothes or necessaries are supplied to a felon in gaol. Although any act done to enable the criminal to escape the vengeance of the law will make a man guilty as accessary after the fact, a mere omission to apprehend him, without giving positive assistance, will not have that effect. Also, if the crime be not completed, at the time of the relief or assistance afforded, the reliever or assister is not judged an accessary to it; as where a mortal wound has been given, but the murder is not then consummated by the death of the party: yet, the crime once complete, not even the nearest ties of blood can be pleaded in justification of concealment or relief, except alone in the case of a wife, whom the law supposes to be so much under the coercion of her husband, that she ought not to be considered as accessary to his crime by receiving him after it has been committed.

By 7 Geo. IV. c. 64, and 11 & 12 Vict. c. 46, the trial and punishment of accessaries *before* the fact is assimilated to that of the principal felon. Accessaries *after* the fact are, by the latter statute, made punishable as for a substantive felony, with imprisonment proportioned to the heinousness of the original crime, but the imprisonment is not to exceed two years. The receiver of stolen goods, whose offence is of the nature of that committed by an accessary after the fact, is, by 7 & 8 Geo. IV. c. 29, made liable to fourteen years' transportation: or now to a similar period of penal servitude; 16 & 17 Vict. c. 99; 20 & 21 Vict. c. 3.

Formerly no accessary could be tried until after the conviction of the principal, the crime of the former being regarded as, in a manner, dependant on that of the latter; but the law is now altered in this respect, by 11 & 12 Vict. c. 46; and 14 & 15 Vict. c. 100. It is now competent to try and convict him without waiting for the conviction of the principal.

The distinction between principals and accessaries holds only in cases of felony.

ACCIDENT. [PREDICABLES.]

ACCIDENTAL COLOURS. A term applied to the ocular spectrum which is usually seen when the eye has been steadily fixed for some time upon a coloured object. Thus, if we look at a red wafer upon a sheet of white paper for about half a minute, and then turn the eye from the wafer to the white paper, we see an image, or spectrum, of the wafer of a bluish green colour; this is the accidental colour of the red, and if we repeat the experiment with other colours, they will in like manner furnish ocular spectra: thus an orange colour will furnish a blue spectrum, yellow will give indigo, and so on, and it will be found in each case, that the colour of the object, added to that of the spectrum, will make up all the colours of white light; hence accidental colours are also called *complementary colours*. [LIGHT.]

ACCLIMATION is a term applied to that change in the human system produced by residence in a place whose climate is different from that to which it has been accustomed, and which enables it to resist those causes of disease which readily act upon it before such change has taken place. A person is thus rendered similar in constitution to the natives of the country which he has adopted. This subject is one of great importance, and has not yet received the attention it demands. As far as present evidence goes, it appears that the white races attain their highest physical and intellectual development, the greatest amount of health, and reach the greatest age, above 40° in the western and 45° in the eastern hemispheres. Whenever they pass below these latitudes they begin to deteriorate and exhibit unmistakeable symptoms of decadence in both health and strength. The same law holds good with the dark races of the tropical parts of the earth. The negro who lives in the interior of Africa is killed by cold. The limits of his health and strength are found at 40° north or south. If he proceeds to higher latitudes, he deteriorates and becomes exterminated. In the northern states of America the mortality of the black population is double that of the white.

"The laws of climate show that each race of mankind has its prescribed salubrious limits. All of them seem to possess a certain degree of constitutional pliability by which they are able to bear, to a certain extent, great changes of temperature and latitude; and those races that are indigenous to temperate climates support best the extremes of other latitudes. The inhabitants of the arctic regions, as also of the tropics, have a certain pliancy of constitution; and while the inhabitants of the middle latitudes may emigrate 30° south or 30° north with comparative impunity, the Esquimaux in the one extreme, or the Negro, Hindoo, or Malay, in the other, have no power to withstand the vicissitudes of climate encountered in traversing the 70° of latitude between Greenland and the equator. The fair races of northern Europe below the arctic zone find Jamaica, Louisiana, and India, to be extreme climates; and they and their descendants are no longer to be recognised after a prolonged residence there. When an Englishman is placed in the most beautiful part of Bengal or Jamaica, where malaria does not exist, and although he may be subjected to no attack of acute diseases, but may live with a tolerable degree of health his threescore years and ten, he nevertheless ceases to be the same healthy individual he once was; and, moreover, his descendants degenerate. He complains bitterly of the heat, and becomes tanned; his plump plethoric frame becomes attenuated; his blood loses fibrine and red globules; both mind and body become sluggish; gray hairs and other marks show that age has come on prematurely—the man of forty looks fifty years old; the average duration of life is shortened (as shown in life insurance tables); and the race in time would be exterminated if cut off from fresh supplies of emigrants from the home country. Our army medical historians tell us that our troops do not become acclimatised in India. Length of residence in a distant land affords no immunity from the diseases of its climate, which act with redoubled energy on the stranger from the temperate zones. On the contrary, the mortality among officers and troops is greatest among those who remain longest in those climates." (Johnson, Martin, Tulloch, Macpherson, Boudin.) Dr. Macpherson also makes the significant remark, that the small mortality among officers compared with soldiers, in India, is due to the greater facilities they enjoy of obtaining change of climate when they fall sick. Although the constitution of the man may be so modified that comparative health may be retained, yet there is a morbid degradation of the physical and intellectual constitution. If, however, he or his descendants are taken back to their native climate, they may yet revert to the healthful standard of their original types. The good effects of limiting the period of service of our troops abroad to three years, has shown this in sustaining for a greater period the strength of the regiments; a protracted residence of the European regiments in India having been followed by the most disastrous results. "European regiments in India have melted away like the spectres of a dream. A thousand strong men form this year a regiment: a year passes, and one hundred and twenty-five new recruits are required to fill up the broken column; and eight years having come and gone, not a man of the original thousand remains in the dissolving corps."

"With regard to the Bombay Fusilier European regiment, for instance, Dr. Arnot has shown that its losses average 104 per 1000 per annum; a loss equivalent to the entire absorption of the regiment in nine years and seven months. In Bengal also it is an ascertained fact, that a British regiment of 1000 men dissolves entirely away in 11 years, even in favourable times, and with all the improved conditions of the service. Dr. Arnot's statistics show that the Bengal army loses annually 9 per cent. of its numbers, giving a total loss in eight years of upwards of 14,005 men out of an army of 156,130 men." (Aitken's 'Handbook of Medicine.')

In the island of Ceylon the rate of mortality has been recorded amongst five different races of which the British troops are composed. The following table gives the result:—

	Annual death in 1000 men.
Native troops of Bengal and Madras	12
Troops recruited on the coast of Ceylon	23
Malays	24
Negro troops	50
English troops	69

Although from these facts it would appear there is an insuperable barrier to the prolonged occupation of tropical countries by white races, yet much may be done by attention to the laws of health and disease. One cause of the great amount of mortality amongst Europeans in the tropics is that they continue the habits they had acquired in cold countries when they arrive in the hotter parts of the world. An attention to diet, clothing, and residence, would do much to remove many of the causes of disease. It would appear also that many of the races that now inhabit cold climates made their way from warmer countries, and that changes gradually produced in the constitution, as by the slow advance of peoples north or south, may overcome that tendency to succumb which is so evident in the rapid removals to which the above data refer. The question of the permanent occupation of tropical countries has become one of vital importance to the two great European governments of England and France. How this can be done at the least expense of human life can only be ascertained by the study of the laws which regulate acclimation.

ACCOLADE. This French word, derived from the Latin *ad*, to, and *collum*, the neck, signifies, in familiar speech, an embrace; and this idea, or that of union by means of the neck, as when two oxen are yoked together, is that which prevails in various other derivatives from the same root, both in the French and Italian languages. Some, accordingly, have supposed that, when used as descriptive of a certain part of the ancient ceremony of conferring knighthood, the particular act which it denoted was the embrace, accompanied with a kiss, which was bestowed upon the new-made knight, in token of the brotherhood established between them by his admission into the order of chivalry. It has, however, been the more generally-received opinion, that the accolade was what we call in English (though perhaps improperly) the dubbing, the slight blow given to the cheek or shoulder of the knight, "as an emblem," to use the language of Gibbon, "of the last affront which it was lawful for him to endure." There is no doubt as to the great antiquity of this last-mentioned custom. Gregory of Tours, writing in the 6th century, describes the blow on the shoulder as part of the ceremony with which the kings of France, of the first race, were wont to confer the honour of knighthood. It has been derived, by some antiquaries, from the blow which the Roman slave received from his master when manumitted, or made a freeman. The blow of liberation, indeed, whatever may have been its original import, may be traced in various directions among the usages of the middle ages. The blow by which knighthood was conferred seems to have been originally given with the hand, for which the flat part of the sword was afterwards substituted.

ACCOMPANIMENT, in Music, is the subordinate part, or parts, accompanying a voice, or several voices, or a principal instrument, &c. The piano-forte or guitar part of a song is the accompaniment, the air itself being the principal, the other only the useful ally, the support. In a concerto the whole band accompany the instrument for which the chief and prominent part is composed.

Accompaniment is also the harmony of a figured base, or another word for what is, by a foolish, unmeaning term—but too generally adopted to be at once discarded—called thorough-base.

The Accompaniment of the Scale is the harmony assigned, partly by what may be called nature and partly by custom, to that series of notes denominated the diatonic scale ascending and descending, such scale being taken as a base. For an explanation of these matters, see THOROUGH-BASE. See also DIATONIC; SCALE.

Dr. Burney (in Rees' 'Cyclopædia') seems inclined to favour the opinion of Rousseau, that an accompaniment of the smallest possible number of notes is to be preferred. Rousseau had not acquired a taste for rich harmony, for with the music of the German school he was very little, if at all, acquainted; but that Burney should have sanctioned opinions formed upon the imperfect knowledge of the subject existing in the middle of the last century, is somewhat a matter of surprise. A judicious medium, in this as in other things, is the best. The old Italian accompaniment can now hardly be endured; while, certainly, many ultra-Germanists of the present day overpower melody by the multitude of notes which they are so prone to employ.

ACCOMPLICE. [APPROVER.]

ACCOMPTS. [BOOKKEEPING.]

ACCORDION. A musical instrument which came into England, from Germany, about the year 1828.

The Accordion is in the form of a small oblong box, varying from eight to twenty inches in length. The interior exhibits a row of very small elastic metallic laminæ, or springs, fixed at one end in a plate of metal, so that they may vibrate freely. The upper and lower parts of the box are united by a folding apparatus or bellows, which supplies the air required to put the springs into vibration, and to these the air is admitted by means of valves acted on by keys, in the manner of an organ. There is also a very simple contrivance by which a base note or drone may be added, at the discretion of the performer. These instruments vary in size and in capabilities: the compass of the most complete is from G the fourth space in the base staff, to E the seventh additional space above the treble, including all the semitones. Hence the accordion is not limited to melody, but can produce the most agreeable harmonic effects.

The principle on which the accordion, and all other instruments of the kind, is founded, is fully explained by Dr. Gottfried Weber, in his 'Leges Oscillationis,' &c., published in 1827, who refers, as his source of information, to an article by Strohmann, in the 'Allgemeine Musicalische Zeitung' of 1813. This principle, however, had been fully set forth many years before by Professor Robison, in the 'Encyclopædia Britannica,' under the term 'Musical Trumpet;' and it is now known that the Chinese were familiar with it before its introduction into Europe.

The firms of Reinisch and Steinkeller, at Vienna, sent large collections of beautiful accordions to the Great Exhibition of 1851; as did also Wagner of Reuss, and Zimmerman of Carlsfeld. The 40-keyed accordions of the last-named firm were priced as low as six Prussian thalers (17*s.* 6*d.*). Small and roughly-made German accordions are now sold in England at extremely low prices. In the commoner instruments, each key is made to elicit two different tones, according as the wind is made to pass into or out of it; but, in some of the better kinds, there are as many keys as notes.

The gentle tones of this beautiful instrument are found to be so attractive to the inhabitants of rude nations, that Roman Catholic missionaries have lately, in some instances, adopted the plan of taking accordions out with them. In musical capability, however, the accordion is far inferior to an instrument of later introduction. [CONCERTINA.]

The *Flutina* is a form of the accordion in which, by a mode of partitioning the interior cavity into cells, a peculiar flute-like quality is given to the tones.

The *Organ-accordion*, a recent invention, has a row of black and white keys like those of the organ or pianoforte, giving all the tones and semi-tones for three octaves. These keys are played with the fingers of the right-hand, the left-hand being needed to work the bellows. The instrument, too large to be held in the hand, is rested either on a table or on the lap of the performer. It is intended chiefly as an accompaniment to the voice.

Mr. Faulkner has invented an accordion-stand. It is an apparatus to assist in playing the instrument; it will incline to any position suitable to the convenience of the performer; and, by the action of a spring-top, it can be fixed in the position chosen.

ACCOUNT, or ACCOMPT, from the low Latin, *computus*, is a form of action, and of which frequent mention is made in the old law books. Strictly, it lay only against a bailiff or receiver, requiring him to render an account of the moneys received by him as such; but the form of action being found to be one of the most convenient at that time, it was extended to cases where the person called upon to account was neither a bailiff nor an authorised receiver, if he had in any way received and retained money which it was his duty to have handed over to the claimant. At present, this is effected in many cases by the action for "money received to the use" of the plaintiff. The action of account is now rarely used, a suit in chancery being generally resorted to.

(Blackstone's *Comm.*, Mr. Kerr's ed., vol. iii. pp. 171, 172.)

ACCOUNT STATED. This is the title of the common count in the declaration in an action, where the plaintiff seeks to recover the amount due upon a balanced account between the parties. The form states the defendant to be indebted to the plaintiff in a certain sum of money found to be due from the defendant to the plaintiff upon "accounts then stated" between them, from which statement of accounts the law implies a promise by the debtor to pay the sum he then admits himself to owe. This form is generally introduced in actions upon simple contracts for the recovery of pecuniary demands.

It is not essential that there should be cross or reciprocal demands between the parties, or that the account should relate to more than a single debt or transaction; nor need the original demand be one recoverable at law. Thus, a member of a partnership, though he cannot in general sue his partner at law for his share of the profits, may do so after a balance has been struck in his favour. But it is necessary that there should have existed some claim against the defendant, or some previous transactions in respect of which the account is stated, for an action cannot be brought in this form upon a mere agreement to pay a sum of money, the maxim being *ex nudo pacto non oritur actio.* It is, therefore, usual in support of this count to give evidence of an original demand or a prior transaction, and of a balance struck and agreed upon, but it is sufficient in the first instance, to prove an admission by the defendant to the plaintiff or his agent, that a certain sum was then due, without showing the origin or nature of the claim, or proving the specific items constituting the account. Thus an I. O. U., a bill, or a promissory note, is *primâ facie* evidence of an account stated betwixt the immediate parties. The account must have been stated before the action is brought; and the admission, in order to charge a defendant, must be positive, unqualified, and unconditional, and must not be merely the admission of a debt, but either expressly or by reference, the admission of a specific sum being due. If the plaintiff sues in a representative character, as in that of executor or assignee, he must show that the admission was made to him in that character. The statement of an account is not conclusive but only presumptive evidence against the party who admits the balance to be against him, and does not preclude him from showing, by evidence, the existence of error in the account; unless in the case of an account actually settled by payment, which cannot be opened except upon proof of fraud.

An account stated is also a good plea in bar to a bill in equity for an account. As a party may in equity open up a settled account on the ground of error, in order to support such a plea, the statement of account must be shown to have been final, and in writing. It is not essential that it should have been signed, and it will be sufficient if the account has been acquiesced in for a length of time, affording legal presumption of a settlement. A general release may thus be pleaded as a stated account, and a plea of this kind must aver that the account is just and fair, whether error or fraud is charged by the bill of the plaintiff or not.

In answer to a plea of a stated account the plaintiff in equity may show either the existence of fraud, which will be sufficient ground for opening the whole account, or that the account contains specific errors, which will enable him to surcharge, that is, to show omissions for which there ought to be credit, and falsify, that is, to show that there are wrong charges which ought to be deducted.

ACCOUNTANT, a person who professes skill in mercantile accounts. In a commercial community occasions are constantly arising for the employment of accountants. They are generally appointed to examine the books of traders who have been compelled by embarrassment in their affairs to summon a meeting of their creditors; or they may be called in by a trader to investigate his accounts, and to ascertain the state of his affairs. The collection of debts or rents, and the winding-up of the affairs of persons deceased, or who have given up business, are matters often put into their hands. An accountant has no legal status, like a notary or an auctioneer or appraiser, who perform certain duties which only they are allowed to discharge; but by the statute establishing District Courts of Bankruptcy, 5 & 6 Vict., c. 122, official assignees must be selected from persons in trade, or who are or have been "merchants, brokers, or *accountants*."

ACCOUNTANT IN BANKRUPTCY, an officer appointed by the Lord Chancellor (5 & 6 Will. IV. c. 29), who has the control, care, and management of the funds belonging to bankrupt estates. He must make an annual return to Parliament (13 & 14 Vict. c. 106, ss. 31, 36, 47, 191).

ACCOUNTANT-GENERAL, an officer of the Court of Chancery, first appointed under an Act (12 Geo. I. c. 32) "for securing the moneys and effects of the suitors." The Act recites that ill consequence and great prejudice already had, and might again, ensue to the suitors by having their moneys left in the sole power of the Masters of the Court. The bonds, tallies, orders, and effects of suitors were, it appears, until the passing of this Act, locked up in several chests in the Bank of England, under the direction of the Masters and two of the Six Clerks. The Act confirms a previous order of the Court of Chancery for adopting a different system, and sect. 3 enacts that, "to the end the account between the suitors of the High Court of Chancery and the Bank of England may be the more regularly and plainly kept, and the state of such account may be at all times seen and known," there shall be "one person appointed by the High Court of Chancery to act, perform, and do all such matters and things relating to the delivering of the suitors' money and effects into the Bank, and taking them out of the Bank, &c., which was formerly done by the Masters and Usher of the Court." The Accountant-General is "not to meddle with the suitors' money, but only to keep an account with the Bank." He attends several times a-week at the Bank and other places for the purpose of making sales, transfers, and acceptances of stock, according to the orders of the Court. The Bank receives moneys under a power of attorney from the Accountant-General. (As to the practice in the transfer of stock by and to the Accountant-General, see Daniell's 'Practice in Chancery,' 3rd edit. vol. ii. p. 1306, et seq.) His duties are in some respects regulated by the orders issued by the Court of Chancery. The salary is 3000*l.* a-year (under 15 & 16 Vict. c. 87, s. 22).

Before the passing of the Act 5 Vict. c. 5, which suppressed the equity jurisdiction of the Court of Exchequer, there was an Accountant-General of that court. The duties of the Accountant-General and Masters of the Exchequer are now performed by the Queen's Remembrancer.

There is an Accountant-General of the Irish Court of Chancery.

ACCUMULATION. [CAPITAL.]

ACCUMULATION. Before the passing of the statute 40 Geo. III. c. 98, a person might suspend the enjoyment of real or personal estate, and direct that the whole profits, rents, and produce thereof should be accumulated for a period not exceeding in extent that of any life or number of lives in being, and 21 years afterwards. The mischievous extent to which an individual at the close of the last century availed himself of this power of directing an accumulation, gave rise to the above statute, the object of which is to prevent the recurrence of a disposition of property so impolitic and unnatural.

The person in question was named Peter Thellusson. He was the son of Isaac de Thellusson, ambassador from Geneva to the court of Louis XV. He fixed his residence in London about the middle of the 18th century, and accumulated an immense fortune as a merchant. He died on the 21st of July, 1797. His name is now only remembered in connection with his extraordinary will, which led to the restraints upon testamentary dispositions above mentioned.

The property which was the subject of his will consisted of a landed estate of about 4000*l.* a-year, and of personal property to the amount of about 600,000*l.* This property he devised and bequeathed to trustees upon trust for accumulation and investment in the purchase of lands during the lives of his sons, grandsons, and the issue of sons and grandsons living, or *in ventre sa mere*, at the time of his death, and the lives of the survivors and survivor of them; and after that period, to be conveyed to the lineal descendants of his sons in tail male.

It had been long understood to be the rule of law that the absolute ownership of property might be suspended, and consequently the property rendered inalienable during lives in being at the time of the creation of the trust; that is, where the trust is created by will, at the time of the death of the testator. This period was afterwards extended so as to allow for the cases of infancy, and of a child *in ventre sa mere;* but it was for some time questioned whether a term of 21 years might in all cases be added to the period of suspension, though it has since been determined that it may. [SETTLEMENT.] Restraint on the accumulation of income was unknown to the common law, except in so far as the rule against perpetuities necessarily prevented accumulation from being carried beyond its limits; and Mr. Thellusson's will, by confining the restriction to existing lives, escaped the question which then existed as to the allowance of an absolute term of 21 years in addition to a life or lives in being at the time of the creation of the trust.

This will, which, in the events that happened, had the effect of postponing the usufructuary enjoyment of the bulk of the estate till the expiration of nine lives in being at the time of the testator's death, was, after many hard struggles, occasioned rather by the immense value of the property implicated (which it was computed would have amounted, with the expected accumulations, to upwards of 18,000,000*l.*), than by any new difficulty in the principle, finally established by the decision of the House of Lords on the 25th of June 1805. (Thellusson *v.* Woodford, 11 Ves. 112.)

The case of Thellusson *v.* Woodford gave rise to the Act of the 40 Geo. III. c. 98, "for restraining all trusts and directions in deeds or wills whereby the profits or produce of real or personal estates shall be accumulated and the beneficial enjoyment thereof postponed beyond the term therein limited." By the provisions of this Act, no person can settle or dispose of property by deed, will, or otherwise, so as to accumulate the income thereof, either wholly or partially, "for any longer term than the life or lives of any such grantor or grantors, settlor or settlors, or the term of twenty-one years from the death of any such grantor, settlor, devisor, or testator, or during the minority or respective minorities of any person or persons who shall be living or in *ventre sa mere*, at the time of the death of such grantor, devisor, or testator, or during the minority or respective minorities only of any person or persons who, under the uses or trusts of the deed, surrender, will, or other assurances directing such accumulations, would for the time being, if of full age, be entitled to the rents, issues, and profits, or the interest, dividends, and annual produce so directed to be accumulated. And in every case where accumulation shall be directed otherwise than as aforesaid, such direction shall be null and void, and the rents, issues, profits, and produce of such property so directed to be accumulated shall, so long as the same shall be directed to be accumulated contrary to the provisions of this Act, go to and be received by such person or persons as would have been entitled thereto, if such accumulation had not been directed."

It is now settled upon this statute, that a trust for accumulation reaching beyond the allowed period is good for the period allowed by law, and void only for the excess. (12 Ves. 295; 4 Russ. 403.)

ACCUMULATION OF POWER is a term applied to that quantity of motion which exists in some machines at the end of intervals of time, during which the velocity of the moving body has been constantly accelerated.

The simplest case in which there is such an accumulation of power is that of a heavy body, like the rammer of a pile-driving machine, which descends by the action of gravity during a certain time and impinges upon some object At the moment of impact, supposing that the object struck does not move, the velocities of all the particles which had gone on continually increasing during the descent, are destroyed, and thus a shock is produced immensely greater than that which would result from the mere pressure of the body. The battering-ram of the ancients when, being suspended from some fixed point it was allowed to swing by the action of gravity till one of its extremities struck the face of a wall, produced its effect in like manner by the power accumulated in it during its motion. In all such cases, the effect, if measured by the magnitude of an impression or indentation produced in the object struck, is, by Mechanics, directly proportional to the mass in motion, and to the square of the velocity at the instant of impact.

The accumulation produced by the continuous action of gravity, when a body has not far to fall, is commonly increased by that of a quantity of motion obtained by an exertion of muscular power. Thus a smith, when he would strike on an anvil with the greatest force, adds to the power of gravity on the hammer the accumulation of velocity arising from a whirling motion, in a vertical plane, which he gives above his head to the hammer before he allows it to descend.

In the old coining-machines which, like those at present used, produced the impression on the metal by the power of a screw, a great accumulation of force was obtained by causing a number of men to turn the horizontal bars attached to the vertical shaft which carried the screw: by the pressure of the men against the bars, while several revolutions were made about the axis of the screw, an acceleration of motion during that time took place; and the accumulation was instantaneously spent upon the metal, in aid of the pressure arising from the power of the screw alone. The like accumulation of force is obtained, but far more efficiently, in the coining-press of the present day by means of its fly-wheel; the reciprocating motion of a piston connected with a steam-engine communicates, by means of a crank, a continuous movement to the fly, and at the same time, a reciprocating rectilinear motion vertically to the cylindrical shaft (the stamper), on which the screw is formed. With half a revolution of the fly-wheel the stamper is lifted up, and with the other half it is forced down upon the metal.

When a fly-wheel is acted on by any prime mover, as wind, water, or steam, its motion continually accelerates, and a corresponding acceleration is induced in the wheel-work, in rollers, or in the stampers with which it is connected: the resistance to be overcome at what is called the working point destroys however this acceleration, and would allow the movement to be uniform, if it were not for the temporary accelerations or retardations which are caused by variations in the intensity of the moving power, or in the amount of the resistance; and these are almost wholly counteracted by the accumulated power which constantly exists in the fly.

ACCUSATIVE CASE, a term used in the grammatical system of the Latin language, and thence unnecessarily introduced into that of the English language. In Greek this case is not called *accusative*, but the same idea is expressed by a corresponding term in that language. In the article *ablative case*, the meaning of the word *case* was explained. In that article it was seen that the little syllable *em* is attached to the end of Latin nouns, and has the meaning of *motion to.* But where the simple Latin noun terminated in a vowel, the *e* of *em* was absorbed by that preceding vowel. Thus, to take an example, *Roma* was, and is, the name of the Roman capital, though, by Englishmen, generally corrupted into *Rome;* consequently, *to Rome* was expressed by *Romam* (a contraction from *Roma-em*); so, *in Romam*, expressed *into Rome. In Roma*, without the *m*, would signify merely *in Rome.* The accusative then signifying originally the object to which any motion is directed, was afterwards by a very natural metaphor, employed to distinguish the object of any action or feeling; thus, *incendere Romam, to burn Rome.* The Spanish and Portuguese have, in their languages, very closely imitated the Latin in this respect: *despidio de su casa à mi Dulcinea*—if translated word for word would be—he despatched from his house *to my Dulcinea;* but nothing more is meant than what we express by—he despatched my Dulcinea from his house. The *despatching* is with reference to Dulcinea. The employment of the letter *m*, with or without a weak vowel before it, occurs likewise in the Sanscrit language; and indeed in our own, in the pronouns *him* and *whom*, from *he* and *who*. The Greeks preferred the allied letter *n*, which is also found in some classes of the German nouns, as *den Grafen, the Count,* from the nominative *der Graf.* When the term *accusative case* is used in the grammar of our own language, it is only in this second or metaphorical sense, and, consequently, it is equivalent to what many grammars call by the better name of the *objective case*, or more simply the *object.*

ACETAL. (Formula, $C_{12}H_{14}O_4$.) A compound first formed by Döbereiner, and called by him oxygenated ether. It is produced by the slow oxidation of alcohol under the influence of platinum black. A number of watch-glasses containing platinum black, slightly moistened, are to be suspended in a tall wide-mouthed jar or bottle, and near the surface of some alcohol which must cover the bottom to the depth of about an inch. After the bottle has been left for two or three weeks in a warm place, it will be found to contain an acid liquid consisting of acetal, alcohol, aldehyde, and acetic ether. This is to be neutralised with carbonate of potash, as much chloride of calcium as will dissolve is to be added, and the whole subjected to distillation. The first fourth only of the product is to be collected, and chloride of calcium again added. A thin oily fluid rises to the surface, which is acetal, mixed with the before-mentioned impurities. Repeated treatment with chloride of calcium, at a gentle heat, in a retort, expels the aldehyde; caustic potash decomposes the ether, and washing with water removes the alcohol. After once more rectifying from chloride of calcium, the acetal is pure.

Acetal is a limpid colourless liquid, of an agreeable ethereal odour, and a taste resembling that of filberts. Its sp. g. is ·825, that of its vapour 4·24. It boils at 221°, is soluble in about 18 parts of cold water, and miscible with alcohol and ether in all proportions. Oxidising agents convert it into aldehyde and then into acetic acid. In contact with the air, alcoholic solutions of the alkalies convert it into aldehydic resin. It may be considered as a compound of 2 eq. of oxide of ethyle (ether) with 1 eq. of aldehyde.

$$\underset{\text{Ether.}}{2C_4H_5O} + \underset{\text{Aldehyde.}}{C_4H_4O_2} = C_{12}H_{14}O_4.$$

and, consequently, its formation from alcohol may be thus expressed—

$$\underbrace{3\left.\begin{matrix}C_4H_5\\H\end{matrix}\right\}O_2}_{\text{Alcohol.}} + O_2 = \underbrace{\left.\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right\}O_2 + \begin{matrix}C_4H_3O_2\\H\end{matrix}}_{\text{Acetal.}}\Big\} + 2\left.\begin{matrix}H\\H\end{matrix}\right\}O_2.$$

ACETAMIDE. [AMIDES.]

ACETANALIDE. [AMIDES.]

ACETATE. A salt arising from the displacement of the water in acetic acid, $HO, C_4H_3O_3$, by a base. Alkaline acetates and acetates of the alkaline earths may be formed by decomposing their carbonates with acetic acid and evaporating.

Acetate of Potash, $KO, C_4H_3O_3$, is a deliquescent salt crystallising with difficulty; it is used medicinally as a diuretic. It combines with another equivalent of acetic acid, forming a binacetate, $KO, C_4H_3O_3 + HO, C_4H_3O_3$, which crystallises readily, and when distilled is decomposed into the neutral acetate and monohydrated acetic acid.

Acetate of Soda, $NaO, C_4H_3O_3 + 6Aq.$, crystallises in oblique rhombic prisms. It is formed on a large scale in the preparation of acetic acid from crude wood vinegar. The latter is neutralised with chalk, forming acetate of lime, which being mixed with sulphate of soda is decomposed into acetate of soda, sulphate of lime being simultaneously formed.

Acetate of Ammonia (*Spirit of Mindererus*), $NH_4O, C_4H_3O_3$, cannot be well crystallised from its solution formed by neutralising the carbonate of ammonia with acetic acid, since on evaporation ammonia is expelled, and the solution becomes acid. It may be formed however by distilling equal parts of acetate of lime and sal-ammoniac, when binacetate of ammonia is given off as an oily fluid, which crystallises in needles. Dry ammonia converts it into the neutral salt. Acetate of ammonia has a cooling sweet taste and is a diaphoretic. Acetate of lime, $CaOC_4H_3O_3$, crystallises in needles which are efflorescent.

Acetate of Alumina is used largely as a mordant in dyeing. For this purpose it is made by decomposing a solution of alum with acetate of lime, in which case however the sulphate of potash, or ammonia of the alum, remains dissolved; the pure salt may be formed by substituting sulphate of alumina for alum, and acetate of lead for acetate of lime. According to Crum the formula of acetate of alumina is $Al_2O_3, 2C_4H_3O_3 + HOC_4H_3O_3$. Some of the metallic acetates are of great importance in the arts.

The *Proto-acetate* ($FeOC_4H_3O_3$), and the *Sesqui-acetate* ($Fe_2O_3, 3C_4H_3O_3$), *of Iron*, are both used as mordants by the calico printer. They are both made on a large scale by dissolving iron hoops, nails, or turnings, in crude pyroligneous acid. For the formation of proto-salt, access of air is prevented; for the sesqui-salt, encouraged. In Boucherie's process for preserving timber, the wood is impregnated with acetate of iron.

Neutral Acetate of Lead (*Sugar of Lead, Salt of Saturn*), $PbO, C_4H_3O_3, 3Aq.$, is prepared by dissolving litharge in excess of acetic acid; on evaporation, a mass of small white crystals is formed, resembling loaf sugar, but by careful management large transparent prismatic crystals of the salt may be obtained. It is very soluble in water and alcohol, and has a remarkably sweet taste.

Tribasic Acetate of Lead (*Goulard's Water*), $3\ PbO, C_4H_3O_3, 3Aq.$, is prepared by digesting seven parts of litharge with six parts of the neutral acetate of lead in thirty parts of water. It crystallises in minute needles. There are two other basic acetates of lead,—the subsesqui-acetate, $3PbO, 2C_4H_3O_3, Aq.$, and the hex-acetate, $6PbO, C_4H_3O_3, Aq.$, neither of which are of importance. All the subacetates of lead are decomposed by carbonic acid, and have a strongly alkaline reaction. They are employed in the refining of sugar. The neutral acetate of copper,—*verditer*, $CuO, C_4H_3O_3 + Aq.$, is formed by dissolving verdigris in hot acetic acid: on cooling, beautiful dark green crystals are formed. United with arsenite of copper, it forms Schweinfurth green, a beautiful green pigment.

The *Diacetate of Copper* (*Verdigris*), $2CuO, C_4H_3O_3 + 6Aq.$, is prepared commercially, by exposing sheets of copper to the action of acetic acid, produced from the fermenting marc of grapes. The copper becomes encrusted with the crystalline salt, which is removed and pressed into cakes. Pieces of cloth moistened with acetic acid are sometimes substituted for the grape marc.

Verdigris is decomposed by water into a soluble subsesqui-acetate, $3CuO, 2C_4H_3O_3 + 6Aq.$, and an insoluble tribasic acetate, $3CuO, C_4H_3O_3 + Aq.$

There are many other metallic acetates, few of which however are of much importance. They are most of them characterised by their ready solubility in water, and by yielding, on destructive distillation with lime, a volatile inflammable liquid called *Acetone*, q. v. Heated with hydrate of potash or soda, they yield hydride of methyl (light carburetted hydrogen).

Acetic acid forms soluble salts with many of the organic bases, some of which are of great importance in medicine.

ACETIC ACID constitutes the sour element of vinegar, and from it the latter derives its peculiar and valuable properties; vinegar in fact, in whatever way made, is dilute acetic acid, mixed generally with colouring matter, and some slight impurities.

Acetic acid exists in the juice of some plants, as will be shown when the chemistry of vegetable substances is treated of; at present it is to be considered as procured,—first, by the fermentation of saccharine matter; secondly, by the action of heat upon wood; the product of the former constituting vinegar, and that of the latter what was formerly called pyroligneous acid, but what is now largely employed, when purified, for most of the purposes to which vinegar is applied.

It is well known that when certain vegetable juices which contain much sugar are fermented, the first operation, if the heat be not too great, is that of causing the transformation of the sugar into carbonic acid gas and alcohol, the greater part of which last remains with the fermented juice: this is called the *vinous* fermentation, the product being wine if the juice of the grape have been employed. Now sugar is a compound of three elements, which also form alcohol,—viz. oxygen, carbon, and hydrogen; and while a portion of the two former unite to yield the carbonic acid, a part of the three combine to form alcohol or spirit of wine.

If the action is allowed to proceed further and with access of air, the acetous fermentation ensues: the alcohol absorbs oxygen, becoming aldehyde, and eventually acetic acid. The process may be thus symbolically expressed:—

$$\underbrace{C_4H_6O_2}_{\text{Alcohol.}} + 2O = \underbrace{C_4H_4O_2}_{\text{Aldehyde.}} + 2HO.$$

$$\underbrace{C_4H_4O_2}_{\text{Aldehyde.}} + 2O = \underbrace{HO,\ C_4H_3O_3}_{\text{Acetic Acid.}}$$

There can be scarcely a doubt that vinegar, as its name implies, was first procured, and most probably by accident, from the passage of the vinous into the acetous fermentation; and, in fact, it is now usually prepared in wine countries by exposing the wine in casks to the action of the air, at a temperature of about 76° of Fahrenheit's thermometer. Alcohol may also be converted into acetic acid by the action of finely divided platinum. If alcohol, slightly diluted, be allowed to drop on to platinum black, the oxygen condensed in the pores of the latter re-acts on the alcohol, converting it into aldehyde, which becomes, as shown above, acetic acid. This process has been employed on a large scale for the manufacture of the acid, but is now abandoned.

In this country vinegar is procured from an infusion of malt, termed *wort*, which is fermented in the usual way. It is then put into barrels, which are arranged in stoves, with their bungs out, and kept at a temperature of about 84° of Fahrenheit's thermometer. At this heat, which is considerably higher than that required for the vinous fermentation, carbonic acid is produced, which escapes as in the vinous fermentation; while oxygen is absorbed and thus acetic acid produced.

Vinegar thus procured is a well-known reddish-brown coloured liquid; its smell is rather pleasant and refreshing, and its taste is distinctly, but not intensely sour. The strongest malt vinegar is termed by the maker No. 24, and is calculated to contain 5 per cent. of real acetic acid; the manufacturer is allowed to mix with it one-thousandth part of its weight of sulphuric acid (oil of vitriol): vinegar, therefore, is not pure acetic acid, but is a mixture of a small portion of the acid, much water, a little sulphuric acid, spirit of wine, colouring matter, and mucilage.

Vinegar possesses the usual power of acids to redden vegetable blue colours; it combines with the alkalis, alkaline earths, and metallic oxides to form salts, which are termed acetates, some of which are of considerable importance, being largely used both in the arts and medicine.

Vinegar is purified from the sulphuric acid and colouring matter by distillation, but its smell and taste are then less agreeable: and although it is colourless, it cannot be conveniently or economically employed for the chemical purposes to which purer and stronger acetic acid is applied; not only on account of its weakness, but because the mucilage, which rises with it in distillation, renders the salts formed with it extremely difficult to purify. When vinegar is exposed to a low temperature, it is principally the watery part which freezes; and although the fluid portion is thus rendered stronger, it is unfit, on account of the presence of the colouring matter and sulphuric acid, for use as acetic acid.

The *second* method of obtaining acetic acid is by heating wood, as the dried branches of trees, in hollow iron cylinders, with a proper arrangement of coolers, or condensers and receivers.

The acid thus procured is called pyroligneous acid, and was at first supposed not to contain the acetic but a peculiar acid, different from all others. It is of a dark brown colour, has a strong burnt-acid smell, is very sour to the taste and acts strongly on vegetable blue colours. It contains a quantity of tar and oily matter; from these it is purified, in a considerable degree, by re-distillation, but it is still very impure. It is then mixed with chalk, becoming thus converted into acetate of lime, and the solution is concentrated by evaporation.

In order to render the acetic acid sufficiently pure, or rather to obtain an acetate fit for that purpose, the pyrolignite of lime is dissolved in water, and there is added to it a sufficient quantity of solution of sulphate of soda (Glauber's salt). The sulphuric acid contained in the sulphate of soda, and the lime in the acetate combine; and the sulphate of lime formed being very sparingly dissolved by the water, is precipitated in the state of a bulky powder: the soda of the sulphate at the same time unites with the acetic acid of the acetate of lime, forming acetate of soda. By proper evaporation crystals are obtained, which, by re-dissolving in water and again crystallising, may be rendered much purer. But if the salt should be still impure, it must be heated pretty strongly in an iron vessel. If the operation be carefully conducted, the tarry matter and other impurities only are decomposed by the action of the heat; the salt is then to be again dissolved in water and crystallised, and the crystals, after being once more pretty strongly heated to deprive them of their water, are sufficiently pure for the manufacture of pure acetic acid.

For this object 17 parts of dried acetate of soda are distilled with 10 parts of oil of vitriol at a moderate heat. The sulphuric acid combines with the soda as sulphate, and the acetic acid in its monohydrated or glacial form is expelled and condensed in a proper receiver.

$$NaO,\ C_4H_3O_3 + HO,\ SO_3 = NaO,SO_3 + HO,\ C_4H_3O_3.$$

The sulphate of soda thus formed is available for the future decomposition of the acetate of lime.

The acetic acid thus procured has the following properties: it is fluid and colourless, its smell is exceedingly pungent, and its taste very acrid and sour; if applied to the skin it occasions smarting, and even raises blisters upon it. When heated, the vapour which rises from it takes fire if a lighted taper is exposed to it. At about 45° of Fahr. a portion of this acid becomes solid and shoots into beautiful crystals; these contain no sulphurous acid, even though the product should not have been re-distilled; but a portion of sulphurous acid, formed during distillation by the decomposition of a part of the sulphuric acid, remains with the uncrystallised acid, from which it may be separated by mixing it with a small quantity of binoxide of lead (red lead) and re-distilling.

Acetic acid may also be obtained by the mere action of heat upon the binacetate of copper, or, as it is sometimes called, though improperly, *distilled verdigris*. The acetate of copper is first to be dried, so as to expel the greater part of the water of crystallisation, and then subjected to a pretty strong heat, in an earthen or glass retort, to which a receiver is to be properly adapted. The heat decomposes the salt, and the copper remains in the retort in the state of black or protoxide. The acid when first procured has a greenish tint, owing to the admixture of some protoxide of copper; it must be rendered free from this by re-distillation. This acid, though not quite so strong as that procured by the former process, is, however, still more concentrated than that required for general use.

The glacial or monohydrated acetic acid is, however, best procured by distilling dry binacetate of potash at a temperature not exceeding 550°. The following is the re-action:—

$$\underbrace{(KO,\ C_4H_3O_3 + HO,\ C_4H_3O_3)}_{\text{Binacetate of Potash.}} = \underbrace{KO,\ C_4H_3O_3}_{\text{Acetate of Potash.}} + \underbrace{HO,\ C_4H_3O_3}_{\text{Acetic Acid.}}.$$

The residual acetate of potash may be reconverted into binacetate, and repeatedly used for the same purpose. The specific gravity of monohydrated acetic acid, $HO,\ C_4H_3O_3$, at 62° F. is 1·063. It is liquid at temperatures above 55°. It crystallises at that temperature in radiating tufts of plates. Its sp. g. increases on dilution with water till three equivalents of the latter have been added, when it diminishes; and when diluted with an equal weight of water its sp. g. again becomes 1·063. Owing to this anomaly, the quantity of real acid in a solution cannot be estimated from the determination of its density. Glacial acetic acid mixes in all proportions with ether and alcohol. From the former it may be separated by the addition of water.

The uses to which acetic acid, in the state of vinegar, is applied are too well known to require notice; in the form of pyroligneous acid it is employed to preserve meat, and to impart to it the smoky flavour usually obtained by drying. Pure acetic acid is used in chemical researches, and especially for preparing various acetates. In a less pure state it is employed in the arts for preparing acetate or sugar of lead, acetate of copper or verdigris, and acetate of alumina, largely used by calico printers as a mordant.

Anhydrous acetic acid ($C_4H_3O_3$) was first obtained by Gerhardt. It may be produced by distilling three parts of oxychloride of phosphorous with eight of anhydrous acetate of potash. The liquid which passes over is to be returned on the residue and re-distilled till it no longer contains chlorine: it is then to be rectified. The liquid is colourless, boiling at 279·5°, and has a very pungent, irritating smell. The specific gravity of the liquid is 1·073, that of the vapour 3·47.

It gradually becomes converted into hydrated acid from the absorption of moisture.

Sp. Gravity.	Percentage of Monohydrated Acid.	Sp. Gravity.	Percentage of Monohydrated Acid.	Sp. Gravity.	Percentage of Monohydrated Acid.
1·0635	100	1·069	66	1·0424	32
1·0655	99	1·068	65	1·041	31
1·067	98	1·068	64	1·040	30
1·068	97	1·068	63	1·039	29
1·069	96	1·067	62	1·038	28
1·070	95	1·067	61	1·036	27
1·0706	94	1·067	60	1·035	26
1·0708	93	1·066	59	1·034	25
1·0716	92	1·066	58	1·033	24
1·0721	91	1·065	57	1·032	23
1·0730	90	1·064	56	1·031	22
1·0730	89	1·064	55	1·029	21
1·0730	88	1·063	54	1·027	20
1·0730	87	1·063	53	1·026	19
1·0730	86	1·062	52	1·025	18
1·0730	85	1·061	51	1·024	17
1·0730	84	1·060	50	1·023	16
1·0730	83	1·059	49	1·022	15
1·0730	82	1·058	48	1·020	14
1·0732	81	1·056	47	1·018	13
1·0735	80	1·055	46	1·017	12
1·0735	79	1·055	45	1·016	11
1·0732	78	1·054	44	1·015	10
1·0732	77	1·053	43	1·013	9
1·073	76	1·052	42	1·012	8
1·072	75	1·0515	41	1·010	7
1·072	74	1·0513	40	1·008	6
1·072	73	1·050	39	1·0067	5
1·071	72	1·049	38	1·0055	4
1·071	71	1·048	37	1·004	3
1·070	70	1·047	36	1·002	2
1·070	69	1·046	35	1·001	1
1·070	68	1·045	34	1·000	0
1·069	67	1·044	33		

Acetic Acid (*Medical properties of*). Vinegar produces very different effects according to its degree of concentration; its effects are also different on the dead and living organic tissues. It acts as an effectual preservative from the putrefactive fermentation of dead organic tissues, and is hence employed as the means of forming pickles, or meat in a dried state, by simply immersing the substance in it for a few minutes. Wood vinegar, or pyroligneous acid, is most efficacious for this purpose, owing to the creasote present in it. Crude pyroligneous acid is one of the most effectual applications to timber, both to prevent the dry-rot and the ravages of insects. Concentrated acetic acid acts on the living tissues as a caustic poison; applied to the skin it causes heat, redness, and rapid inflammation. The same is the case when taken into the mouth, or applied to any mucous membrane, which it blackens like sulphuric acid. When properly diluted and used in moderation, it heightens the vitality of the stomach and greatly promotes the digestive powers. Indeed free acetic acid is one of those always present in the stomach in a healthy state, and the substitution of lactic acid for it in that organ is one of the most common accompaniments of indigestion, especially in bilious persons. The peculiar property which vinegar possesses of dissolving gelatine points out the propriety of employing it as a condiment when veal or other young meats, or fish, are taken. Its powers are heightened by having aromatic or pungent principles dissolved in it, such as chillies or taragon. In cases of slow digestion the moderate use of vinegar impregnated with these is much to be commended; but the abuse of it is to be reprobated, as productive of serious evils. This is seen in the case of ladies who employ vinegar to retain a slender figure, and who thereby induce organic diseases, even cancer of the stomach. Vinegar assists the digestion of crude vegetables, and is appropriately used for salads. Its power over the nervous system is seen in cases of poisoning with narcotic poisons and in cases of drunkenness. In the former case care must be taken that the narcotic substance is completely evacuated from the stomach before administering it, otherwise much injury may result from a powerful acetate being formed. But after the removal of the poison nothing combats more effectually the secondary symptoms than vinegar, especially if coffee be dissolved in it. Few things will restore a drunken man to his senses more speedily than giving him vinegar to drink, hence the popular custom of putting pickles into the mouth of a drunken person.

Vinegar acts as a refrigerant and as a grateful drink in fever. It may be applied externally likewise to the palms of the hands of consumptive persons, to cool the hectic flush and prevent the subsequent clammy perspirations. In cases of commencing anasarca, or loss of tone of the skin in advancing life, vinegar is a very useful wash. In a concentrated form it is beneficial in some forms of ring-worm of the scalp; though crude pyroligneous acid is preferable, owing to the creasote which it contains. The vapour of strong acetic acid, simple or aromatised, is a powerful restorative when applied to the nostrils in impending fainting, or as a means of relieving headache. It was formerly regarded as a disinfectant, or a protection against plague and similar diseases, but it merely overpowers and does not destroy unwholesome odours; free ventilation is therefore preferable. Acetic acid acts as a powerful solvent both of gum resins, the action of which it thereby increases, such as assafœtida and other vegetable principles, such as those of colchicum, squill, &c., and also of metallic oxides, such as copper.

The vapour of acetic ether carefully introduced by a suitable apparatus through the Eustachian tube into the ear, is very efficacious in restoring hearing in cases of nervous deafness. (Pilcher, *On the Ear.*) Strong acetic acid, either alone or having the active principle of cantharides dissolved in it, furnishes a ready means of forming a blister.

In cases of poisoning by strong acetic acid, chalk should be instantly administered.

ACETIC ETHER. [Ethers.]

ACETINES, artificial oils formed by the direct union of acetic acid with glycerine. They were first made by Berthelot, who has also succeeded in combining some of the fatty acids with glycerine, forming natural fats. There are three compounds with acetic acid. In the act of formation, the elements of water are always separated:

$$\text{Monacetine} = C_{10}H_{10}O_8 = HO, C_4H_3O_3 + C_6H_8O_6 - 2HO.$$
$$\text{Diacetine} = C_{14}H_{12}O_{10} = 2(HO, C_4H_3O_3) + C_6H_8O_6 - 4HO.$$
$$\text{Triacetine} = C_{18}H_{14}O_{12} = 3(HO, C_4H_3O_3) + C_6H_8O_6 - 6HO.$$

Monacetine is formed by heating a mixture of glacial acetic acid and glycerine to 212° for fourteen hours. It is a neutral liquid, possessing a peculiar odour and pungent taste. Its sp. g. is 1·20. Mixed with half its volume of water, it forms a limpid mixture, which becomes opalescent when further diluted, although the glycerine does not separate. It is soluble in ether.

Diacetine is obtained by heating glacial acetic acid with excess of glycerine to 200° for three hours. It is an oil of an agreeable odour, congealing at 40°, miscible with an equal volume of water, but becoming opalescent by further dilution. It is soluble in ether and in benzole.

Triacetine is produced by heating diacetine to 482° for four hours, with fifteen to twenty times its weight of glacial acetic acid. It is a volatile, neutral, odoriferous liquid, of an ethereal and slightly bitter taste, insoluble in water, but very soluble in dilute alcohol. Sp. g. 1·174.

All three acetines are decomposed by alcoholic solution of hydrochloric acid into acetic ether and glycerine.

ACETO-BENZOIC ACID. Formula, $C_{18}H_8O_6 = C_4H_3O_3, C_{14}H_5O_3$. An anhydrous composite acid obtained by treating chloride of othyl with benzoate of soda. The re-action proceeds without the application of heat. The product is purified by washing with water, solution in ether, and final separation of the ether by a gentle heat. Anhydrous aceto-benzoic acid is an oily neutral body, heavier than water, possessing an agreeable vinous odour. It cannot be distilled without decomposition. Boiled with water, it is slowly decomposed into hydrated acetic and benzoic acids; the same decomposition is effected rapidly by solutions of the caustic alkalies, an acetate and a benzoate of the alkali being formed.

ACETO-CINNAMIC ACID. Formula, $C_{22}H_{10}O_6 = C_4H_3O_3, C_{18}H_7O_3$. An anhydrous acid, containing the oxides of the negative radicals othyl and cinnamyl. It is obtained by the action of chloride of othyl upon cinnamate of soda, and in its properties and re-actions closely resembles aceto-benzoic acid.

ACETO-CUMINIC ACID. Formula, $C_{24}H_{14}O_6 = C_4H_3O_3, C_{20}H_{11}O_3$. Formed by the action of chloride of othyl upon cuminate of soda. It is a composite anhydrous acid, closely resembling the aceto-benzoic acid in its properties. Alkalies convert it into acetate and benzoate.

ACETO-SALICYLIC ACID. Formula, $C_{18}H_8O_8 = C_4H_3O_3, C_{14}H_5O_5$. Produced by the action of chloride of othyl upon salicylate of soda. It is a very unstable, composite, anhydrous acid, which is immediately decomposed into acetic and salicylic acids by alkaline solutions.

ACETONE, a derivative of acetic acid. [Ketones.]

ACETONITRYL. [Methyl, Cyanide of.]

ACETONINE ($C_{18}H_{18}N_2$) is formed by the action of gaseous ammonia on acetone. The decomposition is produced by heating the mixture in a sealed tube at a temperature of 212°, $3(C_6H_6O_2) + 2NH_3 = C_{18}H_{18}N_2 + 6HO$. It is an alkaline liquid, with a smell of urine, and is soluble in water, ether, and alcohol. Its combination with hydrochloric acid forms, with bichloride of platinum, a crystalline salt of an orange-yellow colour, insoluble in ether, but soluble in water and in boiling alcohol slightly acidulated with hydrochloric acid. Acetonine stands in the same relation to acetone as amarine to hydride of benzoyl, and is probably a diamine containing three equivalents of the diatomic radical propylene $N_2(C_6H_6)_3$.

Acetonic acid ($2HO, C_{16}H_{14}O_{10}$), is formed when a mixture of acetone, hydrocyanic acid, and hydrochloric acid is heated. $2(C_6H_6O_2) + 2(H, C_2N) + 8HO + 2HCl = 2HO, C_{16}H_{14}O_{10} + 2(NH_4Cl)$. It is soluble in alcohol, ether, and water. It crystallises in prisms, and forms crystallisable salts. Acetonic acid may be regarded as lactic acid, in which two equivalents of hydrogen are replaced by two equivalents of methyl, $C_{12}H_{10}(C_2H_2)_2O_{10}$.

ACETYL. This term has been applied to two distinct hypothetical radicals, viz., first to the group (C_4H_3) which Liebig regarded as the radical of acetic compounds, acetic aldehyde being, according to his view, hydrated oxide of acetyl (C_4H_3O, HO), whilst acetic acid was regarded as the hydrated teroxide of acetyl ($C_4H_3O_3 HO$). Secondly, the name has more recently been applied by Gerhardt to the group ($C_4H_3O_2$) which is regarded by the latter chemist as the true radical of acetic compounds, acetic aldehyde being the hydride of this radical ($C_4H_3O_2, H$), and acetic acid its hydrated oxide ($C_4H_3O_2O, HO$). Williamson proposes the name othyl for the group ($C_4H_3O_2$). [NEGATIVE RADICALS.]

ACETYLAMINE (*Acetylia*). An organic base first obtained by M. Cloëz, and, subsequently, by M. Natanson, in acting upon bibromide of ethylene and bichloride of ethylene with ammonia, and regarded by these chemists as having the formula C_4H_5N. The recent researches of Hofmann prove this body to belong to the family of diamines; according to this chemist it is *diethylene-diamine*, and its formula is $N_2(C_4H_4'')_2H_2$. [DIAMINES.]

ACHROMATIC (from *a without*, and *χρωμα colour*), a term applied to those combinations of lenses used in the best telescopes and microscopes, for preventing the formation of coloured fringes which surround the edges of objects when viewed by means of common instruments. [LIGHT.]

ACIDIMETRY, the process of determining the quantity of real acid contained in a given sample of any acid, and thereby ascertaining its actual or intrinsic value.

There are various methods of accomplishing this: the simplest is by determining the specific gravity of the acid in question. As in most cases the specific gravity of an acid diminishes in regular proportion to the amount of water it contains; the amount of real acid is easily calculated from its density. To facilitate this, tables have been constructed by Dr. Ure and others, in which the specific gravity and the amount of real acid corresponding to it, are placed in parallel columns. These tables will be given in describing the various acids.

The above method however is not always absolutely accurate, and some acids do not admit of its use at all. Advantage has therefore been taken of the fact, that the blue colour of litmus is reddened by acids, while alkalies restore the original colour, to construct a method of estimation which is highly accurate and expeditious. An alkaline solution is prepared of a known strength, and is poured from a graduated tube—an alkalimeter—into an accurately weighed quantity of the acid to be examined (which must be tinged red with litmus) till the point of neutralisation, known by the change from red to blue, is reached. From the number of measures of the test liquid so used it is easy to calculate the quantity of real acid in the sample tested.

A convenient method of preparing the test liquid is to dissolve 530 grains (10 equivalents) of pure dry carbonate of soda—made by fusing the pure bicarbonate—in 10,000 grains of distilled water. The alkalimeter should be made to hold 1000 grain measures, and would thus contain 53 grains, or an equivalent of carbonate of soda. It should be divided into 100 parts, each of which will then contain ·53 of the carbonate. An equivalent of carbonate of soda will exactly neutralise an equivalent of acid, so that 100 grain measures or divisions of the test liquid will represent—

40 grains of sulphuric acid (SO_3), or
49 grains of oil of vitriol (HO, SO_3),
36·5 grains of dry hydrochloric acid (HCl),
54 grains of nitric acid (NO_5), or
63 grains (HO, NO_5),
60 grains of hydrated (glacial) acetic acid ($HO,C_4H_3O_3$), &c., &c.

Supposing, then, that 100 grains of the sample of acid to be tested are weighed, and they require 70 measures of the test liquid, if the acid be sulphuric, then 100 : 40 : : 70 : 28, the amount of real acid in the quantity taken; if hydrochloric, 100 : 36·5 : : 70 : 25·55, and so on. A solution of ammonia may be substituted for that of carbonate of soda, and may be so adjusted that 1000 grain measures shall contain 17 grains of ammonia, which is the case when its specific gravity reaches ·992. It is not easy however to adjust it exactly to such a density; it is better, therefore, when near the convenient strength to estimate the ammonia in a given number of measures of the alkalimeter, by evaporating them to dryness on a water-bath, with an excess of bichloride of platinum. The resulting platinum salt, after being washed on a filter, with a mixture of 2 parts of alcohol with 1 of ether, and carefully dried at 212°, and weighed, contains in 100 parts, 7·624 of ammonia (NH_3).

The strength of the test ammonia may in this way be made to suit the convenience of the operator, and the amount of ammonia in each division being known, the calculation is perfectly simple. Supposing that each measure contains ·20 grains of ammonia, and that 100 weighed grains of the sample of sulphuric acid require 50 measures, the eq. of ammonia, 17 : 40 : : 50 × ·20 : 23·53 grains of sulphuric acid in the quantity taken.

There are other processes for accomplishing the same object. Those used in Alkalimetry, which will be fully described, may, in many cases, be used in a reverse way in Acidimetry, the one process being the reverse of the other. Some acids require special methods of analysis, which will be described under their particular titles.

ACIDS. The acids are a numerous and important class of chemical bodies. As the word acid is, in common language, almost synonymous with *sour*, it might be supposed that the taste of a substance would determine whether it was included among the acids. The term has, however, been so much extended by chemists beyond its original meaning, that some bodies, which are nearly or quite devoid of sourness, are considered as acids because they agree with them in some other qualities. The acids are generally sour; usually, but not universally, they have great affinity for water, and are readily soluble in it: they redden most vegetable blue colours, and combine readily with alkalies and earths, and generally act upon and unite with most metals or their oxides, with great facility, forming compounds which are termed salts. Such are the properties of the greater number of acids; but the last only, namely the power of combining with bases, belongs to them all. Many acids are entirely natural products, some both natural and artificial, while others are altogether the result of chemical agency. They are derived from various sources, and, except in the few particulars above-named, vary greatly in their properties. Thus, under common circumstances of temperature and pressure, some are gaseous in form, as the carbonic acid; others are fluid, as the nitrous, or solid, as the boracic acid; some require water or a base to retain their elements in combination, which is the case with the oxalic acid, while others, as the sulphuric and nitric may exist independently of either. Most acids are colourless, but the chromic is red; some are inodorous, as the sulphuric; others pungent, as the hydrochloric acid; there are acids which are comparatively fixed in the fire, the phosphoric for example; others are volatilised by a more moderate heat, which is the case with the sulphuric acid; whilst those which are pungent to the smell are, to a certain extent, volatile at all temperatures.

Acids occur in all the kingdoms of nature: the margaric acid is of animal origin; the citric and the oxalic acid are products of vegetation; while the chromic and the arsenic acid enter into the composition of certain minerals. In many instances however acids are not exclusively derived from one source, but are sometimes produced by them all, and may be also artificially formed. This is the case with the phosphoric acid, which occurs in animals, plants, and minerals, and is formed whenever phosphorus is burnt in excess of oxygen. The citric acid is produced only by the process of vegetation; but the oxalic acid, also found in plants, may be obtained by chemical agency. The carbonic and the sulphuric acid are very common in mineral bodies, and may also be artificially produced; the former is also one of the results of respiration, combustion, and of animal and vegetable decomposition; and both the carbonic and sulphuric acids may be obtained by combining carbon and sulphur respectively with oxygen. The chromic and the arsenic acid are found only in mineral bodies, but they may be formed by chemical agency; and indeed, except many of the vegetable acids, there are but few which cannot be so prepared.

Soon after Dr. Priestley's celebrated and important discovery of what he called *dephlogisticated air*, in 1774, it was found that several substances, such as sulphur and phosphorus, were converted into acids by combining with this elementary gas. On this account it was assumed, hastily and incorrectly, that all acids contained dephlogisticated air, and derived their acidity from it; on this account the name *oxygen* was given to it, signifying *acid-making*, and it was regarded as the universal acidifying principle; not indeed that it always formed an acid when combined with a body, but that no acid existed without it. It has however since been found that there are acids, the hydrochloric acid for example, which contain no oxygen; and further, it has also been proved, by the brilliant discoveries of Sir H. Davy, that oxygen, by combining with certain elementary bodies, converts them into *alkalies*; a class of substances possessing properties diametrically opposite to those of the acids.

It was therefore considered necessary to divide the acids into *oxyacids*—in which oxygen was supposed to form the acidifying principle; and *hydracids*—in which that principle was due to hydrogen. Hydrated sulphuric acid, HO, SO_3 may be considered as a type of the former class; hydrochloric acid, HCl, of the latter class of acids. When sulphuric or any oxyacid is united to a metallic oxide, the result is a salt in which the water of the acid is replaced by the oxide, forming a so-called *oxysalt*. Thus $HO,SO_3 + NaO = NaO,SO_3 + HO$. When hydrochloric acid or any hydracid is so combined, the hydrogen is replaced, not by the oxide, but by the metal itself. Thus, $HCl + NaO = NaCl + HO$, or chloride of sodium, a salt containing neither oxygen nor hydrogen, and called a *haloid salt* (from ἅλς, the sea), sea-salt being the type of such a compound. Thus the two classes of acids produce in their combinations apparently anomalous results. To obviate this, it was suggested by Sir H. Davy, and has since been supported by Graham, Liebig, and others, that all acids are hydracids, and all salts haloid salts. By this theory, an oxyacid is in all cases a combination of hydrogen with a compound salt-radical. Thus sulphuric acid, instead of being HO, SO_3 is $H +$ the salt radical SO_4, or HSO_4. Nitric acid, not HO,NO_5, but H,NO_6, and so on. In the formation of salts, therefore, the hydrogen of the acid is simply replaced by a metal, as in common salt—

$$NaO + HCl = NaCl + HO.$$
$$NaO + HSO_4 = NaSO_4 + HO.$$
$$NaO + HNO_6 = NaNO_6 + HO.$$

This theory is equally applicable to the organic acids. The formula of acetic acid, $HOC_4H_3O_3$, becomes $H,C_4H_3O_4$; and so with others. Further elucidation of the theories of salts will be found in the article SALTS.

It may be here proper to notice the method adopted by the framers of the French nomenclature, in giving names to different acids. It has been already mentioned, that oxygen was supposed to be the acidifying principle, and it was found that, by combining in different proportions with the same substance, it formed acids of very different properties: but it was not then known that oxygen combined with any one body to form more than two acids. It was, however, proved to unite with sulphur in two different proportions; and in this, and similar cases, the name of the acid which contained least oxygen was made to end in *ous*, and that which contained more in *ic*; thus sulphur*ous* acid contains less oxygen than sulphur*ic* acid.

Cases have, however, occurred during the progress of chemical science, requiring an extension of this principle: an acid has been formed which contains less oxygen combined with sulphur than in the sulphurous, and this is called *hypo*sulphurous acid; another containing more oxygen than the sulphurous, but less than the sulphuric, and this is termed *hypo*sulphuric acid. An acid has also been formed which contains more oxygen than the chloric—this has been called *per*chloric acid.

Acids which form neutral salts by combining with one equivalent of a base are said to be *monobasic*, as the acetic and nitric acids; those which combine with two equivalents of base are said to be *bibasic*, as tartaric and pyrophosphoric acids, whilst those which require three equivalents of base to form a neutral salt are termed *tribasic* acids. [CHEMICAL NOMENCLATURE.]

The means adopted for preparing the acids, whether from the natural compounds which contain them, or by the direct combination of their component parts, are almost as various as the acids themselves. For an account of the processes employed in obtaining them, and of the numerous and important purposes to which the acids are applied in medicine, science, and the arts, or for domestic uses, we refer the reader to each particular acid. Although in the course of the present work some acids of minor importance will occasionally be mentioned, the following are those which, as being used either in scientific researches, in medicine, or the arts, will be more particularly treated of in their respective places:—

ACIDS.

Acetic.	Chlorochromic.	Hyposulphuric.	Pyroligneous.
Aconitic.	Chlorosulphuric.	Hyposulphurous.	Pyrophosphoric.
Acrylic.	Cholalic.	Iodic.	Pyroracemic.
Adipic.	Choleic.	Lactic.	Pyrotartaric.
Alizaric.	Cholic.	Lauric.	Racemic.
Allanturic.	Chromic.	Malic.	Rhodizonic.
Alloxanic.	Cinnamic.	Margaric.	Ruberythric.
Amidobenzoic.	Citric.	Meconic.	Saccharic.
Amygdalic.	Crenic.	Mellitic.	Salicylic.
Angelic.	Croconic.	Mesoxalic.	Sebacic.
Anilic.	Cyanic.	Metastannic.	Selenic.
Anisic.	Cyanuric.	Molybdic.	Selenious.
Anthranilic.	Dialuric.	Mucic.	Silicic.
Antimonic.	Dinitroethylic.	Myristic.	Sinapic.
Antimonious.	Dithionic.	Nitric.	Stannic.
Apocrenic.	Erythric.	Nitromuriatic.	Stearic.
Arsenic.	Ferridcyanic.	Œnanthic.	Suberic.
Arsenious.	Ferrocyanic.	Œnanthylic.	Succinic.
Aspartic.	Formic.	Oleic.	Sulphacetic.
Benzoic	Fulminic.	Osmic.	Sulphantimonic.
Bismuthic.	Fulminuric.	Oxalic.	Sulphantimonious.
Boracic.	Gallic.	Oxalovinic.	Sulpharsenic.
Borofluoric.	Glucic.	Oxamic.	Sulpharsenious.
Bromic.	Glycolic.	Palmitic.	Sulphovinic.
Butyric.	Hippuric.	Parabanic.	Sulphuric.
Camphoric.	Homolactic.	Pectic.	Sulphurous.
Capric.	Humic.	Pelargonic.	Tannic.
Caproic.	Hydriodic.	Pentathionic.	Tartaric.
Caprylic.	Hydrobromic.	Perchloric.	Telluric.
Carbamic.	Hydrochloric.	Periodic.	Tellurous.
Carbazotic.	Hydrocyanic.	Permanganic.	Tetrathionic.
Carbolic.	Hydrofluoric.	Phosphoric.	Titanic.
Carbonic.	Hydrofluosilicic.	Phosphorous.	Trichoracetic.
Carbovinic.	Hydrosulphocyanic.	Phosphovinic.	Tungstic.
Carminic.	Hydrosulphuric.	Phthalic.	Ulmic.
Cerotic.	Hypochlorous.	Picric.	Uric.
Chloracetic.	Hyponitric.	Propionic.	Valeric.
Chloric.	Hyponitrous.	Prussic.	Xanthic.
Chlorocarbonic.	Hypophosphorous.	Pyrogallic.	

ACONITIC ACID, $3HO, C_{12}H_3O_9$ (EQUISETIC ACID; CITRIDIC ACID), exists naturally in *Aconitum napellus*, *Delphinium consolida*, and *Equisetum fluviatile*, but is most easily obtained by the action of heat on citric acid. Crystallised citric acid is submitted to distillation until oily streaks appear in the receiver. The residue contains aconitic acid, which is dissolved out by absolute alcohol, etherified by hydrochloric acid, and then obtained as a potash salt by the action of caustic potash upon the aconitic ether. Aconitic acid is tribasic; it crystallises indistinctly. At a temperature of about 320° it is decomposed into a crystalline substance called *itaconic acid*, and an oily liquid called *citraconic acid*, both having the formula $2HO,C_{10}H_4O_6$.

ACONITINE ($C_{60}H_{47}NO_{14}$). An alkaloid existing in *Aconitum napellus*, and other varieties of the aconite. It crystallises from a solution in dilute alcohol in white grains; it is also often obtained in the state of a vitreous, transparent, compact mass. It is inodorous, but intensely bitter and acrid. It is extremely poisonous; one 50th of a grain is sufficient to kill a sparrow in a few minutes, and a tenth of a grain instantly. It is very slightly soluble in cold water, unalterable in the air, very fusible, and not volatile; its alkaline re-action is very distinctly marked; it requires 50 parts of boiling water to dissolve it, and the solution does not become turbid on cooling; it is very soluble in alcohol, and to a less extent in ether. Aconitine forms perfectly neutral salts. Those which have been examined crystallise with great difficulty, and dry in the state of a bitter gummy mass, which is acrid and very poisonous. Fuming nitric acid dissolves them without colour; moistened with concentrated sulphuric acid, they assume a colour, at first yellow and then reddish violet. Infusion of galls produces in their solution an abundant precipitate of white flocculi, and solution of iodine a kermes-coloured precipitate. Aconitine is said by Geiger and Hesse to dilate the pupil, but that obtained by Dr. Turnbull contracts it; and Dr. Pereira mentions the power of contracting the pupil as one of the distinctive properties of the alkaloid. When applied to the skin in very minute quantity, it produces a sensation of intense heat and numbness. It is used medicinally in the form of ointment, and is of great use in severe neuralgia, and rheumatic affections.

ACONI'TUM (*Monkshood* or *Wolfsbane*), *Medical Properties of*.—The botanical characters of this genus of Ranunculaceous plants have been already given. [NAT. HIST. DIV., vol. i. p. 58.] Which species merits the preference as a medicinal agent is a greatly controverted point. The London and Dublin Pharmacopœias, following the notions of Decandolle as to the identity of his *Aconitum paniculatum*, var. *γ Störkianum*, with the *A. napellus* officinalis, figured by Störk in his 'Libellus de Stramonio, Hyoscyamio, Aconito,' Vindobon. 1762, have given that as the officinal one, while the Edinburgh College has retained the common *A. napellus*. The preponderance of evidence and good sense is in favour of the latter, as, besides the almost impossibility of procuring the plant indicated by the two former, since it is only a rare inmate of botanic gardens, it is substituting a confessedly less potent for a more potent plant. The 'London Pharmacopœia' has restored in the edition of 1851, the *A. napellus*, as the officinal plant. But besides this, two other species are grown at the physic-gardens at Mitcham, whence the London market is chiefly supplied. One, a party-coloured sort, having white flowers with a little blue in them: perhaps intended for the *A. paniculatum* (Decandolle); another *A. exaltatum* (Bernhardi), synonymous with *A. decorum* (Reichenbach). This, if found equally potent as the common *A. napellus*, has much advantage. Its tall size supplies more leaves, and as it does not flower till much later in the year (September) its leaves retain their virtues till the flowers begin to fade—and can yield a supply of fresh leaves, when these are wanted, long after the common species have become inert. *A. ferox* is now largely imported from India, in a dry state, to yield aconitine, of which it contains three times as much as the European species. The aconite of Störk, whatever species he used, was a plant possessed of great acrimony, while *A. paniculatum* has scarcely a perceptibly acrid taste. The officinal parts are the root and leaves. But the seeds might be added with propriety. Every part of the plant has a narcotico-acrid property. The live plant has little of the virose repulsive odour common to poisonous vegetables; nevertheless very sensitive individuals, by merely smelling the flowers, have fainted, and had dimness of vision for some days, and handling the fresh plant has occasioned tremblings and faintness. Honey collected from these flowers has caused severe suffering and even death. In making the essential extract, and in procuring the alkaloid aconitine, the vapours have powerfully affected the operators; hence much care is required on their part. A small piece of the leaf, root, or a single seed, if chewed, causes a feeling of tingling, followed by numbness of the lips and tongue, which lasts for hours. A greater portion causes these sensations in the palate and throat, where in larger or poisonous doses a choking sensation is felt. The resemblance of many aconites, especially before flowering, to several umbelliferous plants in common use, such as celery, lovage, masterwort, &c., proves a frequent source of poisoning by them; a calamity further augmented by the inconsiderate practice of giving ignorant persons portions of the leaves to chew, or as a kind of parsley. (See a melancholy case of poisoning by *Aconitum neomontanum*, in Johnson's 'Medico-Chirurg. Review,' vol. lxi. p. 264.) Such unprincipled practices cannot be too severely reprobated. No complete analysis of the root or leaves of the *A. napellus* has hitherto been published, though Pallas analysed the root of *A. lycoctonum* and Bucholz the leaves of *A. medium*, Schrad. It is probable that all the species contain similar constituents, differing only in degree, the most powerful being the *A. ferox* (Wallich, 'Pl. Asiat. Rariores,' i. t. 41) or Bisk of Northern India. The most important are the alkaloid aconitine, aconitic acid, a fatty oil, and perhaps a volatile acrid principle. The latter probably results from the decomposition of aconitine by the action of heat. Almost all ranunculaceous plants have an acrid principle, which is very easily driven off by heat. Much care is therefore requisite in drying the root or leaves of aconite not to apply too high a temperature. The same precaution is required in forming the extract or inspissating the juice. A knowledge of this fact leads to the most convenient and effectual antidote in cases of poisoning by these plants, viz., causing the patient to drink very warm water till vomiting is excited. Linnæus saw aconite disarmed of its virulence, so that it could be used as a pot-herb, by merely boiling it, and adding a little fat or butter. (Linnæus, 'Flora Lapponica,' p. 187, ed. Lond. 1792.)

The fatty oil is destructive of the sensibility of any part to which it is applied, but whether from inherent powers or from having aconitina dissolved in it is yet unknown. The alkaloid is regarded as the efficient principle when aconite is used medicinally. The forms of administration are various. Powder is objectionable from the variable degree of power. This further varies with the period when the leaves are collected. The best time to gather them is immediately before the flowers wither, as when the seeds advance to maturity the acrimony of the leaves rapidly diminishes. (Christison.) When the seeds are intended to be collected, this should be done just before they are perfectly ripe. The root should be taken up before the flowers expand; it must be carefully, yet speedily dried, at a very low temperature, otherwise it soon becomes mouldy and its activity is impaired, while a high temperature quite dissipates its valuable properties. The watery extract is a worthless preparation; and the inspissated juice of the 'London Pharmacopœia,' improperly termed an extract, is also objectionable. All these anomalies, and the diversity of strength of the different preparations enjoined by the different pharmacopœias of London, Edinburgh, and Dublin, from the existence of which, serious consequences often result, will in future be avoided, by the publication of the 'National Pharmacopœia,' ordered to be prepared under the new Medical Bill. Besides the officinal preparations, various popular ones exist. Of the scientific ones, Dr. Fleming's tincture is the best. It requires great care in its use. An excise officer lost his life, from merely tasting it ('Journal of Pharmaceutical Society,' vol. xi. p. 237). A spurious aconitine is prepared in France, and imported into this country. It is devoid of the valuable properties of the genuine, the high price of which offers too great a temptation to fraud. The best forms are either an alcoholic extract of the leaves, or an alcoholic tincture of the root made by displacement. The inactivity of the watery extract and inspissated juice has led to statements in some popular treatises that it may be given in the dose of twenty grains, a quantity which would prove fatal when the extract is prepared with alcohol. Of this latter it is rare that two grains can be given with safety: a quarter of a grain is sufficient to begin with. Possessing narcotico-acrid properties, the action of aconite on the human frame is different according to the quantity used. In small medicinal doses its most obvious action is purely local; in larger, its action is both local and remote. Thus a small portion chewed produces an immediate action, tingling, followed by numbness of the lips and tongue; increased secretion of saliva also occurs. Minute doses taken into the stomach cause augmented secretion both of the mucous membrane and of the glands in the vicinity, the secretion of the liver is often markedly increased; while tingling of the extremities, with heat, is often felt, and either perspiration or increased action of the kidneys. The effect on the pupil is variously stated. Geiger affirms that aconitine produces dilatation of the pupil, Dr. Pereira most positively asserts, in his Materia Medica, that the external application of it produces contraction; while in his experiments with the extract of the *Aconitum ferox* (recorded in 'Edinb. Journ. of Natural and Geograph. Science,' July 1830, p. 235) he distinctly states that while the animal continued alive the pupils were 'much dilated,' contraction taking place only after the animal was apparently dead. Large doses cause redness and inflammation of the parts brought in contact with it; but the intellectual powers do not seem impaired by it, even when a fatal result occurs. Sir B. Brodie thinks that it occasions death by destroying the functions of the brain. ('Phil. Trans.' 1818, p. 186.) For this effect he does not consider absorption necessary; while Dr. Pereira concludes from his experiments, that the intensity of its remote action on the nervous system is in proportion to the absorbing powers of the part to which it is applied ('Edinb. Jour.' p. 242). The susceptibility of the heart to galvanic agents is greatly impaired by it.

When first introduced into medical practice it was recommended in many diseases; but it is now almost entirely restricted to painful affections of the nerves, and to rheumatic complaints, particularly when they are complicated with syphilis. For nervous affections it is more used externally than internally, but this last mode is to be commended at the same time. An ointment is formed with one or two grains of the aconitine to one drachm of axunge. A small portion of this is to be applied frequently to the part affected. An eruption sometimes appears, especially if the ointment be strong. The internal use of aconitine is scarcely to be advised, one-fiftieth of a grain having endangered the life of an adult. The very high price of this article is an obstacle to its extensive employment; but ingenious chemists are endeavouring to simplify the process of extracting it. To obtain it perfectly pure it is almost essential to use sulphuric ether in the preparation of it, which necessarily increases the expense. The alcoholic tincture or extract is of great service in chronic rheumatism, and even in some cases of acute rheumatism.

Should poisoning occur, no time is to be lost, as it has proved fatal in one hour after being eaten instead of horseradish, at Bristol ('Jour. of Pharmaceutical Society,' vol. xiii. p. 294). Animal charcoal has been recommended as an antidote. But even if really useful, it is only serviceable when quite freshly prepared, in which state it is rarely to be had promptly. The best mode of proceeding is—as soon as it has been ascertained that Monkshood has been taken, if the root or leaves have been eaten—to endeavour to empty the stomach as quickly as possible. Warm water alone, or with flour of mustard in it, will generally effect this; or a stomach pump, if at hand, may be used. Perhaps magnesia diffused through the water may be useful. But 'abundance of very warm water' is good alone. Afterwards hartshorn, properly diluted, tincture of cardamoms or brandy may be given. The patient should be kept walking, if possible. Should inflammation ensue, venesection may be needed.

ACOUSTICS is sometimes divided into the science of hearing (from ἀκούω, *to hear*), and that of *sounding* or PHONICS (from φωνή, *sound*). It is not necessary to attempt to define what sound is, or to dwell on the fact that some sounds differ only in intensity or loudness, as the reports of a cannon and a musket; others in musical pitch, as two notes of the same instrument; others again in character or tone, or, as the French call it, *timbre*, such as the same note sounded on a flute and a trumpet. These differences being understood, we proceed to inquire by what agency these different sounds are conveyed to the ear; in what manner the ear is acted upon by sounds of different loudness, tone, and character; and how far we can explain the remarkable fact that we can hear and distinguish, at the same time, almost any number of different sounds. Unfortunately, our knowledge is limited by the nature of the question, which requires the improvement of one of the most difficult branches of mathematical analysis; and by our very imperfect knowledge of the constitution of matter, and the effect which the putting in motion of some particles of a body has upon the other particles. Strictly speaking, we ought to say, that sound has no existence except in the mind of the hearer; but, in accordance with common phraseology, we shall speak of a body as *sounding* when it is in that state in which it would produce the impression of sound, if the proper medium were placed between it and the ear.

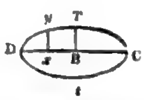
No body can produce a sound, as we know from observation, unless its parts be put into rapid motion. We have evidence of this in a tuning fork, the string of a musical instrument, the parchment-head of a drum, &c. Neither will any sound be perceived unless there is a continual supply of solid or fluid matter, possessed of a moderate degree of elasticity, between it and the ear. Thus, a bell, when rung in the exhausted receiver of an air-pump, yields hardly any sound; and the small portion which it does give may be destroyed or materially diminished by lining the receiver with cotton or wool; or still better, by exhausting the receiver as much as the air-pump will allow, then filling it up with pure hydrogen gas and again exhausting. The air is generally the medium through which sound is conveyed; but only because this is most commonly the one with which the *membrana tympani* or membrane of the drum of the ear is in direct communication. A bell rung under water has been distinctly heard by M. Colladon across the whole breadth of the lake of Geneva, a distance of 9 miles, the sound being observed to pass through the water with a velocity of 4708 feet per second; those who work in one shaft of a mine can often distinctly hear the sound of the pickaxe in another shaft through the solid rock; and persons wholly deaf, who therefore are not at all affected through the ear, have received pleasure from music, by placing their hands upon a shutter or other solid body near the instruments. Biot's experiments, too, have shown some very curious results of the varying velocity of sound for different media. He fixed a bell at the end of an iron tube of about 3120 feet in length, and he found that the sound of the bell was double as heard at the other end, the first sound being transmitted through the metal, and the second through the column of air in its interior. He also found that the slightest whisper at one end was distinctly communicated to the other. To this fact he added the observation, that the well-known double report of a musket is owing to the same cause, the sound being unequally carried through the air and the vapour floating in it. In the following remarks we will confine our attention to what takes place in air during the production of sound.

The body of air which surrounds us produces no sound if it be all moved together, that is, if the velocity of all its particles be the same: the highest wind makes no noise except when it is forced against some obstacle; but the sound of a cannon is heard in whatever direction the wind may blow: it may also be remarked, that the strongest band of music does not produce any sensible wind in any direction. It is therefore to some other kind of motion that we must look for the agent of sound, and the manner in which sonorous bodies move immediately points it out. If a tuning-fork or string be struck, a rapid succession of vibrations is the consequence, which, as we shall see, causes the particles of air to vibrate in a similar manner. We find, moreover, that in order to produce a note, there must be not only a succession, but a *rapid* succession, of vibrations. Now, experiments show that the ear is not capable of receiving the impression which we call *sound*, unless the particles of air in contact with it vibrate at least 30 times in a second. The vibration produced in the particles of air by a sonorous body may be distinctly proved by the following experiment. Let a tuning-fork be sounded, and while yet in vibration, let it be stopped by the finger. A sensation will be felt for an instant, for which we have no name in our language, arising from the prong of the fork rapidly, but gently, striking the finger, and very different from that which is produced by merely touching the fork when at rest. Now, blow into a common flute, and at the same time stop gently two or three of the higher holes. The same sort of sensation, though in a much smaller degree, will be felt on that part of the fingers' ends which is in communication with the interior air. For this purpose the fingers should be warm, but if the observer be not used to the instrument, the effect is made more certain by tuning the string of a violoncello to the note which is to be fingered on the flute, and then sounding the former strongly, while the latter is held over it, with the fingers placed as before. The column of air in the flute will be made to vibrate by the motions of the string, forming a case of what is called *sympathetic vibration*. That any very violent and sudden noise produces a concussion in the air even farther than the sound can be heard, is proved by the fact, that the explosion of a large powder-mill will shake the windows in their frames for nearly twenty miles around.

We now proceed to describe, as far as can be simply done, the motion which takes place in the air when the impression of sound is communicated; and here we stop to explain a method which may be adopted in many cases, of making the eye assist the reason. Suppose we wish to register what takes place in the vibration of a spring, of which the position of rest is A B (*fig.* 1), but which, having been set in motion, passes through all the positions between A C and A D. The

Fig. 1.

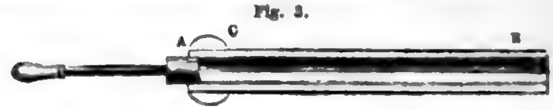
Fig. 2.



spring being drawn aside by the finger or other disturbing cause to A C, and then released, the elasticity of the metal makes continued efforts to restore it to its first position A B, by which it is made to move, and with continual accession to its velocity, until it actually does arrive at A B, where, if the velocity were suddenly destroyed, it would remain at rest. But the velocity still continuing, the spring continues to move towards A D, with a change of circumstances, inasmuch as the elasticity, now opposing its motion, gradually destroys the velocity by the same steps as it was before gradually created; so that when the spring comes to A D, it will be again at rest, but will not continue so, since the elasticity will cause the same phenomena to be repeated, and the spring will move back again towards A C. But for friction and the resistance of the air it would again reach A C; it does not, however, get so far, owing to these causes, which always diminish, and never increase, velocity. This alternation will go on until the spring is reduced to a state of rest. Similar phenomena occur in the motion of a pendulum, of the string of a harpsichord, and generally, wherever small vibrations are excited in a body, which remove it, but not much, from its position of rest. We might, perhaps, conclude, that each successive oscillation is performed in a shorter time than the preceding, seeing that a less space is described by the spring. But this is not the fact; it can be observed, as well as demonstrated, that the oscillations which take place before a body recovers the effects of a small disturbance and resumes the state of rest, are severally performed, if not in the same time, yet so nearly in the same time, that the difference may be entirely neglected in most practical applications. Such being the case, we may omit the effects of friction and resistance, so far as the *time* of vibration is concerned, and consider the spring as describing exactly the same path in each successive vibration. Let D C (*fig.* 2) be the line described by the top of the spring, which we may call a straight line, since it is very nearly so, and while the spring moves from D to C, imagine a curve D y C to be drawn, in such a way that, the spring being at x, the perpendicular $x\,y$ is the rate per second at which the top of the spring is then moving. A little attention will show that the curve which we have drawn represents the various changes of motion just alluded to: thus T B, the greatest perpendicular, is over the point B, where the spring moves fastest; and at D and C there is no perpendicular, because the spring comes to rest when it reaches those points. During the return from C to D, in which the motion is the same, but in a contrary direction, let a similar branch C t D be drawn, on the other side of C D. We will call the whole curve D T C t D the *type* of the double vibration of the spring, the two branches being the types of its two halves. Now, suppose a column of air inclosed in a thin tube A B (*fig.* 3), which is indefinitely extended towards B, but closed at A by a piston which can be moved backwards and forwards from A to C, and from C to A, after the manner of a spring, the type of its motion being represented by the curves on A C. And first let the piston be pushed forward from A to C. If the air were solid, we should say that a column of air A C in length would be pushed out of the end B of the tube in the time in which the piston is driven in, but we certainly can have no notion that such an effect would be produced upon a column of elastic fluid like the air. Experiment, as well as mathematical demonstration, show us that though every particle of the fluid will finally be

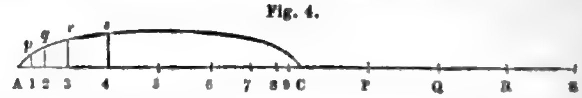
put in motion, yet that those particles which are nearer the disturbing piston receive their first impression sooner than those which are more

Fig. 3.



distant; and we find that this successive *propagation*, as it is called, of the disturbance, goes on *uniformly* at the rate of about 1125 feet in a second, the temperature being 62° of Fahrenheit; for example, a second must elapse before those particles, which are 1125 feet distant from A, will have their first news, so to speak, of what is going on at A, and in the same proportion for other distances. It is also shown that the velocity of communication is not affected by the greater or less degree of violence with which the air is struck, but remains the same for every sort of disturbance. With such a velocity, we may see that the column of air made up of all the particles which feel, or have felt, the effects of the disturbance, must be very long when compared with A C, the extent of an almost insensible vibration; so that it will lead to no sensible error if we suppose that the effect of the piston at every point of its course is propagated instantaneously to C, and *thence* only, with the velocity of 1125 feet per second. We will now consider what this effect is. Divide the whole length A C, *fig.* 4, into a large number of very small parts, *described in equal times*, and instead of the piston moving continuously, and with imperceptible changes of velocity, along A C, let it move by starts from each point to the next, with the proper increase or decrease of velocity. In the figure we have divided A C into ten parts, but the same reasoning applies to any greater number. We have much enlarged A C (*fig.* 4), to give room for the figure: the reader

Fig. 4.

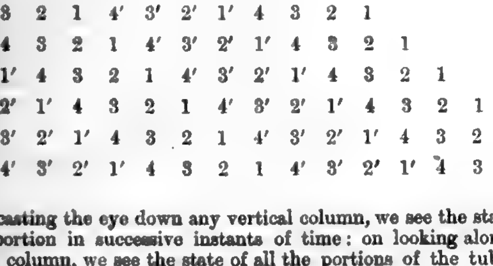


may help his ideas by supposing that A C is viewed through a powerful microscope, and the rest of the tube by the naked eye. Whatever may be the common time of moving through each of the parts A 1, 1 2, &c., the portions of the column affected by the starts of the piston will be of the same length, and each will be as much of 1125 feet as the time of each start is of one second. Set off the lengths C P, P Q, Q R, &c., each equal to this length, and for the present let us agree to call the common time in which the piston starts through A 1, 1 2, &c., an *instant*. The reader must bear in mind throughout that we intend to carry the supposition of dividing A C into parts to its utmost limit, by which we shall have to suppose C P, P Q, &c., to be very small, though still great when compared with A 1, 1 2, &c. We also think it right to repeat, that all the figure on the left of C is immensely magnified, and that the propagation is supposed to be instantaneous from 1, 2, &c., to C. In the first *instant*, the piston moves through A 1, with the velocity p 1 per second, and forces the column of air A 1 into C P, which therefore has its density increased, or is compressed, the air which was held in C P and A 1 together being now confined in C P. As the propagation has not travelled farther than P, the effect is just the same as if there had been a solid obstacle at P during the first instant. The portion C P is then compressed, strictly speaking, *unequally*; that is, the parts near to C are more compressed than those near to P; but on account of the small length of C P, and the rapidity of the transmission, we may suppose all the parts to be equally compressed. Again, the particles near C begin to move towards P, and for a similar reason we may suppose the velocities of all the particles to be the same; this velocity being that of A during the first instant. The reader must not confound the absolute velocity of the several particles, which is always small, with the rate at which they transmit their velocities and compressions, which is very great. We will use the phrase that the portion C P has received its *first compression*. If the piston were stopped at the end of the first instant, the whole effect upon C P would be transferred to P Q in the second instant, both as to compression and velocity, and the particles of C P would return to their first state, and receive no further modification. But in the second instant, the portion C P receives its *second compression*, which is greater than the first, since a column 1 2 longer than A 1 is forced into it. Similarly, the velocity is increased, being 2 q per second instead of 1 p. If the spring were then stopped, the third instant would see the portion P Q transmit its velocity and compression to Q R, C P to P Q, and C P would resume its natural state. But in this instant, C P receives its third compression, which is greater than the former two, and the same process goes on, each portion transmitting its velocity and compression to the *succeeding* one, receiving in its turn more than it parted with, from the *preceding*. This continues until the piston has reached the middle point of A C, after which the compression of C P still continues, but becomes less and less in successive instants, because 5 6, 6 7, &c., down to 9 C, decrease in length, in the same way as A 1, 1 2, &c., increased. When the piston begins to return through C 9, in the eleventh instant, the portion C P receives its *first rarefaction*; for the air in C P now occupies C P and C 9; the particles in C P therefore move towards C instead of from it, and the preceding modifications are successively repeated in *quantity*, but changed into their contraries; that is, each portion undergoes successive rarefactions, equal in amount to the former condensations, and the particles move *towards* C with the same velocities which they formerly had *from* C. This continues until the piston reaches A again, after which the same phenomena recommence in the same order. Thus it appears that the absolute velocity of each particle is in the direction of the propagation so long as it is compressed; but in the contrary direction, when it is rarefied, and that each particle, during the progress of a double series of compressions and rarefactions, moves forward in the direction of propagation, and back again to its former place, where it rests, unless a third vibration follow the first two. When we talk of the compression of a particle, we mean that it is nearer the succeeding particle than it would have been in its natural state; and *vice versâ* for rarefaction. We may represent these phenomena in the following table, which, to save room, is made on the supposition that A C was divided into four parts, and might be equally well constructed if the number of parts into which A C was divided had been greater. The numbers in the top horizontal line are the successive portions of the tube, those in the left vertical column the successive instants of time, and under any portion of the tube, opposite to any instant of time, will be found the state in which that portion of the tube is at that instant of time,—1 denoting its first compression, 1′ its first rarefaction; these latter numbers recommencing when a complete cycle of changes is finished. The blanks denote that the effect has not yet reached the corresponding particles.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	2	1														
3	3	2	1													
4	4	3	2	1												
5	1′	4	3	2	1											
6	2′	1′	4	3	2	1										
7	3′	2′	1′	4	3	2	1									
8	4′	3′	2′	1′	4	3	2	1								
9	1	4′	3′	2′	1′	4	3	2	1							
10	2	1	4′	3′	2′	1′	4	3	2	1						
11	3	2	1	4′	3′	2′	1′	4	3	2	1					
12	4	3	2	1	4′	3′	2′	1′	4	3	2	1				
13	1′	4	3	2	1	4′	3′	2′	1′	4	3	2	1			
14	2′	1′	4	3	2	1	4′	3′	2′	1′	4	3	2	1		
15	3′	2′	1′	4	3	2	1	4′	3′	2′	1′	4	3	2	1	
16	4′	3′	2′	1′	4	3	2	1	4′	3′	2′	1′	4	3	2	1

On casting the eye down any vertical column, we see the state of the same portion in successive instants of time: on looking along a horizontal column, we see the state of all the portions of the tube at the same instant, as far as the effect has reached them. In the latter case, we see that all the successive states are continually repeated, in such a way, that whatever states two portions may be in, the intermediate portions have all the intermediate states. There is also at the beginning an unfinished series in process of formation. If we look down a column, we see that any one particle successively undergoes the different states, from the moment when the effect first reaches it. We shall now suppose the division of A C to go on without end, and examine the final result. The different states of compression or rarefaction will then become more and more numerous, but the difference of quantity between each and its preceding will become less and less, so that when we at last give to the piston a *continuous* or gradually increasing and decreasing velocity, we must also suppose a continuous or gradually increasing and decreasing compression or rarefaction of the air in the tube. This being premised, we return to the figure, and construct the *type* of the motion of the piston, both backwards and forwards, and also the *type* of the state in which the particles of air actually are for two or three several positions of the spring; as in the figure below, which we proceed to explain. (*Fig.* 5.)

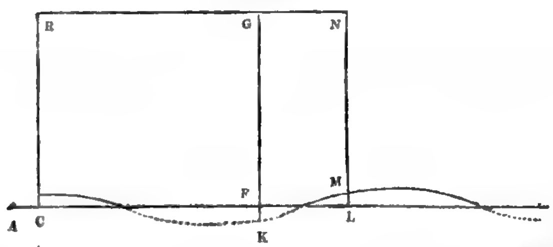
Fig. 5.



In *fig.* 5 (1) the piston has travelled from A to the small perpendicular, through something more than a quarter of a vibration: the first disturbance has reached D, and the curve D K is the *type* of the state of each particle as to velocity; that is, the perpendicular F G is the rate per second at which the particle F is moving from C, and the same for every other perpendicular.

If the piston be performing its third complete vibration, or its second vibration *forwards*, there will have been a preceding series of compressions and rarefactions propagated onwards, as in *fig.* 5 (1). In *fig.* 5 (2), a vibration forwards has been completed; the curve on C D now represents a complete undulation, as far as the compressions are concerned. In *fig.* 5 (3), the return of the piston has commenced, and the particles between C and D are rarefied, and moving towards C; this we explain by placing the *type* beneath the tube, and dotting the curve; F G expressing the velocity per second of the particle F towards C. The length of the whole wave C D is easily calculated. If, for example, the single vibrations of the piston are made in $\frac{1}{100}$ of a second, the first impulse will have travelled through one hundredth part of 1125 feet, or $11\frac{1}{4}$ feet. This is the length of C D, in *fig.* 5 (2). The complete series of compressions is called a *wave of compression;* and that of rarefactions a *wave of rarefaction.* And the same type which represents to the eye the velocities of the various particles, will also serve to represent the degrees of compression or rarefaction. For those particles which are moving quickest from C are most compressed, and those which move quickest towards C are most rarefied. In returning to *fig.* 4, we see that A 1, 1 2, 2 3, &c., are spaces described in equal times, and are therefore in the same proportions as the velocities, that is, as 1 *p*, 2 *q*, 3 *r*, &c. But these spaces, in the preceding explanation, are proportional to the degrees of condensation; these latter then are proportional to the velocities. If, then, we suppose the series of compressions and rarefactions to have gone on for some time, and an unfinished wave of compression to have been formed at the instant we are considering, we may represent the whole state of the particles in the tube at that instant by the following figure (*fig.* 6):—R G N is a line parallel to the tube, and therefore G F is of the same length for all positions of F. It is to be made 1125 feet in length. Its use depends upon the following proposition:—That in the simple undulation which we are now considering, so long as the disturbance is small, the velocity of any particle bears to the *velocity of propagation* (two very distinct things, as we have before observed) the same proportion as the change in the density bears to the density of undisturbed air. This follows from the investigation attached to *fig.* 4: for, in the fourth instant for example, the column 3 4 of air is forced into C P, and 3 4 and C P being spaces described in equal

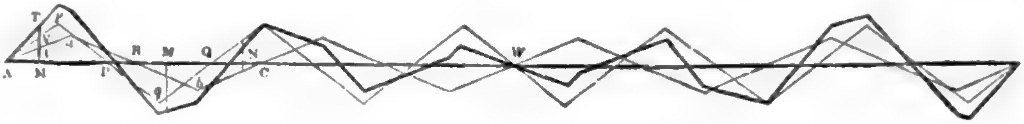
Fig. 6.



times with velocities 4 *s* and 1125 feet per second, are spaces proportional to these velocities. And the compression will be the same if we increase C P in any proportion, provided we increase the quantity of air forced into it in the same proportion. A similar proposition holds for rarefactions. Or, in other words, F K being the velocity with which the particle at F is moving *towards* C, the rarefaction of the particles at F is that which would be obtained by allowing the air naturally contained in a tube G F, 1125 feet long, to expand into the length G K. Similarly, the compression at L is that which would be obtained by compressing the air in a tube N L into the shorter tube N M. If we wish to see the state of these particles at any succeeding instant, let the *curvilinear* part of the figure travel uniformly forward at the rate of 1125 feet per second, new curves being continually formed and finished at C: we shall thus have the state of the whole tube at any succeeding moment. Before proceeding to apply this explanation to the phenomena of sound, we must see what will take place if the tube be agitated by several different undulations at once.

All readers, however little acquainted with Mechanics, are aware, that if a body be impressed by two forces in the same direction, it will proceed with the sum of the velocities produced by the two forces; and with the difference of the velocities, if the forces act in contrary directions, the motion in the latter case being in the direction of the greater of the forces. Hence, if there be different undulations excited in the same column of air, the velocities of each particle will be made up of the *sum* or *difference* of those which it would have received from each undulation, had each acted alone; the *sum* when it would have been compressed by both, or rarefied by both, and the *difference* when it would have been compressed by one and rarefied by the other. And the compressions or rarefactions being proportional to the velocities, a similar proposition will hold of them. We have represented in *fig.* 7, the state in which a column of air would be at a given instant from two different waves, the types of which are drawn, and the broad line is the type of their united effects. We know that any two lengths are either in the proportion of two whole numbers, or if not, two whole numbers can be found, which are as nearly proportional to them as we please. We have, to take a simple case, drawn the lengths of the waves in the proportion of 5 to 4. (*Fig.* 7.) The types of the waves are different portions of straight lines, one whole condensation and rarefaction taking place, as indicated by A a B b C in the first, and by A p P q Q in the second. We suppose the waves to commence together. This supposition, of the condensation and rarefaction proceeding in such a way that their types shall be parts of straight lines, is not to be obtained in practice, since, as we have seen,

Fig 7.



such motion as that of a spring, and (we may add) of a string or of a drum, would produce regular curves. But it is as allowable in illustrating the effects of combined undulations as any other; and if, moreover, we round the corners of the types of the single waves, thus making them present an appearance similar to that in the preceding figures, a slight rounding of the corners of the broad line will show sufficiently well what the combined wave would have been, if the preceding figures had been rounded. And the supposition of rectilinear types facilitates the drawing of such figures (which we would recommend to our readers), since, as they will observe, the type of the combined wave consists also of portions of straight lines which break off only when the type of one of the single waves changes from one line to another. The general rule for forming the broad line, derived from a preceding observation, is—let the perpendicular or ordinate [ABSCISSA] be the *sum* of the perpendiculars of the types of the waves, when they fall on the *same* side of A P, and the difference when they fall on different sides; observing, in the latter case, to let the broad line fall on the side of that wave which has the greatest perpendicular. Thus at the first M, M T is the sum of M U and M V, and particles at M are in a greater state of compression than the first wave would give them, which arises from the second; similarly at the second M there is an increase of rarefaction. At N, the air is compressed by one wave, and rarefied by the other, but more compressed than rarefied. At P, B, Q, C, &c., where one of the waves causes neither compression nor rarefaction, the broad line coincides with the other wave.

On looking at the figure thus produced, we see—

1. That it is composed of a cycle of successive compressions and rarefactions, in which, however, the rarefactions differ in kind from the preceding compressions; so that we must not give the term *wave* to each set of compressions or rarefactions, as we reserve this word to denote cycles of changes, which are followed by similar cycles of contrary changes.

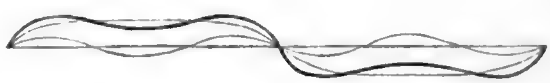
2. That when the lengths of two waves are as five and four, four of the first will be as long as five of the second; so that the waves recommence together at W, but not exactly as before, the wave of condensation from the first being accompanied by the wave of rarefaction from the second. This difference, however, is not found at the end of the second similar cycle of four and five; so that after eight of the first waves, corresponding to ten of the second, the combined wave begins again to have the same form as at first.

3. The complete cycle denoted by the broad line may be divided into two, joining at W; in the second of which a series of rarefactions is found similar to every series of compressions in the first, and *vice versâ*. We may, therefore, give the name of wave to the part of the broad line intercepted between A and W, consistently with our definition of this word.

4. If the waves had not begun together, a wave would have resulted of the same length as the preceding, if we began at any point where the compression from one was exactly compensated by the rarefaction from the other.

5. If both waves had been of the same length, the resulting wave would have had that length; or if the first wave had been contained an exact number of times in the second, the resulting wave would have been of the length of the second. We subjoin a cut (*fig.* 8) representing a wave contained three times in another wave, and the resulting wave.

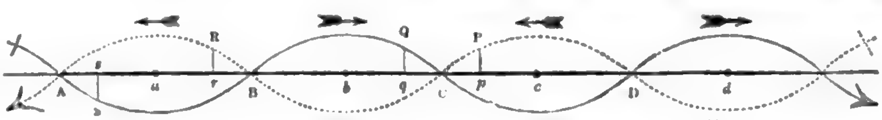
Fig. 8.



We have hitherto considered combined undulations as propagated in the same direction: let us now take two waves of equal lengths propagated in opposite directions, rising, as we may suppose, from two pistons, one at each end of the tube. After a certain time, depending on the length of the tube, two waves will meet, by which we mean that the particles will begin to be affected by the motion of both pistons, and the manner in which the joint effect is represented is the same as before, though the phenomena are very different. In the former case, having represented the resulting wave at one instant, we could trace the change of state throughout every particle of the fluid, by supposing the type of that resulting wave, or a succession of such types, to move along the tube at the rate of 1125 feet per second; in the present case, the waves are propagated in contrary direction, so that any given effect from the first wave is no longer continually accompanied by another given effect from the second wave. We must also recollect, that the motion of the particles in each wave of compression is in the direction of the propagation; so that a particle under the action of two waves of compression, has opposite velocities impressed upon it, and therefore moves with the difference of the velocities; and so on.

Now let A, B, C, D, &c., be the points where the two series of waves meet in the axis, and let us choose the instant of meeting for the time under consideration. Let the continued line represent the waves propagated from left to right, and the dotted line those propagated from right to left, as marked by the arrows at the parts at which they end; the arrows above them representing the directions of the absolute velocities which the waves over which they are placed give to the particles. (*Fig* 9). All the particles are now neither compressed nor rarefied; for it is evident that, whatever condensation or rarefaction a

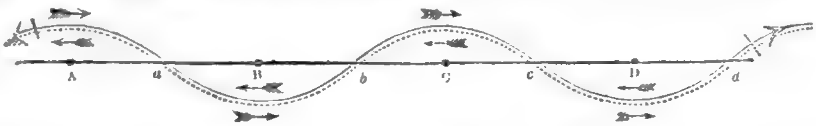
Fig. 9.



particle experiences from the wave moving to the right, there is a contrary rarefaction or condensation from that which moves to the left. But every particle has the velocity derived from either wave doubled by the other. Again, the particular points A, B, C, D, &c., are never put in motion; for it is plain that by the time any point P comes over C, giving it the velocity of P p to the left, the point Q, similarly placed on the other wave, will also have come over C, giving it the equal and contrary velocity Q q; so that, as far as velocity is concerned, all the impression produced on A, B, C, D, &c., is equivalent to two equal and contrary velocities, or to no velocity at all, for we are considering the case of particles, and not of rigid bodies, where such opposite equal forces would form a "*couple*," and produce *rotatory* motion. But when P has come over C, the compression, answering to P p, is doubled by that answering to Q q. So that the particles at A, B, C, &c., undergo no change of place, but only condensation or rarefaction. Also the particles at a, b, &c., halfway between A and B, B and C, &c., never undergo compression or rarefaction, but only change of velocity. For by the time any point R, from one wave, has come over a, with the condensation answering to R r, S will have come over it from the other, with the equal rarefaction answering to S s; so that the effect of the combined waves upon a, is always that answering to equal condensation and rarefaction, or no change at all. But the velocities answering to R r and S s are equal, and in the same direction; so that the points a, b, &c., have the velocities which one wave would have given them doubled by the other. Hence at a, b, c, &c., the particles suffer no change of state, but are only moved backwards and forwards. Now, let the time of half a wave elapse, in which case the types of the undulations will coincide, and those parts will be over the capitals on the axis, which are now over the small letters, and *vice versâ*, as in *fig.* 10, where the coincidence is denoted by a continued and dotted line together, the latter being, of course, a little displaced.

Half a wave since, all compression and rarefaction had disappeared throughout the tube, the velocity of every particle being double that which either wave would have caused. The case is now altered; no particle has any velocity, since there are the signs of equal and contrary velocities at every point of the tube; but every particle is either doubly compressed, or doubly rarefied, except a, b, &c., which, as we proved, are never either compressed or rarefied. In one more half wave, the phenomena of the first supposition will be repeated; that is, all condensation or rarefaction will be destroyed throughout, the particles however being all in motion, except A, B, &c., but in directions *contrary* to those they had at first; while, at the end of a fourth half wave, the phenomena of the second supposition will be repeated, that is, all velocity will be destroyed, the particles being all *condensed* or *rarefied*, according as they were before rarefied or condensed. The reader may easily convince himself of these facts by drawing the corresponding figures. To put the results before the eye, suppose the tube to be of a highly elastic material (thin India-rubber, for example), so as to bulge outwards a little when compressed from the interior, or to contract in diameter by the pressure of the outward air when the inward is rarefied. Recollect, also, that A, B, C, D, &c., remain without

Fig. 10.



motion, their only change being condensation or rarefaction; while a, b, c, &c., are never compressed or rarefied, their only change being that of place. We exhibit side by side the successive appearances of the tube, and the relative situations of the types between A and C, the arrows always representing the direction of the motion of the particles. A half-wave elapses between each two configurations. (*Fig.* 11.)

These phenomena will recur in the same order, and this mode of undulation, though it is necessary to show how it arises from the combination of two waves, is nevertheless more easy to be explained by itself than either of these two. For if we recollect that when particles of air move away on both sides from a given point, there must be a condensation in the parts towards which they move, and a rarefaction in those which they quit, (2) will evidently follow from (1). At this second period, the elasticity of the air will have opposed and destroyed the velocities of the particles; so that there now only remains a tube of particles at rest for the moment, condensed towards the ends and rarefied in the middle. There will therefore immediately commence a rush of air towards the rarefied parts, which will end by producing the

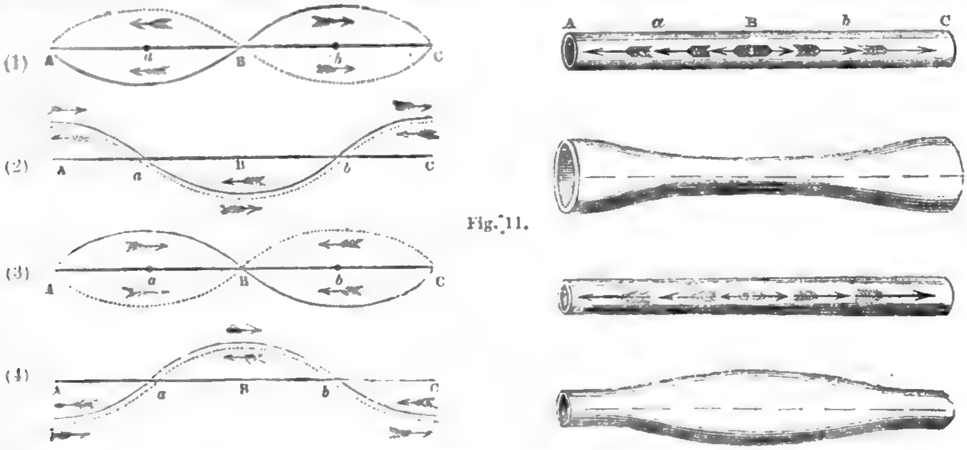


Fig. 11.

state represented in (3), where equilibrium is restored, as far as compression and rarefaction are concerned; but where, at the moment under consideration, nothing has yet taken place to deprive the particles of the velocity which they received from the elasticity of the air before the natural state was recovered. There is now a motion of particles, in all directions, towards B, which will go on producing compression at B, and rarefaction at A and C, until all the velocity is destroyed. This is the state represented in (4), from which (1) follows again; and so on. The states of the column intermediate between the times of (1), (2), &c., are easily imagined. Between (1) and (2) the compression at the extremities will have begun; but not yet to the complete destruction of the velocities. Between (2) and (3) the motion of the particles towards the middle will have begun; but will not yet have placed them in their natural positions; and so on. The particle at B, is evidently never in motion, being always equally pressed on both sides. The same would be seen of A, and C, if the tube were extended on both sides.

It is evident also, that except at the instant when compression and rarefaction are all destroyed, there must be a point at which the transition occurs from condensation to rarefaction; and *vice versâ*. It is not however so evident, in this way of viewing the subject, that these points always remain in the same position at a and b, which is the result of our previous investigation. The reader must however recollect, that, when we talk of the points a and b being always free from condensation or rarefaction, we do not say that it is *the same air* which is always uncondensed or unrarefied, but only that the different portions of air, which pass by a and b, are in their natural state at the instant of the passage.

Now it must be evident, that if, in the motion of a fluid, there be certain particles which remain at rest, it is indifferent whether we suppose those particles to be fluid or solid; for all that we know of a solid, as distinguished from a fluid, is, that the particles of the latter yield *sensibly* to any applied force, while those of the former do not. Hence, when such impulses are communicated to a fluid, that some of its particles must remain at rest, the question never arises, so to speak, as to whether those particles would, or would not, move with the fluid, or resist, if the conditions of motion were so altered, that forces, which did not counterbalance, would be applied to those particles. Let us now suppose that a solid diaphragm is stretched across the tube at A; the motion will still continue exactly as before; and we may produce this species of complex undulation by a piston at one end only of the tube, provided the other end be closed. For, on this supposition, all the successive states into which the air at the end furthest from the piston is brought, cannot be communicated to the outside air, and must, therefore, be either retained, or returned back again through the column of air. The latter effect results; and the returning wave, which is of the same kind as the advancing wave, produces the phenomena just explained. If A and B were both closed during an undulation, no piston would be necessary, if it were not that there is no substance but what will vibrate in some small degree, and the vibrations communicated to the tube from the internal air gradually destroy the internal motion, by the communication of motion to the external air.

We have hitherto considered only the motion of air in a small tube, and have found that the velocity of the particles, as well as the condensation and rarefaction, may be propagated undiminished to any extent. The case is somewhat different when we consider undulations propagated in all directions at once. Imagine a small sphere, which is uniformly elastic in every part, and which, by some interior mechanism, is suddenly diminished in its dimensions, and afterwards as suddenly restored. A wave of rarefaction and condensation will be propagated in every direction; which wave, at any instant, will be contained between two spheres, concentric with the sphere already mentioned, the radii of which differ by the length of the double wave: at least, unless there be some reason in the state of the atmosphere, why the propagation should take place more quickly in one direction than another. We have no reason, at first sight, to suppose that the velocity of propagation would be exactly, or even nearly the same as if a portion of the air through which the waves pass had been contained in a tube, unconnected with the exterior air. But it is found, both by mathematical analysis and experiment, that the velocity of propagation remains unaltered in both cases; and also that the *absolute* velocities of the particles diminish. This last is a natural consequence of a very simple principle—namely, that when one body, or collection of bodies, strikes a larger body, or collection of bodies, in such a way that its whole motion is destroyed, the velocity of the larger body will not be so great as that of the communicating body, but less in the same proportion as its mass is greater. The law of this diminution should be, from theory, *inversely as the distance*; that is, by the time the wave has moved from 3 miles to 5 miles, the compressions and velocities should be as 5 to 3; but we have no direct means of submitting this to experiment, the absolute velocities being imperceptible.

We now proceed to the application of these principles. We know that when the air is violently or rapidly propelled in any direction, undulations such as we have described are produced, and that the impression called *sound* is produced also. When a gun is fired, the great elasticity of the gases which are disengaged by igniting the gunpowder, forces the air forwards out of the gun, which the instant afterwards is allowed to return. If feathers or dust be floating in the air, they have been observed to move forwards, and then back again, just as we have found the particles of air around them would do in the course of a double wave. The intensity or loudness of the sound seems to depend upon the greatest absolute velocity of the particles, and not at all upon the velocity of propagation, which is found to be the same for all sounds. Thus in a musical chord, spring or drum, the harder the metal or parchment is struck, the louder is the sound, but without any difference of tone, character, or velocity of propagation. There is no instrument of which the sound may not be made louder or weaker without any other change than giving greater velocity to the immediate cause of sound. We will not enter further into this part of the subject than to observe, that, generally speaking, we are not authorised to say that sound travels with equal loudness in all directions. It might do so in the case where it was communicated by the sudden contraction and expansion of an elastic sphere, as above supposed; but this is a supposition which we cannot put in practice. If a tuning fork be sounded and turned round in the hand while held up before the ear, very perceptible diminutions and augmentations of loudness will be perceived. This is however explained *otherwise* on the principle of *Interference*, by the fact that when the branches coincide, or are equidistant from the ear, the waves of sound combine their effects, while in all intermediate positions, as they reach the ear in different phases of vibration, they interfere, and produce partial silence.

The immediate communicator of sound is the tympanum or drum of the ear, an elastic membrane, which is set in vibration by the motion of the particles of air against it, and vibrates in the same time with them. From this membrane vibrations are communicated to the fluid filling the *labyrinth* of the ear, through the air in the tympanic cavity, and probably not, as was formerly supposed, through the delicate chain of bones connecting them. [Ear, in Nat. Hist. Div. of Eng. Cyc.] We might expect, that when the wave of sound is of considerable length, we should hear its different parts, that is, feel a difference between the beginning and end where the velocities and compressions are small, and the middle where they are greatest. This happens to a small extent in the difference, for example, between the 'roar' of a cannon and the 'report' of a musket. No explanation can convey a better idea of the difference than these two words. These simple uncontinuing sounds are the result of few waves, there being no cause for their continuance.

We have not space in this article for any discussion of the manner in which sounds are conveyed through other bodies besides air, for which see Vibration. Noises conveyed through solid bodies travel in general more quickly, and are heard better; the scratch of a pin may be distinctly perceived through a long spar of wood, though inaudible by the person who makes it. With regard to gases, both theory and experiment agree in enabling us to assert, that any two of the same pressure and temperature, (that is, where the barometer and the thermometer would present similar indications in each gas,) convey sound with velocities which are inversely as their densities. Thus, air being about fifteen times as heavy as hydrogen, the velocity of propagation in the latter is about fifteen times that in the former. Such a result cannot be directly submitted to experiment; but, as we shall see in the article Pipe, there are methods equally certain for ascertaining the truth.

The velocity of sound had been determined by experiment before the time of Newton, who gave the first mathematical solution of the question, with the following result; that if the atmosphere, instead of decreasing in density as we ascend it, were all to be reduced to the density at the earth's surface, but to be so diminished in height, that the pressure at the earth's surface should not be altered, the velocity of propagation would be that acquired by a heavy body falling unresisted from half the height of this *homogeneous atmosphere*. This reasoning, however, gave the velocity nearly *one-sixth* too small; and the cause of the difference was afterwards supplied by the sagacity of Laplace. This we shall try to explain. We know that air and all gases resist compression, and will expand themselves if the pressure of the superincumbent atmosphere be removed. This tendency is what we mean by the *elastic force* of the air or gas. If we take a column of air reaching from the earth's surface to the top of the atmosphere, the elastic force at any one stratum is equal to the weight of the superincumbent column, since it balances that weight. Moreover, it is observed, that, *at the same temperatures*, the elastic forces of two different strata are as their *densities*, that is, for air of half the density of common air, the elastic force is only half as great, and so on. It is also observed that any increase of temperature increases the elastic force if the density remain the same, and also that compression always increases the temperature; and *vice versâ*. If, therefore, a vessel of air were pressed into half its dimensions, it would double its elastic force from the condensation, which would also receive a further addition from the increase of temperature. Again, if the same were rarefied into double its first dimensions, the elastic force would be halved by the rarefaction, and receive a further decrease from the diminution of temperature. The increase or decrease arising from temperature would not last long, since the altered mass would communicate heat to the surrounding bodies in the first case, and receive it from them in the second; but in calculating such instantaneous effects as the propagation of sound, it is evident they ought not to be neglected. The supposition on which Newton went was, that the elastic forces of two strata of air are always in the same proportion as their densities, which is not true, unless the temperatures are the same. We may also here remark, that an alteration in the *barometer* only, produces no alteration in the velocity of air; for, if the barometer rise, though the pressure of the air is increased, yet the density is increased in the same proportion; that is, the force which is to set each mass in motion receives no greater increase in proportion than the mass which is to be moved. But a rise in the thermometer, accompanied by no change in the barometer, increases the velocity of sound, for there is an increase in the elastic force, without any increase in the density. A very good measure of this velocity made near Paris in 1822, under the directions of the Academy of Sciences, gave 1118 feet per second at the temperature of 61° of Fahrenheit. Earlier experiments had given 1130 feet, which, if the French measure is assumed as accurate, represents the velocity at a somewhat higher temperature. The number which we have adopted, viz., 1125 feet per second, at 62° of Fahrenheit, is shown by Sir John Herschel, in his masterly treatise on 'Sound' in the 'Encyclopædia Metropolitana,' to accord very nearly with the mean of the best experiments. The formula for calculating this velocity is *now* given as follows:—

$$V = 1090{\cdot}8 \left\{ (1 + 0{\cdot}003665 \times t)\left(1 + 0{\cdot}375\,\frac{\Upsilon}{\Pi}\right) \right\}^{\frac{1}{2}}.$$

where t is the centigrade temperature, Υ the density of vapour, and Π that of air, at the time. Every increase or decrease of temperature of 1° of Fahrenheit, causes a corresponding increase or decrease of $1\frac{1}{10}$ of a foot in the velocity of sound, which gives about 1090 for the velocity when the air is at the freezing point. We may add, that in the present state of our knowledge of the manner in which the temperature and elastic force of the atmosphere are connected, observation and theory give results which differ from one another by about a hundredth part of the whole.

When the exciting cause of sound is continued, as for example, when a board is scratched with a pin, we have a continued sound, caused by the succession of waves which the ear receives, which waves we have no reason to believe are all of the same length. But whenever the exciting cause is one, the vibrations of which can be shown to be performed in exactly the same time, so that the waves caused by them are all of the same length, we perceive a sound which gives pleasure to the ear, and has the name of *harmonious* or *musical*. This, however, only happens when the vibrations are at least thirty in a second, or the wave of a sound at most about 38 feet long. This fact is so well established, that we may consider it as certain that the pleasure arising from musical sounds is a consequence of the perfectly equal times of the vibrations which produce them, and of its result, the equal lengths of the sonorous waves propagated from them through the atmosphere. This will not appear so extraordinary, if we consider the very delicate nature of our organ of hearing. A person of tolerable ear can distinguish between two sounds, which only differ in that the one is a consequence of 400 vibrations in a second, and the other of 405. We must therefore grant to the ear a much higher power of perception as to sounds than the eye has to length or surface. Some increase of the perceptive power may arise from the very great number of vibrations, since a result in some degree corresponding is observed in vision. If we look at a large number of parallel lines ruled close together at equal distances, any little deviation from parallelism or equidistance is much more sensibly seen than when the number of lines is small. And even to the eye, any moderately rapid succession of objects of the same kind is much more pleasing when they follow at equal distances and periods of time.

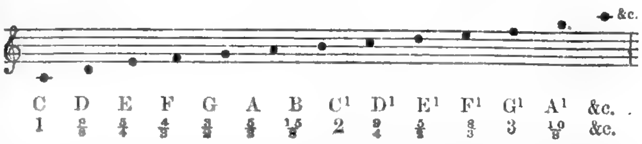
The difference between two musical sounds, which we express by saying that one is higher or lower than the other, is a consequence of the different number of vibrations performed by the two in the same time, and the sound which we call *higher* has the greater number of vibrations. And some sounds, when made together, produce an effect utterly unbearable, while others can be tolerated; others again are extremely pleasant, while some, though very different in pitch, appear so alike, that we call them the same, only higher. It is found by experiment that two sounds are more or less *consonant*, when heard together, according as the relation between their vibrations is more or less simple. Thus, when two vibrations of the first are made in one vibration of the second (which is the simplest ratio possible, when the sounds are really different), that similarity is observed to which we have just alluded; the first sound is called the *octave* of the second, and both are denoted in music by the same letter. When the number of vibrations of the two are as 3 to 2, the one which vibrates three times while the other vibrates two, is called a *fifth* above the other; because in the musical scale of notes

𝄞 C D E F G A B C' D' &c.

the vibrations of C and G are in this proportion, and G is the *fifth* sound reckoned from C. If the ratio of the vibrations be that of 3 to 4, that is, if the higher note makes four vibrations, while the lower note makes three, which is the case with C and its *fourth* F; or that of 4 to 5, which happens with C and its *third* E; the combined effect of the two is agreeable. The same may be said of C and its *sixth* A, in which the ratio is that of 3 to 5, or of E and its *minor sixth* [MUSIC] C^1, in which the ratio is that of 5 to 8; or of E and its *minor third* G, in which the ratio is that of 5 to 6. We write underneath (Fig. 12) the common musical scale in the treble clef, with the denominations of the notes and the fraction of a vibration which is completed while the first C completes one vibration, which fraction is greater than unity, as the notes are rising. Thus while C vibrates once, D vibrates once and one-eighth; or 8 vibrations of C take place during 9 of those of D.

This is the musical scale pointed out by nature, since all nations have adopted it, or part of it at least. It fully verifies our assertion that the ear delights in the simplest combinations of vibrations. It would be hardly possible to place between 1 and 2, six increasing fractions whose numerators and denominators should, on the whole, contain smaller numbers. We find, in the six intermediate fractions, only 2, 3, 4, and 5 singly, or multiplied by one another, no product exceeding 15. Neither has the whole of this scale always been adopted. It seems to have been formerly universal to reject F and B, the *fourth* and *seventh* of the scale; as is proved by the oldest national airs of the orientals, the northern nations, and even of the Italians [SCALE].

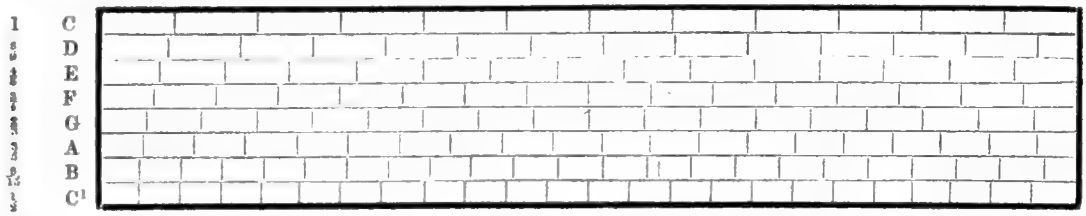
Fig. 12.



The following table will represent the proportions of the lengths of the sonorous waves which yield the preceding notes. These lengths decrease, as we have seen, as the *times* of vibration *decrease*, or as the numbers of vibrations in a given time increase.

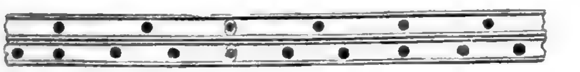
Now, let two of these notes be sounded together, for example, C and G, in which two waves of C are equivalent to three of G. The resulting wave is, as we have seen in the preceding part of this article, twice as long as the wave of C, and the curve which represents the condensation and velocity of the particles of air is compounded, as before described, of those of the waves of C and G. The ear is able to perceive three

Fig. 13.



distinct sounds, one of which is almost imperceptible, and indeed inaudible, unless carefully looked for. The two perceptible sounds are those of C and G from which the wave was made; nor are we well able to explain how this can be. Undoubtedly, if the curve, which is the type of the compound wave, were presented to a mathematician, he would be able, with consideration and measurement, to detect its elements; and to make that resolution which is done by the most unpractised ear. But we may, perhaps, assert that a savage, or a person totally unused to music, would not separate the sounds, but if C and G were sounded separately, and afterwards together, would imagine he had heard three distinct notes. The third sound, which is very faint indeed, is that belonging to the whole compound wave, which, being twice as long as the wave of C, belongs to the note called C, an octave below the first C of the preceding scale, which may be denoted by C^1. We may perhaps give an idea of this combination in the following way:—

Fig. 14.



Let us suppose a series of equidistant balls to roll past us at the rate of two in a second, and another series at the rate of three in a second,—and let us moreover suppose that these balls roll in tubes placed one over the other, so that we only see each as it passes an open orifice in its tube, as in Fig. 14. It is evident that we thus obtain three distinct successions: 1, that by which we might count 3 in a second from the lower tube; 2, that by which we might count 2 in a second from the upper tube; 3, that by which we might count single seconds, from observing when two balls pass together, and waiting till the same happens again. And we must recollect that any sound, however unmusical in itself, produces a musical note, if it be repeated regularly and often; so that it is not from the phenomenon itself, but from the frequency of its succession at equal intervals, that the pleasant sensation is derived. Thus in a passage, which has a strong echo, that is, where waves are reflected from wall to wall, as in the tube closed at both ends, already described, if the foot be struck against the ground, a faint musical note is heard immediately after the echo has ceased. By the action of the foot, shorter waves are excited, as well as the long wave, by the reflection of which the echo is caused. None of these would be repeated were it not for the reflection; but when the main sound is weakened by reflection, the shorter waves begin to produce the effect of a musical note, being, as we must suppose, less weakened than the longer wave. And we may here take occasion to observe, what will be further discussed in the articles PIPE and CHORD, that it is difficult to excite a perfectly simple wave, unaccompanied by shorter ones, which latter are always contained an exact number of times in the longer. Thus, if the note called C_1, or an octave below C in *fig.* 12, be struck on a piano-forte, the sounds G and E^1 (see the figure) will be distinctly heard as C becomes weaker, the waves of these notes being respectively one-third and one-fifth of those of C. When two notes are struck together, the effect is not pleasing, except when the numbers of waves per second in the two bear a very simple proportion.

We have noticed all the cases which the musicians call *concords*: the remainder, though contributing much to the effect of music, being called *discords*. Thus, if F and G be sounded together, in which (*fig.* 12) F makes $\frac{4}{3}$ of a vibration while G makes $\frac{3}{2}$, or F makes 8 vibrations while G makes 9, the effect is disagreeable, at least if continued for some time. On the piano-forte, in which the notes when struck subside into comparative weakness, this is not so much perceived; but on the organ, in which the notes are sustained, the effect is intolerable, and accompanied by an apparent shaking of the note, producing what are called *beats*, which we shall presently explain. Nevertheless, it becomes endurable, if not too long continued, provided F, the *discordant note*, as it is called, is allowed to pass to the nearest sound, which will make one of the more simple combinations of vibrations with G. The nearest such sound is E, which makes 5 vibrations, while G makes 6. For further information, we must here refer to the article HARMONY.

We now come to the absolute number of vibrations made by musical notes; all that we have said hitherto depending only upon the proportions which these numbers of vibrations have to one another; so that any sound might be called C, provided the sound produced by twice as many vibrations in a second were called C^1, and so on. From the measurements recorded in the 'Memoirs of the Academy of Berlin' for 1823, it appears that the middle A of the treble clef, or the A in *fig.* 12, was produced by the following numbers of waves per second in the following different orchestras, showing a *small* variation between them, but one by no means insensible to the ear:—

Theatre at Berlin	$437\frac{32}{100}$
Paris, French Opera	$431\frac{34}{100}$
— Comic Opera	$427\frac{61}{100}$
— Italian Opera	$424\frac{17}{100}$

From this we may form an idea how many vibrations are necessary to create the sensation of a musical sound, and also at what point of the scale the vibrations per second would become so numerous that this effect should cease. If we take one of Broadwood's largest pianofortes, and recollect that they are generally tuned (for private purposes) a little below the pitch of the orchestra, we shall not be far wrong in assuming that the A above-mentioned on these instruments is the effect of 420 vibrations per second. The lowest note, which is almost inappreciable (that is, though perfectly audible as a sound, yet hardly distinguishable from the notes nearest to it), is the fourth descending C from this A, and the highest is the third F above it, though the C above that, or the *fourth* ascending C from the A, can be well heard, and may be had by whistling into a very small key. We must, however, remark, that the point at which a series of undulations ceases to give a sound either from its slowness or rapidity, is different to different ears; sometimes so much so, that while one person complains of a note as too shrill, another cannot hear it at all. We write the above scale below, putting the A, whose vibrations we know, in its proper place,—

$$C_3 \quad C_2 \quad C_1 \quad C \quad A \quad C^1 \quad C^2 \quad C^3 \quad C^4.$$

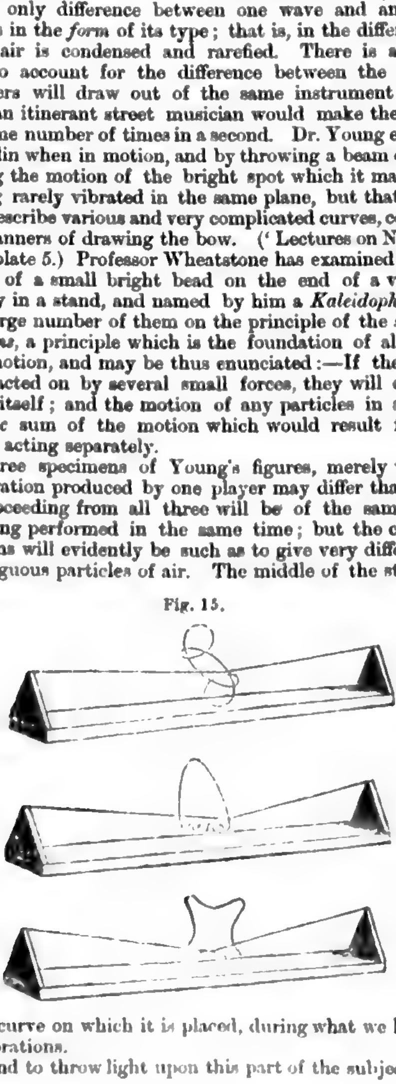
On looking at *fig.* 12, we see that A makes 5 vibrations, while C makes 3; that is, A making 420 vibrations per second, C makes 252; therefore, C_1 makes the half of this, or 126; C_2 makes 63, and C_3 $31\frac{1}{2}$. Again, C^1 makes twice as many vibrations per second as C, or 504; C^2 makes 1008, C^3 2016, and C^4 4032 vibrations per second. That is to say, in round numbers, the ear receives a musical impression from any sound which arises from a number of vibrations between 30 and 2000; and we may certainly say that, in every orchestra, the hearers are employed in distinguishing and discriminating between various rates of succession in the undulations of the air around them from 60 to 2000 per second.

We have previously alluded to a phenomenon of sound, or rather of combined sounds, called a *beat*. If two notes whose vibrations are either nearly in the same ratio, or nearly in one of the simple ratios above-mentioned, be sounded together, the effect of their being out of tune is a tremulous motion of the sound, the pulsations or beats of which can be counted if the notes be not too high. For example, suppose two simultaneous notes whose vibrations are 100 and 104 per second. Here 25 vibrations of the first are made during 26 of the second; and the reader who has studied the preceding part of this article will see that the resulting wave is as long as twenty-six of the second waves; but that if the waves from the two be much alike in their types, this resulting wave will consist of a cycle of rarefactions and condensations very much resembling the separate waves. The whole resulting wave being twenty-six times as long as the second wave, will run through all its changes *four* times in a second, which is not sufficient to give a musical sound, but will only add to the sound of one of the waves the periodical tremulous sensation which is called a beat, which may be imitated by ringing the syllables *who, ah*, in rapid succession on the same note of the voice. If, however, these *beats* recur at sufficiently short intervals to produce on the ear the impression of a continuous sound, a new note, called the *grave harmonic*, is heard, lower than either separately. For information as to the use made of these beats, see the article TEMPERAMENT.

It only remains to consider the different character of sounds. The same note, as to *pitch* or tone, may be sounded by a horn and a flute; nevertheless, each instrument has a character of its own, which enables every one to distinguish between the two. It is not to the different loudness of the two, for either, by skilful players, may be made to give the weaker sound; neither does it depend on the number of vibrations, for that, as we have seen, determines only the pitch of the note: the only difference between one wave and another of the same length, is in the *form* of its type; that is, in the different manner in which the air is condensed and rarefied. There is also only this feature left, to account for the difference between the tones which different players will draw out of the same instrument; since both Paganini and an itinerant street musician would make the same string vibrate the same number of times in a second. Dr. Young examined the string of a violin when in motion, and by throwing a beam of light upon it and marking the motion of the bright spot which it made, he found that the string rarely vibrated in the same plane, but that the middle point would describe various and very complicated curves, corresponding to different manners of drawing the bow. ('Lectures on Natural Philosophy,' vol. ii. plate 5.) Professor Wheatstone has examined these curves by the motion of a small bright bead on the end of a vibrating rod, fixed vertically in a stand, and named by him a *Kaleidophone*, and has calculated a large number of them on the principle of the *super-position of small motions*, a principle which is the foundation of all the science of vibratory motion, and may be thus enunciated:—If the particles of any body are acted on by several small forces, they will obey each, as if it acted by itself; and the motion of any particles in any direction is the *algebraic* sum of the motion which would result from the disturbing forces acting separately.

We give three specimens of Young's figures, merely to show how much the vibration produced by one player may differ that of another. The waves proceeding from all three will be of the same length, the vibrations being performed in the same time; but the condensations and rarefactions will evidently be such as to give very different relative states to contiguous particles of air. The middle of the stretched wire

Fig. 15.



describes the curve on which it is placed, during what we have hitherto called two vibrations.

It might tend to throw light upon this part of the subject if practical musicians would observe, in the same manner, the curves which they produce, and describe the different qualities of tone arising from them. As yet, we have no direct experiments which tend to connect any particular form of vibration with any particular quality of sound. We shall enter upon the best method of doing this in the article CHORD.

Some confusion arises in books on this subject, from the use which different authors make of the words *vibration* and *wave*. Some mean, by a vibration, a motion to and fro, while others call the same motion *two* vibrations; and by a wave, the complete succession of condensations and rarefactions, which others call *two* waves, one of condensation, the other of rarefaction. For further information, we refer the reader to Sir J. Herschel's article, already cited, to Robison's 'Mechanical Philosophy,' Biot's 'Précis Elémentaire de Physique,' and Pouillet's 'Traité de Physique.'

ACQUITTAL from the French *acquitter*, to free or discharge, signifies a deliverance or setting free of a person from a charge of guilt. One who, upon his trial for a criminal offence, is discharged by the jury, is said to be acquitted. The acquittal by the jury has, however, no force in law until judgment has been given upon the verdict by the court. After this judgment, if the party be indicted a second time for the same offence, he may plead his former acquittal in bar, as a complete answer to the second charge, by what is called a plea of *autrefois acquit*. Upon this plea being admitted or proved, the person indicted will be entitled to be discharged, as the law will not permit a man to be twice put in danger of punishment for the same offence.

ACQUITTANCE is a discharge in writing of a debt, or sum of money due. A general receipt or acquittance in full of all demands will discharge all debts, except such as are secured by what are termed specialties, viz. bonds and instruments under seal, which are considered by the law as of too great force to be discharged by a verbal concord and agreement, or any less formal and solemn acquittance than a deed. Where an acknowledgment of satisfaction is by deed, it may operate as a good answer to an action on the debt, even though nothing has ever been actually received.

Courts of equity, and even courts of law in some cases, will order accounts to be gone into anew, notwithstanding the production of a general acquittance or receipt in full of all demands, upon proof that such acquittance was obtained by fraud or given under a mistake, and that the debt or other demand has not been in fact satisfied.

ACRE, a measure of land, of different value in the different parts of the United Kingdom. When mentioned generally, the statute or English acre is to be understood. Its magnitude may be best referred to that of the square yard by recollecting that a square whose side is 22 yards long is the *tenth* part of an acre; whence the latter contains $22 \times 22 \times 10$, or 4840 square yards. The chain with which land is measured is 22 yards long; so that *ten* square chains are one acre. This measure is divided into 4 roods, each rood into 40 perches, so that each perch contains $30\frac{1}{4}$ square yards. Thus:—

Acre.		Rood.		Perch.		Square yards.	Side of equivalent squares in yards.
1	=	4	=	160	=	4840	69·5701
		1	=	40	=	1210	34·7851
				1	=	$30\frac{1}{4}$	5·5

The Irish acre is larger than the English, inasmuch as 100 Irish acres are very nearly equivalent to 162 English acres. More correctly, 121 Irish acres are 196 English acres; but the former ratio points out an easier arithmetical operation, and will not be wrong by so much as one acre out of 5000.

The Scottish acre is also larger than the English, 48 Scottish acres being equal to 61 English acres. There are also local acres in various parts of England, such as the Cheshire acre of 8 yards to the pole. The English statute acre is used in the United States of North America.

The French *Are* is a square whose side is 10 metres, and 1000 English acres are equivalent to 40,466 ares.

ACROLEINE ($C_6H_4O_2$), a substance obtained by the dehydration of glycerine ($C_6H_8O_6 = C_6H_4O_2 + 4HO$), and by the oxidation of allylic alcohol ($C_6H_6O_2 + O_2 = C_6H_4O_2 + 2HO$). It was obtained by Redtenbacher by the distillation of glycerine with phosphoric acid. The operation must be carried on in vessels charged with carbonic acid gas, as acroleine is rapidly oxidised in atmospheric air. It may be regarded as the hydride of a radical called *acryl*. This substance resembles acetyl, or othyl, and represents in acroleine the position of acetyl in acetic aldehyde. Thus, $H, C_6H_3O_2$ is the atomic constitution of acroleine, which when oxidised in the atmosphere becomes converted into *Acrylic acid*, $HO, C_6H_3O_3$, a substance perfectly analogous to acetic acid. Acroleine is often formed as a result of the distillation of oils and fats. Thus, castor-oil yields acroleine and some other peculiar products on distillation.

Acroleine is a limpid colourless liquid. Its vapours are intolerably pungent and suffocating (whence its name), attacking the eyes and respiratory organs most violently; a very minute quantity will produce this effect. The unpleasant, pungent smell of a blown-out candle when the wick is left in a state of ignition is due to a trace of this substance. Its sp. g. is less than that of water; it boils at 125°, and is soluble in 40 parts of water. Even in sealed vessels it cannot be long preserved, becoming converted either into a white, flocculent, inodorous powder called *diracryle*, which is insoluble in water, alkalies, acids, oils, and bisulphide of carbon; or into a resinous substance called *resin of diracryle*, which is soluble in alkalies, alcohol, or ether, but insoluble in water. Diracryle is probably isomeric with acroleine.

ACRO'NYCHAL (sometimes incorrectly written Acronical, and Achronical), a word derived from the Greek, signifying 'that which determines the extremities, or the beginning and end, of the night.' It is only used in reference to the rising or setting of the stars; and a star is acronychal or rises acronyeally when it rises at or very near sunset, and consequently sets at or near sunrise. To determine what stars rise acronychally on any given night, elevate the pole of a common globe so that the arc intercepted between it and the horizon may be equal to the latitude of the place. Turn the globe until the sun's place is on the horizon at the *western* side, then will all stars which are either on or within a short distance of the horizon on the *eastern* side be acronychal.

ACROSTIC, a Greek term, signifying literally the beginning of a line of verse. An acrostic is a number of verses so contrived that the first letters of each being read in the order in which they stand shall form some name or other word. According to some authorities, a writer named Porphyrius Optatianus, who flourished in the 4th century, has the credit of being the inventor of the acrostic. It is probably, however, of older date. Eusebius, the bishop of Cæsarea, who died in A.D. 340, gives in his 'Life of Constantine,' a copy of Greek verses which he asserts to be the composition of the Erythræan Sibyl, the initial letters of which make up the words ΙΗΣΟΥΣ ΧΡΙΣΤΟΣ ΘΕΟΥ ΥΙΟΣ ΣΩΤΗΡ, that is, 'Jesus Christ, the Son of God, the Saviour.' These verses, which are a description of the coming of the day of judgment, have also been translated into Latin hexameters, so as to preserve the acrostic in that language, in the words JESUS CHRISTUS DEI FILIUS SERVATOR. The translation, however, wants one of the wonderful qualities of the original; for it will be observed that the initial letters of the five Greek words being joined together, form the word ΙΧΘΥΣ, that is, 'the fish,' which St. Augustine, who quotes the verses in his work entitled 'De Civitate Dei,' informs us is to be understood as a mystical epithet of our Saviour, who lived in this abyss of mortality without contracting sin, in like manner as a fish exists in the midst of the sea without acquiring any flavour of salt from the salt water. This may be therefore called an acrostic within an acrostic. But there are also other ways of complicating these ingenious productions. Addison, who notices this along with other sorts of false wit, in his lively papers on that subject, in the first volume of the 'Spectator,' says, "there are compound acrostics, where the principal letters stand two or three deep. I have seen some of them where the verses have not only been edged by a name at each extremity, but have had the same name running down like a seam through the middle of the poem." There are even instances of the same name being five times repeated in so many successive columns. Such an acrostic has been designated a pentacrostic. This species of elaborate trifling was extremely fashionable among the early French poets, from the age of Francis I. down to that of Louis XIV. Some also of our English poets of considerable eminence used formerly to amuse themselves in the same way. Thus, for instance, among the works of Sir John Davies, are twenty-six short poems, entitled 'Hymns to Astræa,' each of which is an acrostic on the words Elizabetha Regina. These, which were first published about the end of the 16th century, are perhaps the most elegant compositions of this description in any language. Afterwards such puerile ingenuity fell into disrepute; and Dryden, in his 'Mac-Flecknoe' (published 1682), thus contemptuously makes the dying monarch of the realms of nonsense and dulness address his son and successor Shadwell:—

> "Leave writing plays, and choose for thy command
> Some peaceful province in acrostic land."

The acrostic, being addressed merely to the eye, and conveying no pleasure either to the imagination or to the ear, cannot of course add to the poetical effect of the lines which it ornaments—any more than would the printing of the initial letters in a differently coloured ink. But it is sometimes useful, as an aid to the memory, in recollecting such verses as are composed only to be got by heart, for the sake of the facts of which they form a summary. Thus, in some editions of the Latin dramatist Plautus, we find prefixed to each play a few verses which contain at the same time an acrostic on its name and a sketch of the plot. In this case, the knowledge of the initial letter of each line must help the memory to recover it, if it should be forgotten. There are two epigrams in the Greek Anthology, one in honour of Bacchus and the other of Apollo, which are called acrostics, though of a somewhat peculiar fashion. Each contains twenty-five verses, of which the first introduces the subject of the poem, and each of the twenty-four others consists of four words, which are epithets of the god: all the epithets in the first line begin with A, those in the second with B, and so on. These poems, therefore, are merely acrostics on the alphabet, four deep. The Jews sometimes employ a sort of acrostic in designating many of their writers. Thus the commentator on 'Maimonides,' Rabbi Yom Tof bar Abraham, is commonly called Ritba, from the initial letters of the five words composing his full title. (In the article entitled 'Literary Chronology,' in the 'Companion to the Almanac for 1832, many illustrations of this practice are given.') The initial syllables of the verses of the Psalms were anciently called acrostics. The following is a curious specimen of a Latin acrostic:—

S A T O R
A R E P O
T E N E T
O P E R A
R O T A S

ACROTE'RION (in Architecture), from the Greek Ακρωτηριον, 'the extremity of anything.' It is used technically to designate the pedestal which supports the statue or other ornament on the summit or upper angle, and is sometimes applied also to the similar ornaments over the feet, or lower angles, of a pediment; in the latter case they are all included under the plural *acroteria*. Some writers understand by this term also the statues which are placed upon the pedestals, but this use of the term is unsanctioned by any ancient authority. It may, however, with propriety be used much more extensively than has been the custom. The *finial* on the apex of a spire, pinnacle, or gable, in works of pointed architecture, is an acroterion; and in St. Paul's Cathedral in London, although the pediments over the entrance fronts have their acroteria, yet the acroterion of the edifice is the cross which surmounts the grand central part of the composition. This term is not found in many ancient authors; we derive it from Vitruvius, who uses it in the plural sense above-mentioned.

ACRYL. [ACROLEINE.]

ACRYLIC ACID. [ACROLEINE.]

ACT OF FAITH. [AUTO DA FÉ.]

ACT OF PARLIAMENT. [STATUTE.]

ACT. This word is a form of the Latin *actum*, from the verb *agere*, which is used generally to express the doing of any act whatever. *Actum verbum generale est sive verbis sive re quid agatur* (D. 50, 16, 19). The Latin word Actio, from which our word action is derived, had, among other significations, various legal meanings. Of these meanings one of the most common was the proceeding by which a man pursued a claim in a court of justice, who was accordingly in such case called the Actor. (D. 40, 12, 7 sub fin., and 'Cicero in Partit.' c. 32.) In this sense we have in our language the expression Action at Law. The word Act, a thing done, is sometimes used to express an act or proceeding of a public nature, of which sense the most signal instance among us is the term Act of Parliament, which means an act in which the three component parts of the sovereign power in this country, King, Lords, and Commons, unite; in other words, a Law properly so called. In this sense also, as expressing a proceeding of a public nature, it is used in our English Universities to signify the exercise by which a candidate for the higher degrees in Divinity, Law, and Medicine shows his proficiency. In scholastic phrase, "to keep an act" meant to perform publicly an exercise in Latin, accompanied with a Latin thesis. The word Act is also sometimes applied to denote the record of the Act, and by the expression Act of Parliament is now generally understood the record of an Act of the Parliament, or the written record of a Law. In the French language, also, the word *acte* denotes a written record of a legal act, the original document, which is either private, *acte sous seing privé*, which requires the acknowledgment of the parties in order to complete evidence (for the regulations affecting which, see 'Code Civil.' art. 1322, *et seq.*), or a public authenticated act, *acte authentique*, which, without such acknowledgment, is considered genuine and true, the probatio probata of that which it contains. ('Code Civil.' art. 1317.) This meaning of the word Act or Acts is derived from the Romans, among whom Acta signified the records of proceedings, and especially public registers and protocols in which the acts and decrees of the public bodies and functionaries were entered, as Acta Populi, Principum, Senatûs, Magistratuum. (Sueton. 'Julius Cæs.' c. 20.) The 'Acta Publica,' or 'Diurna' or 'Acta Urbis,' was a kind of Roman newspaper, or a species of public journal for all Rome (Cic. Attic. 6. 2. 6; Tacitus, 'Ann.' 13 c. 21), as opposed to the private journal (diurna) which, according to the old Roman love of order, each family had to keep. Augustus had one kept in his house, in which were entered the employments and occupations of the younger members of his family. Julius Cæsar established the practice of drawing up and publishing the Acta both of the senate and the people. (Suetonius, 'Julius Cæsar,' 20.) Augustus subsequently forbade the publication but not the drawing up of the Acta, and the practice of keeping such records continued, in some shape or other, even to the time of the Emperor Julian. Only a few fragments of them are extant. They are not unfrequently referred to as authorities by the Roman writers. (Sueton. 'Claudius,' c. 41.) These Acta were journals of the proceedings of the bodies to which they belonged, and of the chief events that took place in Rome. When Suetonius says ('Augustus,' 36) that Augustus forbade the publication of the Acta of the Senate, it must not be supposed, with some critics, that the Senatus Consulta are included in the Acta, for the business of writing and recording the former was a far more solemn and important one, as may be seen in Livy (iii. 517) and Suetonius ('Julius Cæsar,' 28, and 'Augustus,' 94.)

Under the Germanic Empire the term Acta Publica denoted the official transactions of the empire, decrees and the reports of the same, which were first collected under this title by Caspar Loedorpius (Frankfort, 1629), and his continuators.

The word Acta has been used in an analogous way in other instances in modern times. The 'Acta Sanctorum' denote generally all the old stories of the martyrs of the Church; and, specially, that large work begun in 1643 by the Jesuit Bolland, and continued by his successors to 1794, in 53 folio volumes, which contain such accounts. The 'Acta Eruditorum Lipsiensia' was the title of the first learned and critical review that was published in Germany, after the model of the French 'Journal des Savans,' and the Roman 'Giornale de' Litterati.' It was established in 1680, by Otto Mencken, a professor of Leipzig, and written in Latin. It was published monthly, and was continued for a century. Other journals of a like kind also adopted the name of Acta. The name of 'Transactions' is now given in England to the Acts of most learned and scientific bodies: the Acts of the Courts of Justice, so far as they are made public, are called 'Reports,' the 'Acta forensia' of the Romans, D. 26. 8. 21, while the proceedings of the courts as registered are called 'Records.'

(Rotteck and Welcker, *Staats-Lexicon*, art. by W.)

ACT (in the Drama), that portion of a play which is separated from the rest by an interval, during which the stage is left empty, and the action is supposed to proceed unseen by the spectators. In the Greek drama there were no acts; although in some modern editions, such as Burton's 'Pentalogia,' we find Greek plays thus divided. The language does not possess a word answering to the Latin and English 'Act.' Among the Greeks the stage was never left empty from the beginning to the end of the performance. When the other actors retired, those forming the chorus still remained, and continued the business of the play by their songs. For these songs, it is important to observe, were in general essential parts of the drama; they were not of the nature of a piece of music, or a dance, or any other extrinsic representation, thrown in merely to fill up a chasm in the action; they carried forward the action in the same manner as the ordinary dialogue did. For an exact copy of the form of a Greek drama in this respect, the English reader may be referred to the 'Sampson Agonistes' of Milton. In that play there is no division into acts; nor is there any such division in Buchanan's two Latin tragedies, entitled, 'Jephthes' and 'Baptistes,' which are also professedly composed upon the Greek model. The latter poet, we may add, has followed the same plan in his translations of the 'Medea' and the 'Alcestis' of Euripides. From this constitution of the Greek drama, it naturally followed, that the real duration of the action of any play could not well be supposed greatly to exceed that of its theatrical representation. In other words, what has been called the Unity of Time became a principle almost invariably observed in every dramatic composition. On the Roman stage there was no chorus, and the play was divided into acts, as on our own. But, although Plautus has frequently in his comedies supposed a considerable portion of time to pass between the close of one act and the opening of another, the most famous of the Latin dramatists, Terence, has not availed himself of this liberty, but has adhered closely to the practice of his Grecian models, in not permitting the interval between the acts to form more than a very short interruption of the progress of the story. By modern dramatists, however, the practice of dividing a play into acts has generally been taken advantatage of to extend the time of the story greatly beyond the space to which it was necessary to confine it on the Greek stage. Each act, in fact, is now what the Greeks would have called a separate drama, except that it does not contain a complete plot; and the whole play may be compared to those Trilogies of the Greeks, in which three dramas, representing so many successive separate parts of the same history, followed one another in one theatrical exhibition. Perhaps it was this consideration which made the Romans call each of the separate portions in question an Act or *Actus;* for that word is exactly a translation of the Greek δραμα, which was used to designate an entire play. The term, therefore, may be taken as, in its original and proper sense, denoting a distinct and, to a certain extent, independent theatrical action or picture, although capable also of being introduced as one of a series of such pictures, united by some common subject. And this is precisely what Shakspere must be understood to mean, when, in the famous speech which he puts into the mouth of Jaques, in 'As you like it,' comparing the world to a stage, he goes on to say, "One man in his time plays many parts, his *acts* being seven ages." The infant, the school-boy, &c., are acts only in the sense of being so many separate pictures or exhibitions of human life, each complete in itself, although following each other according to a natural order of succession, like the acts of a play. Viewed in this light, it will be perceived that the division into acts is really that distinction of the modern drama which, more than anything else, gives to it its peculiar character. Dr. Johnson has observed that, in modern plays, "The time required by the fable elapses, for the most part, between the acts; for of so much of the action as is represented, the real and poetical duration is the same. . . . . . The drama exhibits successive imitations of successive actions; and why may not the second imitation represent an action that happened years after the first, if it be so connected with it, that nothing but time can be supposed to intervene. Time is, of all modes of existence, most obsequious to the imagination; a lapse of years is as easily conceived as a lapse of hours." In the rude exhibitions of the English stage before Shakspere, the violation of the classical unities was startling to educated minds. Thus Sidney, in his 'Defence of Poesy,'—"Where the stage should always represent but one place, and the uttermost time presupposed in it should be, both by Aristotle's precept and common reason, but one day, there is both many days and many places inartificially imagined."

We may here remark, that although the French dramatic writers have adhered to the principle of leaving the stage empty only at the end of an act, many of the English have followed a different practice. In Shakspere particularly, every successive scene uniformly presents a new set of characters, and most commonly a change of place also. He rarely interrupts the action, however, for any considerable space, except during the interval between two acts; but here he does not hesitate to pass over any length of time he may find convenient. In the 'Winter's Tale,' Perdita, who was a new-born infant at the end of the third act, is grown up a young woman at the beginning of the fourth. In this instance, indeed, the dramatist introduces Time to explain and apologise for the license he had taken to

> ——————"Slide
> O'er sixteen years, and leave the growth untried
> Of that wide gap."

Time is here said to appear 'as Chorus;' and in the beginning of Henry V., Chorus is also brought forward to request the audience to allow their thoughts in the course of the representation to pass from one place to another;

> ——————"Jumping o'er times;
> Turning the accomplishment of many years
> Into an hour-glass."

Neither of these personages, however, performs exactly the office of the ancient Chorus.

We may add, that the old English Mysteries and Moralities, the first produce of our national dramatic genius, were long destitute of any division either into scenes or acts. The earliest of the Moralities which assume the regular dramatic shape, are not more ancient than the beginning of the reign of Elizabeth. Moralities continued to be both printed and acted long after this date. 'The Chester Mysteries' were performed in the year 1574. Down to this time there is every reason to believe that the scene never was changed from the beginning to the end of any stage-spectacle.

As for the Moralities, they were acted even in the reign of James I., and they are enumerated under the name of 'Morals' in the license granted to the company of which Shakspere was a member in 1603. But even several of our early tragedies and comedies, down to an era subsequent to this, were without any division into either scenes or acts. There is no such division in Preston's 'Cambises,' the play to which Shakspere is supposed to allude in 'Henry V.,' and which the author entitles 'A lamentable Tragedy mixed full of pleasant Mirth,' printed in 1561; nor in Peele's 'David and Bethsabe,' which appeared in 1579. In the tragedy of 'Soliman and Perseda,' 1599 (supposed to be by Kyd), there are acts, but not scenes; but there are neither one nor other in Dekker's 'Satiromastix, or the Trussing of the Humorous Poet,' nor in the comedy of the 'Wily Beguiled,' both of which appeared after the commencement of the 17th century, the latter so late as 1623.

Much discussion has taken place among the critics, on the reasons of the rule which restricts a regular dramatic composition to the extent of neither more nor less than five acts; and which Horace, in his 'Art of Poetry,' has laid down in a peremptory and well-known verse. Upon this subject the French writer, Marmontel, has delivered a very sensible judgment, the substance of which is, that the rule neither stands upon such a foundation as to constitute it an essential law, nor is it so unreasonable as to deserve to be banished from the theatre. The action must have its just extent given to it, and no more. The law of nature must be followed, which is superior to that of art.

ACT, in the universities, an exercise to be performed by students before they are admitted to their degrees. In the University of Oxford it has almost fallen into disuse, and in Dublin is a mere form; but at Cambridge it is still preserved as a preliminary test of the comparative merits of the candidates for the degree of Bachelor of Arts, who aspire to University honours. It is also performed by candidates for the degrees in law, physic, or divinity. The student proposes certain questions connected with his subject to the presiding officer of the *schools* (the place in which acts are kept), who thereupon nominates other students to oppose them. The discussion is carried on syllogistically and in Latin, and terminates by the presiding officer questioning the *respondent* or the person who is said to "keep the act," and his *opponents*, and dismissing them with a short compliment to each, in proportion to his deserts.

ACTA DIURNA (proceedings of the day) was the title of a gazette, to use the nearest modern term, drawn up and published daily at Rome, both under the republic and the empire. It appears to have contained an abstract of the proceedings of the public assemblies, of the law courts, of the punishment of offenders, an account of any public buildings or other works in progress, together with a list of births, deaths, marriages, and divorces, &c. In the very earliest times of Rome, provision was made under a religious sanction for the due registration of birth, assumption of the *toga virilis* (or dress of manhood), and death, accompanied by the payment of a certain fee into the respective treasuries of the goddesses Juno, Lucina, Juventas, and Venus Libitina. From the registers thus formed such extracts as were important might be made for publication. The law courts would furnish authority for the statement of divorces; and in this article of news there was no deficiency. Not a gazette appears, says Seneca, without its divorce, so that our matrons, from constantly hearing of them, soon learn to follow the example. The due supply of information on political and judicial affairs was to be obtained, as now, by reporters (*actuarii*). In the celebrated debate of the Roman Senate, upon the punishment of those who had been concerned in the Catilinarian Conspiracy, we find the first mention of short-hand writers, who were specially employed by Cicero to take down the speech of his friend Cato; and it is interesting to observe that this was the only speech of that extraordinary man which still existed in the age of Plutarch. But it must not be inferred, from this fact, that these reporters or any other persons were at liberty to publish an account of any proceedings in the senate. Until the first consulship of Julius Cæsar the senate was a close court. This great man, by a ludicrously distorted view of Roman history, has been generally represented as the destroyer of his country's liberties; yet he no sooner entered upon his office than he made provision for giving the same publicity to all the proceedings of the senate which already existed for the more popular assemblies; and this single act was perhaps the most fatal blow which Cæsar gave to the aristocratic interest. (Suetonius, 'Life of Julius Cæsar,' c. 20.) Under the despotism of Augustus such an institution was inconvenient, and therefore repealed. The *Acta* of the senate, though, of course, still registered, were no longer published; and, as all the popular assemblies were now deprived of real authority, the 'Acta Diurna' henceforward can have had little political interest. What disgraceful news they sometimes recorded, Suetonius tells us, in his 'Life of Caligula,' c. 36. Even in its best days this state-gazette was no doubt, an extremely meagre document,—conducted as it was on government authority, without the advantages of competition, and what is still more important, without the possibility of extensive circulation; for what could a newspaper have been before the art of printing was discovered? Yet, with all these disadvantages, the 'Acta Diurna' were often consulted and appealed to by the historians of after times, as documents of the highest authority, whilst in the Imperial times they were placed on an equality with the Fasti. "Sic enim in fastos Actaque publica relatum est," says Suetonius (Nero, 5). (For a more minute account, see Lipsius in his *Excursus on the Annals of Tacitus.* Lib. v. c. 4.)

ACTINO'METER (from ακτὶν, a sunbeam; and μετρον, a measure) is an instrument employed for the purpose of ascertaining the intensity of the heat of the direct rays of the sun. It consists of a hollow cylinder of glass, united at one end to a thermometer-tube, the latter being terminated at the upper extremity by a ball which is drawn to a point and broken off so as to leave a very small orifice, which is closed with wax: to this tube is applied a scale of equal parts. The other end of the cylinder is closed by a metal cap furnished with a silver screw, which turns tightly in a collar of leathers; the cylinder is filled with ammonia-sulphate of copper (a deep blue fluid), and the actual temperature of this fluid (on which its dilatability depends) is ascertained by an interior thermometer. The cylindrical portion, which acts as a bulb to the graduated stem, is inclosed in a box which is blackened within on three sides. The box has a thick glass in front, and the use of the screw is to diminish or increase the capacity of the cylinder. The instrument was invented by Sir John Herschel, who described it in the 'Edinburgh Journal of Science' for 1825. His objection to the indications of the thermometer as a means for indicating the heating power of the solar rays, is, that the various radiating effects of surrounding objects greatly interfere with the success of such observations, and that *time* ought to be considered as an element in the observations.

In making the observations with the actinometer, the instrument is disposed so that the sun may shine on its glass face, when the liquid will mount rapidly in the thermometer-tube. At the end of three or four minutes the extremity of the liquid is brought to the zero of the scale by turning the screw; after which, at the end of one minute, two minutes, and three minutes respectively, the observer registers the number of the graduation corresponding to the top of the column of fluid as it continues to rise. The instrument being then covered with a screen, three observations are made as before, at intervals of one minute, as the liquid descends in the tube. The instrument is again placed so that the sun may shine upon it, and afterwards in the shade, when two other sets of observations are made, and so on.

A mean of the two differences between the readings at two nearest observations while the sun was shining on the instrument, added to the difference between the readings at the intermediate observations while the instrument was in the shade, is taken as a measure of the intensity of the sun's radiation at the middle time between the first and third observations; and a mean of such results for all the triplets of observations is considered as the general mean.

The length of a degree on the thermometric scale is at present arbitrary, and the relative values of the degrees on the scales of different instruments are determined by comparing together the indications made in like circumstances. Sir J. Herschel proposed to establish, as a unit for the intensity of solar heat, that value which would, in one minute of time, dissolve a thickness equal to one millionth part of a mètre of a horizontal sheet of ice when the sun's light falls vertically upon it. This he calls an *actine;* and, from experiments made by him at the Cape of Good Hope, he determined the value of a degree on the scale of one of his actinometers to be equivalent to 6·093 actines.

The actinometer is useful in determining the quantity of solar heat which is absorbed in passing through different strata of the atmosphere, for which purpose the observations must be made at stations differently elevated above the general level of the earth or sea. It may also be employed to determine the diminution of heat which takes place during eclipses of the sun.

The reader interested in the subject, will find full details respecting this instrument in the 'Manual of Scientific Enquiry," published by the Board of Admiralty.

ACTION is a Roman term (*actio*), and signifies the legal process by which a man claims possession of some specific thing to which he has a right, or requires another to do something which he has agreed to do, or to make pecuniary compensation for neglecting to do it; or by which he claims pecuniary satisfaction for the illegal act of another to his person or property. It is necessary here to notice briefly that celebrated division of Roman Actions, viz., those *in rem* (*vindicationes*), and those *in personam*, generally termed *condictiones*, though this word is strictly applicable to such actions as arose from unilateral transactions, and were brought for the recovery of property.

The Roman *Actio in Rem* was the action in which a man claimed a thing from another as his property, or some use of a thing; and the action might be against any person who disputed his right. To this class belonged all those actions which by their nature could, as a general rule, be instituted *by* a person merely by virtue of some right vested in him *against* any one who disputed or obstructed such right, and *for* the purpose of compelling him to respect it. On the other hand, the Roman *Actio in Personam* was against some determinate person, who made himself liable to the action by not performing his contract, or by doing some illegal act to another man's person or his property, (Gaius iv. 1; 'Instit.' iv. tit. 6); and all these personal actions presupposed circumstances giving rise to some special duty in the defendant. The distinction between the two, however, is more clearly shown in the mode in which the demandant asserted his right, for in the *actio in rem* he stated it in general terms, without the name of any defendant being given (*e. g.*, "Si paret, fundum ex-jure Quiritium Titii esse"). In the *actio in personam* the defendant was individually pointed out ("Si paret Numerium Negidium . . . . . dare oportere"). What were called interdicts in the Roman law, may also be referred to the class of actions *in personam;* but the term *interdictum*, when considered in opposition to *actio*, denoted a kind of action in which the procedure might be more quick and summary than the *actio*. The right of action is nothing more than the right actively to exercise, with the aid of a judge, that power of compelling the performance of, or forbearance from, some positive act with which every right is accompanied, as expressed in the maxim, "Ubi Jus ibi remedium," and in the Roman definition of 'action,' "Nihil aliud quam jus persequendi in judicio quod sibi debetur" (J. 4, 6 pr.)

The English division of actions bears some analogy to the Roman division, but it is much less clearly conceived.

ACTION AT LAW is the proceeding for recovery, through the intervention of the law, of that which is legally due: it has been defined to be "a lawful demand of one's right;" or "the right of a man to prosecute by judicial proceeding that which is his due." The general object of every action is thus to put one party in possession of a right of which he has been injuriously deprived by another. This may be effected, where lands or goods are wrongfully withheld, by the actual delivery of them to the proprietor. In the case of assaults, slander, breaches of contract, or other personal wrongs, the only remedy is to award to the sufferer pecuniary compensation for the injury. For one and all of these purposes the law of England appoints specific forms, by which alone can be obtained those legal remedies, which the law affords the injured party in the infinite variety of disputes and controversies that arise between individuals. Where the wrong is of such a nature that there is detriment to the public as well as injury to the individual, it becomes the subject of a criminal prosecution. For those wrongs in general done by one individual to another, which do not amount to legal crimes, the proper remedy is by action at law. It is true, that in some cases the legal remedy is insufficient, and that the injured party, to obtain proper redress must resort to a suit in Chancery. But the circumstances in which these courts (which administer that branch of our law called equity) must be applied to will be more appropriately considered under another head. [EQUITY.]

Actions in England are usually divided into three kinds, according to the subjects of them; namely, real, personal, and mixed.

Real Actions are so called because they exclusively refer to real property, or subjects connected with land. The word *real* here signifies that the action is in respect of a thing (*res*). In the Roman jurisprudence the expression *in rem* did not mean that the action was in respect of a thing (*res*), but it was a technical mode of expressing the generality of the action, as opposed to *in personam*, which had reference to a particular person or persons. Real actions, then, are brought for the recovery of lands, advowsons, or other hereditaments. They were, in the earlier periods of our history, of constant occurrence; and our ancient books of reports are principally occupied with cases of pleas of land, which, before this country had attained to commercial importance, was the most valuable species of property, and, consequently, the most fruitful source of litigation. From the nicety and inconvenient length of the process, they were almost discontinued, when the action of ejectment was by statute made the only mode of trying title, except in the case of dower to a wife, and a disputed right to the exercise of ecclesiastical patronage. (3 & 4 Wm. IV. c. 27.)

Personal Actions are by far the most numerous class of actions. It is by them that differences respecting debts, promises, and contracts, are settled; and that compensation is sought for personal insults and injuries of almost every description, including even some of the minor crimes and misdemeanours, which are punishable both as crimes and as civil injuries.

Mixed Actions partook of the nature of both, being brought for the recovery of lands, and also for damages,—either for some injury done to the land, or some other wrong, such as the illegal detention of it from the owner.

All real and mixed actions were abolished by 3 & 4 Wm. IV. c. 27, except Right of Dower, Dower, Quare impedit, and Ejectment. The two former are brought by a wife for recovery of her dower; by the third, the right to present to a benefice is tried; and by the fourth, the title to real property is ascertained. The action of Ejectment thus preserved was, however, strictly an Action of Trespass. By the 'Common Law Procedure Act, 1852,' Ejectment, the forms of which have been reconstructed, regains the appearance of a real action.

Personal actions are founded either on contracts or on torts (a term used to signify such wrongs as are distinguishable from breaches of contract), and these torts are usually considered as of three kinds: nonfeazance, or the omission of some act which one is bound to do; misfeazance, or the improper performance of some act which he may do; malfeazance, or the commission of some act which is unlawful. Actions founded on contract are sometimes described as actions *ex contractu*, and those on tort as actions *ex delicto;* a division which, as well as the terms used to express it, is derived from the Roman law ('obligationes ex contractu,' 'obligationes ex delicto:' Gaius, iii. 182).

Actions are either local or transitory: local actions are founded on such causes of action as refer to some particular locality, as in the case of trespass to land; transitory actions are such causes of action as may be supposed to take place any where, as in the case of trespass to goods, assaults, and the like. Real actions are in their nature local; personal actions for the most part transitory. Local actions must be tried in the county where the cause of action arose, and by a jury of that county: transitory actions may be tried in any county, (in general at the pleasure of the plaintiff). When an injury is committed out of England, and its nature is such as to make the action local, no action will lie for its redress in any English court; but if the nature of the injury is such that the action is transitory, such action will lie in the English courts. When the cause of action arose abroad, in a transitory action it was formerly necessary to have recourse to a legal fiction, and to allege that it arose in an English county. This was necessary, because every action must be tried *theoretically* by a jury of the county where the cause of it arose; and hence the fiction, alleging, for instance, an assault in Majorca, "*to wit; in the Ward of Cheap, in the City of London.*" This fiction is now abolished, but the plaintiff in every declaration must specify in the margin, some English county as that in which he intends that the cause should be tried.

As to actions generally, it is to be observed as generally true that the right of action is not assignable, so as to enable the assignee to sue at law in his own name; but in certain cases it is transferred by operation of law. Thus the rights of action of a bankrupt or insolvent pass (with certain exceptions) to the assignees; and upon the death of either of the parties between whom there is a cause of action, the right of maintaining such action survives in general to or against the executors or administrators.

In respect to suits which are more strictly personal, that is, affect only the person, as in the case of an action for slander, the maxim is that they die with the person. By the Common Law this extended to every case of tort; but it is now no longer the rule as regards torts committed in respect of property. The 4 Edw. III. c. 7, empowers executors or administrators to maintain an action for trespass to the goods of the testator or intestate; and by 3 & 4 Wm. IV. c. 42, executors or administrators may maintain an action of trespass for any injury to the real estate of the deceased, which was committed six calendar months before his death, provided the action is brought within one year after his death. The same action may also be maintained against executors or administrators for any injury done by the deceased to the real or personal property of another, if it was done within six calendar months before his death, and the action is brought within six calendar months after the executors and administrators have assumed office. The 9 & 10 Vict. c. 93, also allows an action for damages to be brought by the executor or administrator of a person whose death has been caused by the wrongful act, neglect, or default of another, if the act, neglect, or default would have intitled the party injured to maintain an action if death had not ensued. At Common Law, no such suit was maintainable. By the statute, it is to be for the benefit of the husband, wife, parent, or child of the deceased.

The regular parts of an action at law, that is to say of a personal action, are: 1. the Process, or those proceedings which have for their object the compelling of the defendant to appear; that is, to admit that he has a general intimation of the suit, and is ready to receive more particular notice of its ground and object. This is done by writ of summons served personally on the defendant. 2. the Pleadings, consisting of the *declaration*, in which the plaintiff fully sets out his grievances, the *pleas* on which the defendant answers the declaration by contradicting the allegations contained in it; asserting his own right, or justifying his conduct: to this the plaintiff may reply; and thus the parties may continue to altercate, in legal language, until material questions are distinctly asserted by one party and denied by the other. 3. the Trial, where the questions for decision which are called the *issues* are tried by the jury (or in some rare cases by a judge or the court), who after hearing the *evidence* of both parties, give their *verdict* either for the plaintiff or defendant. 4. the Judgment, which in pursuance of this verdict is pronounced by the court to which the proceeding belongs. 5. the Execution, issued by the court against the person or goods of the unsuccessful litigant, unless there be, 6. an Appeal, by error being brought on the judgment, which ends only in the judgment of the House of Lords.

It ought to be mentioned, that formerly, in all actions of debt, the plaintiff might commence by arresting the defendant where the debt amounted to 20*l*. Arrest on mesne process is now abolished. [ARREST.]

(For further particulars see *Blackstone's Commentaries*, Mr. KERR's ed. v. iii. *passim;* Jacob's *Law Dictionary*. See also as to real actions, DOWER; EJECTMENT; QUARE IMPEDIT.)

ACTION UPON THE CASE. [CASE, ACTION UPON THE.]

ACTION AND RE-ACTION. [MOTION, LAWS OF.]

ACTION, LEAST PRINCIPLE OF, is a name given by Lagrange to a law of motion which he has thus enunciated:—In a system of moving bodies, the sum of the products of the masses of the bodies by the integral of the products of the velocities and the elements of the spaces passed over, is constantly a maximum or a minimum.

The principle, in a limited sense, originated with Maupertuis, who, in the 'Mémoires de l'Académie des Sciences de Paris,' for 1740, designating it the 'Law of Rest,' states that when bodies in motion act upon one another, the sum of the products of the masses by the velocities, and by the spaces described, is a minimum; and from this principle he deduced the laws of the reflexion and refraction of light, and of the collision of bodies. Euler also, in his 'Traité des Isopérimètres' (Lausanne, 1744), showed that when isolated bodies describe curvilinear paths by the action of central forces, the integral of the product arising from the multiplication of the element of the curve by the velocity is always a maximum or a minimum. But the generality of the principle was established by Lagrange, who has extended it to the motion of a system of rigid bodies acting upon one another in any manner whatever; and his first applications of it to the solution of dynamical propositions are contained in the second volume of the 'Mémoires de l'Académie, &c., de Turin.'

The analytical expression of the principle is that $\Sigma m\int vds$, or $\int\Sigma mvds$, is a maximum or a minimum, and consequently that the infinitely small variation of that quantity is zero. It would be more correct to say that the variation is zero, whence, except in peculiar cases, the formula called the *action* is a maximum or a minimum. (Here m is the mass of a body, v its velocity, and ds the element of the space passed over.) But $ds = vdt$ (dt being the element of time;) therefore, $\int\Sigma mvds$ is equivalent to $\int\Sigma mv^2dt$. Now, Σmv^2 is the expression for the active or living force of a finite number of rigid bodies or molecules [VIS VIVA]; and it follows that the principle of 'least action' is the equivalent of the expression that the integral of the product of the vis viva of a system by the element of time, is in general a minimum.

The truth of the 'Principle of least action' may be readily proved from the general dynamical equation [VIRTUAL VELOCITIES], the sum of the terms containing X, Y, and Z, being made equivalent to $\delta(\frac{1}{2}\Sigma m.v^2)$, or to $\Sigma mv\delta v$, conformably to what is shown in the article just quoted; and the whole being transformed agreeably to the process used in the 'Mécanique Analytique' (sect. iii. No. 39). It will be needless, however, to give the details, since, as is observed by Poisson, the use of the principle is only to serve as a rule for forming the differential equations of motion, and these may be obtained at once from the General Equation to which reference has been made above. We have thus given what is sufficient, with reference to the *name* of this principle. But we warn the student that he must look for further explanation in full treatises: all that we say in so brief a space abounds with possibilities of misconception. On the physical view of the principle there are some instructive remarks in Nichol's *Cyclopædia of the Physical Sciences.*

ACTIVE OR LIVING FORCES. [VIS VIVA.]

ACTON BURNEL, STATUTE OF. This statute was passed at Acton Burnel, in Shropshire, at a Parliament held by Edward I., on his return from Wales. Acton Burnel was never even a market-town, and Leland says ('Itin.' vii. 19), that the Parliament was held in a great barn. The truth is, however, that it was held in the great hall of the castle of the Lord Chancellor Burnel, the author, no doubt, of this statute, and also of the 'Statute of Westminster the First,' passed in 1275. Its date is October 12, 1283.

The preamble reciting that merchants "be greatly impoverished because there is no speedy law provided for them to have recovery of their debts at the day of payment assigned;" enables a creditor to bring his debtor before the mayor of London, York, or Bristol, or before the mayor and a clerk appointed by the king to acknowledge the debt, and fix a time for payment. If the debtor neglected to pay his debt at the time appointed, the mayor ordered his chattels and devisable burgages to be sold, to the amount of the debt, by the appraisement of honest men; the moveables being to be delivered to the creditor if no buyer came forward. The most minute directions are given as to the mode of making and recording the acknowledgment, and levying the debt, if unpaid, by execution. If the debtor had no effects, he was to be imprisoned until he or his friends had come to some agreement with the creditor; and the creditor was bound to provide him with bread and water, if he were so poor as to be unable to support himself: but the cost of his maintenance was added to the original debt, and was required to be repaid before the debtor could obtain his release. The creditor might accept sureties or mainpernors, who by this act placed themselves precisely in the same situation as the debtor; but they were not liable till the goods of the principal had been sold and found insufficient.

The Statute of Acton Burnel was further explained, and new provisions added by 13 Edw. I., st. 3, passed in 1285, and called the 'Statutum Mercatorum.' If the debtor failed to make good his payment at the time, he was, if a layman, to be placed at once in prison. If he could not be found, the merchant might have writs to all the sheriffs in whose jurisdiction the debtor had lands; and as a last resource the merchant might have a writ to take the debtor's body. The keeper of the prison became answerable for the debt if he refused to take custody of the debtor. Within a quarter of a year, the chattels and lands were to be delivered to the creditor for sale in payment of his debt. If within the second quarter he did not make terms, all his goods and lands were to be delivered, the latter as if a gift of freehold, to the creditor, to hold until the debt was paid; the debtor being maintained on bread and water by the merchant. Precautions were taken against the debtor fraudulently making over his property. Lands given away by feoffment subsequently to the recognisances were to return to the feoffer. The death of the debtor did not bar the debt; for though the body of the heir could not be taken, his lands were answerable as much as during the lifetime of the debtor. Jews were excluded from the benefits of the statute. ('Stat. of Realm.' i. 98.)

Reeves ('Hist. of the English Law," ii. 162) observes that the above statute may be "considered as contributing to extend the power of alienating land." Any common creditor by judgment was empowered by the Statute of West. 2, to take half the debtor's land in execution, "but a merchant who had resorted to this security might have the whole." He adds that "a recognisance acknowledged with the formalities [here] described was in after times called a statute merchant;" and "a person who held lands in execution for payment of his debt, as hereby directed, was called tenant by statute merchant." Barrington ('Obs. on the more Ancient Statutes,' p. 119), states that in 1536 an ordinance of Francis I. was issued, which very much resembled the statutes merchant, and shows, he says, "the more early attention paid to commerce in this country."

It need scarcely be added that the Statute of Acton Burnel has long been practically obsolete.

ACTS OF SEDERUNT, in the law of Scotland, are rules made by the Lords of Council and Session, the Judges of the Court of Session, by virtue of Acts of Parliament for regulating the procedure and forms of administering justice. These are called Acts of Sederunt because they are made by the Lords of Session *sitting* in judgment.

ACTS OF THE APOSTLES. The authenticity of this book has not been doubted; it constitutes the second part of the Gospel according to St. Luke, which he dedicated to Theophilus (Luke i. 1; Acts i. 1). The Acts belong to the *Homologoumena*, or those canonical books which were by all parties recognised as genuine (Euseb., 'Hist. Ecclesiastica,' iii. 25). The Severians (Euseb., 'Hist. Eccles.,' iv. 29) and the Manichæans (Augustin. 'Epist.' 23) acknowledged the authenticity of the Acts, although they rejected, for doctrinal reasons, their authority. Although the authenticity of the Acts was well established, they were less read among the lower classes; and accordingly Chrysostomus, at the end of the 4th century, wrote at the commencement of his 'Commentary to the Acts,' "Many do not know even the existence of this little book, nor him who wrote and composed it."

The time at which St. Luke wrote the Acts may be gathered from the following circumstances:—The arrival of St. Paul in Rome took place in the spring of about the year A.D. 63. St. Paul, in his Epistles to the Colossians (iv. 14), to Timothy (2nd ep. iv. 11), Philemon (ver. 24), testifies to St. Luke being with him in Rome; and as this arrival is mentioned in the Acts, they must have been written after the year 63; and since the death of St. Paul, about the year 68 or 69, is not mentioned by St. Luke, the Acts were probably composed and circulated before this date. Theophilus, to whom the Acts were dedicated, may be considered as the representative of the inquiring heathen; consequently, it was proper that the Acts should be written, as they are, in the Greek language; and the style, like that of the Gospel of St. Luke, is much purer than most of the other writers in the New Testament, the few Hebraisms generally occurring in the reproduced speeches of some of his introduced personages.

The explanations and commentaries on the Acts of the Apostles are numerous from the times of the early fathers and in foreign languages, particularly the German. In England, all the commentators have bestowed much attention on this portion of the New Testament; and Paley subjected it to a searching examination in his 'Horæ Paulinæ,' in connection with Paul's Epistles, a labour which has been successfully continued by the Rev. W. J. Conybeare, M.A., and the Rev. J. Howson, in the 'Life and Epistles of St. Paul,' of which a second edition was published in 1856. For the dates of the recorded events there is a variance of opinions. Those of Mr. Greswell ('Dissertations,' &c., 1837), and Dr. Anger ('De Temporis in Actis App. Ratione,' Lips., 1833) are probably as close an approximation to correctness as can be made; the two very nearly agree, and their difference with Usher, Pearson, Michaelis, and others is, that Mr. Greswell fixes the Ascension in the year A.D. 30, while most of the others give the date as A.D. 33; that he assigns the stoning of Stephen, the conversion of St. Paul, and the first journey of St. Paul to Rome, to A.D. 27, 38, and 41 respectively, while the others give A.D. 34, 35, and 38,—the latter appearing to be more consistent with the data afforded by St. Paul himself in Gal. ii. as compared with Acts xi. 12. The other assigned dates are—St. Paul's second journey to Jerusalem, A.D. 44; the third journey (Acts xv.), A.D. 48; his arrival at Corinth, A.D. 52; fourth journey to Jerusalem (Acts xviii.), A.D. 54; his abode at Ephesus, A.D. 53—55; fifth journey to Jerusalem (Acts xxi.), A.D. 56; arrival at Rome, A.D. 61.

Messrs. Conybeare and Howson differ slightly from this, fixing the conversion of St. Paul in A.D. 36, his first journey to Jerusalem in A.D. 38, and the second in A.D. 45; but they all agree in fixing the visit in the year of the famine. The date of the fifth journey to Jerusalem also is given by these gentlemen as A.D. 58 instead of A.D. 56.

It may be worth mentioning, that the title of the book is an arbitrarily and not happily imposed one; the Acts of the Apostles are confined to those of Peter and of Paul, of the martyrdom of James, with a slight mention of the writer. The book was probably interrupted by the death of the writer, as it terminates abruptly, and records the death of neither of the principal personages.

ACTUARY, a word generally used to signify the manager of a joint-stock company under a board of directors, particularly of an insurance company: whence it has come to stand generally for a person skilled in the doctrine of life annuities and insurances, and who is in the habit of giving opinions upon cases of annuities, reversions, &c. Most of those called actuaries combine both the public and private part of the character. The actuaries now form by themselves a separate profession.

The name has acquired a legal character since it was recognised in the Friendly Societies Act of 1819, which enacted that no tables were to be adopted in any Friendly Society, unless the same should have been approved by "two persons, at the least, known to be professional actuaries, or persons skilled in calculation." The Committee on Friendly Societies of 1825 reported that "petty schoolmasters or accountants, whose opinion upon the probability of sickness and the duration of life is not to be depended upon," had been consulted under this title, and recommended that the actuary of the National Debt Office should be the only recognised authority for the purposes above-mentioned, in which recommendation the Committee of 1827 joined. The 10 Geo. IV, c. 56, made no alteration, but by the 9 & 10 Vict. c. 27, the power of certifying tables is confined to the actuary of the National Debt Office, or an actuary of not less than five years' standing in some public insurance company.

The registrar of the Lower House of Convocation is called the actuary. Bishop Gibson says that he is an officer of the archbishop, the president of the convocation, and cites as follows, from the fees established by Archbishop Whitgift (1583-1603) for the vicar-general's office: "Feoda Actuario Domus Inferioris Convocationis solvenda." (Gibson's *Synodus Anglicana*, 1702.)

The word actuary is from the Roman *actuarius*, which was used in various senses, but its earlier and more common meaning was short-hand writer.

ACUPUNCTURE, a term used to denote the insertion of a needle into the skin or flesh. Acupuncture is an operation which has been long in use in eastern countries, and which appears to have been adopted there from the notion that several diseases attended with severe pain arise from air or vapour pent up in the body, to which a puncture with a needle affords an outlet, and thereby removes the malady. Europeans travelling in those countries several times witnessed the practice, and were struck with the results; but either their reports were not credited, or the operation appeared to the physicians and surgeons of Europe so unpromising, that upwards of a century elapsed after the knowledge of it was familiar to many European practitioners before a single trial of it was made. As long back as the year 1679, a medical officer in the East India Company's service states that a guard of the Emperor of Japan, appointed to conduct the English to the palace, was seized with violent pain of the abdomen, attended with vomiting, in consequence of having drunk a quantity of iced water when heated. After trying in vain to relieve his complaint by taking wine and ginger, and conceiving that his suffering arose from air or vapour pent up in the walls of the abdomen, to which vapour the insertion of needles into the skin would afford an exit, he underwent the operation of acupuncture in the presence of the narrator, which was performed in the following manner:—He laid himself upon his back, placed the point of a needle upon his abdomen, struck its head with a hammer once or twice to make it pass through the skin, turned it round between the forefinger and thumb till it entered to the depth of an inch, and then, after about thirty respirations, withdrew it, and pressed the puncture with his fingers to force out the imaginary vapour. After having made four such punctures, he was instantly relieved, and got well. Some years afterwards, a physician, who accompanied a Dutch embassy to Japan, confirmed this account, by the statement that the Japanese are in the constant habit of performing this operation in various disorders attended with acute pain, and that he himself frequently witnessed the instantaneous cessation of the pain as if by enchantment. No further notice appears to have been taken of this mode of treatment in Europe for upwards of a century, when it was alluded to by the celebrated Vicq-d'Azyr in the 'Encyclopédie Méthodique,' merely for the purpose of congratulating the world that the statements of Ten Rhyne and Kæmpfer, the physicians who had given the first accounts of it, had not induced any European physician or surgeon to practise it. In the year 1810, however, some trials of it were made by Dr. Berlioz, a physician of Paris, who found, or fancied he found, it so efficacious a remedy, that he was induced to employ it very extensively, and many French practitioners imitated his example with the same apparent results. It has been subsequently tried in England, and sufficient experience of it has now been obtained to prove that the operation itself is attended with little or no pain, and that it may be employed at least with safety, if not with advantage.

There are two cases in which it seems likely to be beneficial,—first, in painful local affections unattended with change of structure in the part diseased, and without local inflammation or general fever,—and, secondly, in that species of dropsy termed anasarca, in which the water is accumulated in the cells of the cellular membrane that lies immediately beneath the skin. It is probable that all the cases of the first class consist of disordered states of the nerves of the parts affected [NEURALGIA]. There cannot be a question that this remedy has proved beneficial in cases of this kind sufficiently often to warrant the trial of it, whenever these disorders do not yield to the ordinary modes of treatment; and under these circumstances there is the greater reason for resorting to it, since the operation occasions no pain, and since no evil consequence of any kind has ever been known to result from it. But if the part affected be inflamed, and more especially if there be any degree of febrile action in the system, the acupuncture of the part will certainly do no good, and will very likely produce mischief.

In anasarca a few punctures made with the needle will allow a ready exit to the fluid, which may continue to drain during several days in succession; and when this is the case, it invariably affords relief, and sometimes saves, and oftener prolongs, life. Scarification is a remedy of the same kind in ordinary use, but the inflammation that results from this practice is sometimes severe, and occasionally runs into mortification. Acupuncture is affirmed by many who have made trial of it to be equally effectual, and to be much less apt to be attended with these evil consequences.

The needles employed in oriental countries are always made of the purest gold or silver; those of gold are preferred, and great care is taken to obtain them well tempered. In China their manufacture is a distinct occupation, understood by few, and those few are licensed by the emperor. Some of these needles are fine, about four inches in length, with a spiral handle, for the purpose of more easily turning them, and are kept by means of a ring, or a piece of silk thread, in grooves, each capable of holding one needle: the grooves are formed in each side of a hammer, usually made of the polished horn of the wild ox, ivory, ebony, or some other hard wood; the hammer is rather longer than the needle, and has a roundish head, covered on the side that strikes with a piece of leather, and rendered heavier by a little lead within. The needles employed in Europe are of steel, long and fine, and furnished either with a nob of sealing-wax at their head, or, what is more convenient, a little handle of ivory or wood, screwing into a sheath for the needle. They are best introduced by a slight pressure, and a semi-rotating motion, between the thumb and forefinger, and withdrawn with the same motion. In cases of neuralgic pain the needle should be allowed to remain in from a quarter of an hour to two hours. It would appear, that in cases of this kind, a number of needles introduced, and hastily withdrawn, is not as effectual as the introduction of a single needle that is allowed to remain for the space of a couple of hours. When the only object is to afford an exit to the fluid collected in anasarca, of course the mere puncture is sufficient; there is no use in allowing the needle to remain.

A modification of this operation has been recently proposed in cases of neuralgia. A tubular needle, connected with a syringe, is introduced into that part of the course of the diseased nerve which is most painful on pressure, and a weak solution of morphia is injected into the tissues. In many cases this has been followed with instantaneous relief. It requires, however, care, as, in some cases, profound narcotism has been induced.

AD LIBITUM, Latin, or *ad lib.* in music, denotes that the performer is at liberty to pause, or to introduce any cadence or addition of his own, according to his judgment. An accompaniment is said to be *ad libitum*, when it is not essential, and may be either used or omitted as circumstances may require, without materially affecting the composition.

ADA'GIO, in Music, an Italian adverb, signifying *slowly, leisurely,* and used to indicate the slowest movement in music. It has long been the custom to point out the quickness or slowness, as also the manner or character, of a piece of music, by some Italian word, placed at the beginning of the composition. These are sometimes very inadequate to the purpose, and much is commonly left to the judgment of the performer. The use of the metronome [METRONOME], fixes the intention of the composer as regards movement, that is to say, quickness or slowness. With respect to style, to the passion meant to be expressed, much must still depend on the taste and intelligence of those to whom the execution of a work is intrusted.

The five principal terms denoting the degrees of motion, beginning from the slowest and proceeding to the quickest, are—*Adagio*, very slow; *Largo*, slow; *Andante*, a moderate time; *Allegro*, quick; *Presto*, very quick. Other terms relating to slowness or quickness are but modifications of the above.

These words are also used substantively: thus we say, an 'Adagio' of Haydn; an 'Andante' of Mozart, &c.

ADAR, the twelfth month of the Hebrew year. (Esther, iii. 7.) The name of this month is Chaldee, and does not occur in the earlier books of the Bible, where the months are usually designated by their numerical order.

In the Jewish calendar, Adar is the sixth month. In ecclesiastical computations, it is still the last of the year. As the year being composed of twelve lunar months is shorter by about eleven days than a true year, an additional month is periodically inserted after Adar, and is called Ve-Adar, or another Adar. This intercalation occurs seven times in nineteen years.

Adar may begin as early as the 1st of February, or as late as the 3rd of March. In years of twelve months, there are twenty days in Adar; in those of thirteen months, there are thirty days in the month. A fast is observed by some Jews in memory of the death of Moses, on the 7th day of the month; another, on the 9th, for the schism in the schools of Shammai and Hillel. On the 13th day of the month, the Fast of Esther is kept by the whole Jewish nation. This fast is said to have been instituted in memory of the intended destruction of the Jews in the Persian empire on that day. (Esther, iii. 13.) If the 13th day should be a Saturday, the Fast of Esther is celebrated on the preceding Thursday: all other fasts (except the Great Fast of Expiation, which is never postponed) are, in similar cases, held on the Sunday following. The feast of Purim, which lasts two days, belongs to the 14th and 15th of the month, in memory of the defeat of the plans laid for destroying the Jews. (Esther, ix. 15—21.)

In the years in which the month Ve-Adar is inserted, the Purim and the Fast of Esther belong to that month; and the 14th of Adar is called the First or Little Purim. It appears, then, that in the intercalary year, it is the first Adar that is really the intercalary month, as the festivals remain to Ve-Adar. (Ideler, 'Lehrbuch der Chronologie,' Berlin, 1831.) The festival in honour of the dedication of the second Temple, is kept by some Jews on the 16th, and by others on the 23rd of this month. There is no exact account of the day of dedication; the temple was completed on the 3rd day of the month. (Ezra, vi. 15.)

Adar is the name of the seventh month of the Syro-Macedonian year, which coincides nearly with our March.

ADDISON'S DISEASE. [KIDNEYS, DISEASES OF.]

ADDITION, from the Latin *addo* to *give to*, is the putting together of two or more magnitudes into one. In arithmetic and algebra it also signifies the most convenient method of doing this, so that the sum or collection of added quantities may be counted or reckoned in the same manner as the parts of which it was composed. The sign of this operation is $+$, which is generally pronounced *plus*, the Latin for *more*. Thus $a+b$ directs us to add the number denoted by b to that denoted by a, and represents the sum of a and b.

Addition of whole numbers in arithmetic is performed partly by memory, partly by the aid of the decimal system of numeration. [NUMERATION.] The sum of every two numbers, each of which is not greater than 9, must be remembered; from whence the addition of such numbers as 28 and 9, 33 and 6, &c., can be performed in the head. The further process is the same in principle, whether the several quantities to be added together be tens, hundreds, &c., pence, shillings, &c., or any other denomination. Presuming that no reader will be ignorant of the ordinary methods, we show the general principle for all cases in the following question, in which any lines of headings may be taken:—

Hundreds. Shillings. Roods.	Tens. Pence. Perches.	Units. Farthings. Sq. Yards.
b	c	d
f	g	h
l	m	n

Add together d, h, and n, and if they be units, convert the sum into tens and units; if farthings, into pence and farthings, &c., meaning thereby, take the greatest number of tens out of all the units, of pence out of all the farthings, &c., in $n+h+d$, and write what is left under n. *Carry* (as it is called) the tens, pence, &c., to the next column on the left, and add successively m, g, and c to them, taking the hundreds, shillings, &c., as the case may be, from the result, and writing the remainder only under *m*. Carry the hundreds, &c., to the next line on the left, and so on.

The addition of fractions is, in principle, as follows: We cannot immediately express the sum of one-half of a foot and one-third of a foot otherwise than by writing $\frac{1}{2} + \frac{1}{3}$ of a foot. But if we recollect that *one-half* is *three-sixths*, and one-third is *two-sixths*, it is evident that the sum of one-half and one-third is *five-sixths*. The rule, therefore, is: Reduce the various fractions to others of equal value, and having the same denominator, add the numerators retaining the denominator: or, multiply every numerator by every denominator, except its own; add the results, which gives the numerator of the sum: multiply all the denominators together for the denominator of the sum. Thus, for—

$$\frac{2}{3} + \frac{3}{7} + \frac{4}{5} \text{ which is } \frac{199}{105}$$

$$\left.\begin{array}{r} 2 \times 7 \times 5 = 70 \\ 3 \times 3 \times 5 = 45 \\ 4 \times 3 \times 7 = 84 \end{array}\right\} \text{Add}$$

$$\begin{array}{rl} & 199 \text{ numerator} \\ 3 \times 7 \times 5 = & \overline{105} \text{ denominator.} \end{array}$$

To add decimal fractions, arrange them so that the decimal points shall fall under one another, proceed as in common addition, and let the decimal point in the sum total be placed under the other decimal points:—

$$\begin{array}{r} 2{\cdot}61 \\ {\cdot}04 \\ {\cdot}118 \\ \hline 2{\cdot}768 \end{array} \qquad \begin{array}{r} 14{\cdot}103 \\ 1{\cdot}04 \\ 118\phantom{{\cdot}000} \\ \hline 133{\cdot}143 \end{array}$$

To add algebraical quantities, write them all one after another, without changing any sign, and connect the terms, which before had no sign, with the rest, by the sign $+$. Thus $a + b$ and $a - 2b$ added, give $a + b + a - 2b$. This is the sum, which may be reduced to a simpler form, by observing that b subtracted twice and added once, is equivalent to b subtracted once, and that a is added to a. The expression then becomes $2a - b$.

When the quantities are fractional, the preceding rule follows the application of another similar to the rule in fractional arithmetic. Thus, for—

$$\frac{a}{a+b} + \frac{b}{a-b} \text{ the sum of which is } \frac{a^2+b^2}{a^2-b^2}$$

$$\left.\begin{array}{r} a \times (a - b) = a^2 - ab \\ b \times (a + b) = ab + b^2 \end{array}\right\} \text{Add}$$

$$\begin{array}{rl} & a^2 - ab + ab + b^2 \\ \text{or} & a^2 + b^2 \text{ numerator} \\ (a + b) \times (a - b) = & \overline{a^2 - b^2} \text{ denominator.} \end{array}$$

ADDITION OF RATIOS. A phrase which may, perhaps, at first, puzzle the mathematical student who reads old books, and which we therefore explain here. Take two ratios or proportions, say 3 to 7 and 5 to 9; the ratio of 3×5 to 7×9, or of 15 to 63 was formerly said to be the *sum* of the ratios of 3 to 7 and 5 to 9. Similarly the ratio of 25 to 4 was said to be *double* of the ratio, or the *duplicate ratio*, of 5 to 2; that of 125 to 8, *triple* or the *triplicate ratio*, and so on. [RATIO; LOGARITHM.] The sum of the first ratios in any modern work would probably mean $\frac{3}{7} + \frac{5}{9}$; but the term 'sum of the fractions,' would most likely be used in preference.

ADHESION. This term has generally been employed to denote the property by which two solids, a solid and a fluid, two solids and an interposed fluid, or two fluids, remain attached to each other when their surfaces are brought into contact. Adhesion may, in some instances, be considered as being but little if at all different from cohesion, and dependent upon the same cause, while, in other cases, it appears to be connected with, and probably to a considerable extent derived from, chemical affinity. When, for example, two surfaces of lead are pressed together, the adhesion resembles mere cohesion, it acts at insensible distances like that power, and no change of properties ensues in the metal. If, however, the surface of a piece of lead is put into contact with mercury, the two metals act upon and combine with each other, and an amalgam is produced by virtue of the chemical affinity existing between these two metals. There are other instances in which the adhesion is not distinctly to be referred to cohesion, and in which it certainly does not depend upon chemical affinity, as when a plate of glass adheres to the surface of mercury, or when liquids rise in small tubes by capillary attraction.

Among the earlier attempts to determine the force of cohesion are those of Dr. B. Taylor, in a paper on Magnetism ('Phil. Trans.' 1721). He performed various experiments to ascertain the force of adhesion between wood and water, by determining the force in weight required to separate them. He found it to be directly as the surface, and that a square inch of wood required fifty grains to raise it from the surface of the water.

M. Achard ('Berlin Memoirs,' 1776) made a vast number of experiments on the force of adhesion between plates of glass of different diameters, and many liquids, and upon the adhesion of twenty different substances with as many liquids. It had been supposed that adhesion was derived from atmospheric pressure, but M. Achard found that by varying the pressure no change occurred in the adhesive force of glass and water; and that the adhesion of fluids to solids was uniformly in the inverse ratio of the temperature. The diminution in the force of adhesion by increase of temperatures was attributed by Guyton de Morveau to the rarefaction of the fluid by heat, and the consequent reduction of the points of contact in the same space.

As the surfaces of the solids employed by Dr. Taylor and by M. Achard must have been wetted by the liquids, it has been objected to their experiments, and especially by M. Dutour in the 'Journal de Physique,' that they do not prove any adhesion between the solid and the liquid, but cohesion between the two portions of the liquid which have been separated. If this objection be valid, then those only can be considered as proper cases of adhesion, in which no particle of one substance remains with the other after the separation of their surfaces, as when glass is separated from mercury; M. Dutour found that a disc of glass 11 lines (French) in diameter adhered to mercury with a force of 194 grains.

M. Guyton published in 1777, in his 'Elémens de Chimie,' a series of experiments on the force of adhesion between eleven metals and mercury; his method was as follows: The metals were made chemically pure, circular, and one inch in diameter; they were all of the same thickness, and were suspended from a ring in the centre at the arm of an assay-balance and counterpoised; the surface of the mercury was then brought up to the plates, and the mercury was changed after each experiment: the weights required to detach them were as follow:—

	Grains.		Grains.
Gold	446	Zinc	204
Silver	429	Copper	142
Tin	418	Antimony	126
Lead	397	Iron	115
Bismuth	372	Cobalt	8
Platinum	282		

In these experiments the phenomena of adhesion appear to depend upon the degree of chemical affinity existing between the mercury and the metals applied to its surface. If the affinity were weak, the two surfaces would separate by the application of a slight force. Indeed, M. Guyton himself considers that the weight required to separate the different metals from mercury may directly express their affinity for it. It will be evident on a moment's consideration that the degree of adhesion is perfectly independent of the densities of the different metals.

The sixty-third volume of the 'Philosophical Magazine' contains a paper by Mr. Bevan, in which the subject of adhesion appears to be considered in a point of view which had previously excited but little attention, viz., the real force of adhesion of different nails when driven into wood of different species; the weight, without impulse, necessary to force a nail a given depth into wood, and the force required to extract the same when so driven. The term adhesion in this case is applied to the force, whether arising from friction, or cohesion, or partly from both, with which wood resists the drawing out of a nail. Mr. Bevan has given a table of the adhesion, &c. of different kinds of nails when driven into dry Christiania deal; in this table it appears that a sixpenny nail, 73 to the lb., $2\frac{1}{2}$ inches long, forced $1\frac{1}{2}$ inch into the wood, required 327 lbs. weight to extract it; the percussive force required to drive the sixpenny nail to the depth of one inch and a half into the dry deal, with a cast-iron weight of 6·275 lb., was four blows or strokes falling freely through the space of twelve inches, while the steady pressure required to produce the same effect was 400 lbs. With different kinds of timber the results varied greatly, and Mr. Bevan concludes that a sixpenny nail driven two inches into dry oak, would require a force of more than half a ton to extract it by steady pressure. Mr. Bevan ('Phil. Mag,' and 'Annals of Philosophy,' vol. ii. p. 291) has also determined the force required to draw screws out of different kinds of wood; the screws used were about two inches in length, ·22 diameter at the exterior of the threads, ·15 diameter at the bottom, the depth of the worm or thread, being ·35, and the number of threads in one inch = 12. These screws were passed *through* pieces of wood, exactly half an inch in thickness, and drawn out from the following dry woods by the annexed weights, beech 460 lbs., ditto, 790 lbs., ash 790 lbs., oak 760 lbs., mahogany 770 lbs., elm 655 lbs., sycamore 830 lbs. The force required to draw similar screws out of deal and the softer woods, was about half the above.

About twenty years ago, Professor W. R. Johnson undertook a series of experiments on the adhesion of iron spikes of various forms, when driven into different species of timber. The results of his experiments were published in the 'Franklin Journal.' This inquiry was important from the great use of spikes in the construction of railroads in America, where the cheaper flat rail was preferred to the edge rail, and was fastened to wooden sleepers by means of spikes. Whenever the speed of a train was suddenly checked by the break, the friction of the wheel tended to drive the rail lengthwise, and thus to force all the spikes with which it was fastened into closer contact with the ends of the fibres which had been cut through in driving them; and, as this partial or total dragging of the wheels may take place sometimes in one direction and sometimes in the other, the spikes must be subjected to alternate impulses on opposite sides. Indeed, the ordinary action of the common locomotive produces a constant succession of these opposite dragging forces, the driving-wheels of the engine urging the rails backward while the train tends to urge them forward. Professor Johnson has seen rails entirely detached on a line where the transit was all in one direction, and where the cars descended by gravity, while in other cases the inclined position of the heads of the spikes showed that they were pressed into an oblique or leaning position in the wooden sill. The mode of performing the experiments was to drive each spike to a certain distance above its cutting edge into the edge of a piece of plank or scantling, and to draw it out by a direct longitudinal strain by means of a suitable apparatus. This consisted of a strong band or strap of iron connected with a weighing-beam, which held the piece of plank, and a clasped pincers, with a suitable jaw, for taking hold of the head and projecting part of the spike; this was attached to the opposite part of the machine, which, being tightened by a strong screw, held the spike firmly while the application of weights upon the longer arm of the lever drew the timber away and released the spike. Care was taken to cause the strain to pass through the axis of the spike, and, by a very gradual application of weights, to avoid surpassing that force which was just sufficient for its extraction.

The first experiments were with Burden's patent square spikes with a cutting edge for driving across the grain of the timber. This spike was ·375 inch square, and was driven into a sound plank of seasoned Jersey yellow pine to the depth of $3\frac{3}{8}$ inches; the force required to extract it was 2052 lbs.; the weight of the part driven into the wood was 866 grs. Troy. The second trial was upon a flanched, grooved, and swelled spike, having the grooves between two projecting wings or flanches on the same sides as the faces of the cutting edge; the other two sides were planes continuing to the head. This spike was driven into the same kind of wood as before, and the weight required for extracting it was 1596 lbs.; the weight of the part driven in was $708\frac{1}{4}$ grs. The cutting edge was ragged and irregular, and the distance to which it was driven was $3\frac{3}{8}$ inches as in the first trial. "To know the relative values of the two forms of spikes, we have but to divide the weight required for the extraction of each by the number of grains in the part which had been buried in the wood. Thus, 2052÷866 =2·37, and 1596÷708·25=2·112. Hence, the plain spike had an advantage over the swelled and grooved one in about the proportion of 23 to 21. It should be mentioned, also, that the plain spike was drawn out by a very gradual addition of force; whereas the force of 1596 lbs. drew the grooved spike immediately after its application. In the first trial, an attempt was made to detect any yielding or gradual retreat of the spike before the final start, but none was perceived."

The third and fourth experiments were made with the same spikes respectively as the first and second; but instead of yellow pine the timber employed was thoroughly seasoned white oak. The plain spike, driven $3\frac{3}{8}$ inches into that timber, required for its extraction a force of 3910 lbs., and, as before, exhibited no signs of movement until the instant of starting, when it suddenly came out about a quarter of an inch, or as far as the range of motion and the elasticity of the machine would permit. The flanched, swelled, and grooved spike, driven $3\frac{3}{8}$ inches into another part of the same piece of plank, from which the plain one had been extracted, was drawn out with a force of 3791 lbs. A slow motion, to the extent of $\frac{1}{25}$ or $\frac{1}{20}$ of an inch, was in this trial perceived to precede the starting of the spike, and was accompanied by a gradual protrusion of the fibres of the timber immediately around the iron. In these experiments, though the plain spike bore the greater absolute weight, yet, when the weight of metal is considered, it is seen that the relative values of the two are 4·515 in the plain, and 5·354 in the grooved form. "Hence, it appears that in yellow pine the grooved and swelled form was about five per cent. less advantageous than the plain, while in the seasoned oak the former was $18\frac{1}{2}$ per cent. superior to the latter. It is also apparent that the advantage of seasoned oak over seasoned yellow pine, for retaining spikes, is, by a comparison of experiments 1 and 3, as 1 to 1·9; and by a comparison of 2 and 4, it is as 1 to 2·37." Other experiments were also tried upon a spike of given form, which was driven a certain distance into different timbers, and the order of retentiveness beginning with the highest was as follows: 1. Locust; 2. white oak; 3. hemlock; 4. unseasoned chestnut; 5. yellow pine. The results of numerous experiments are given in tables, from which it appears, among other conclusions, that the fibres of the wood should press the faces of the spike as nearly as possible in their longitudinal direction, and with equal intensities, throughout the whole length of the spike. The following arrangement gives the spikes in the order of their ratios of retention to weight:—

1. Narrow flat	7·049
2. Wide flat	5·712
3. Grooved, but not swelled	5·662
4. Grooved and notched	5·300
5. Grooved and swelled	4·624
6. Burden's patent	4·509
7. Square hammered spike	4·129
8. Plain cylindrical	3·200

In promoting the adhesion of surfaces, it is not unusual to make one of the solids semi-fluid or ductile by heat or otherwise, and on returning to its hard state, provided it does not crystallise, the adhesion is not diminished unless indeed the unequal contractions of the two substances by the same reduction of temperature forces them apart. The fitness of different cements for joining different substances depends chiefly on their expanding equally with those substances. Metals, being generally more expansible than other solids, will not adhere to ordinary cements, but require metallic ones, or *solders*, as they are called, and these must be so compounded as to have nearly the same rate of expansion as the metals which they are intended to unite. "Glass and stones, being both less expansible and less various in their rates of expansion, adhere to a greater variety of substances; and light porous solids, being very little affected by change of temperature, adhere still more generally to those of the same kind, which may be softened by heat or liquid solvents, and return to the solid state gradually and without tendency to crystallise. The most universally adhesive bodies (as pitch) are those which retain, even at low temperatures, a certain ductility by which they may readily yield to the various expansions and contractions of the rigid bodies in contact with them; and the rigid bodies most readily made to adhere are the worst conductors of heat, because they cannot undergo very sudden changes of temperature or bulk, and so allow time for the adhering body to accommodate itself. The non-adhesiveness of animal membranes is very remarkable, and probably a provision for their cleanliness and freedom from foreign matter. Crystallisation, by requiring a body while solidifying to obey with rigour certain internal laws of its own, is a great bar to adhesion. The adhesion of two solids is generally stronger than the cohesion of at least the weaker one. Hence, if two pieces of wood be glued, gummed, or pasted together, and then separated, a layer of cement adheres to each; and if there be a bank-note in the midst of the cement, it will be split into two layers, simply because its own cohesion is less than that of the cement, or of the wood, or the adhesion between the cement and either wood or paper." *

Adhesion between solids is the chief cause of that resistance to motion which is termed *friction*. Friction is generally greater between similar kinds of matter than between different kinds. Thus, an iron axle experiences more friction when moving in an iron socket than in a brass one, and in order to reduce the amount of friction in machinery, it is usual to interpose between the grinding surfaces some such lubricant as plumbago, or grease, the particles of which have but little tendency to cohere.

The adhesion of caoutchouc fits it for a variety of applications. Its complete adhesion to glass makes it useful for stopples, and enables the chemist to make air-tight and flexible joints in his apparatus. It is also well adapted, by its adhesion, to be employed for bands for driving machinery. Its adhesion is ingeniously employed in the manufacture of *cards*, used for carding cotton. A cotton-card consists of a wire-brush with a flexible back, the latter being supplied at one time by leather; but as the holes through which the wire teeth were passed, became enlarged by use, the teeth were no longer held in their places; but by making the flexible back of two pieces of linen with an interposed layer of caoutchouc, the adhesion of the latter to the wire caused it to follow the teeth when any strain was put upon them, and by its elasticity restored each tooth to its proper position when the strain was removed.

ADIPIC ACID (2HO, $C_{12}H_8O_6$). When oleic acid, spermaceti, fat, or wax is acted on by nitric acid, several new acids are formed, and amongst them adipic acid. It crystallises in hemispherical, radiated tufts, which fuse at 266°, and distils without decomposition. It is very soluble in hot alcohol or ether, and also in boiling water.

ADIPIC ETHER ($C_{12}H_8O_6 + 2C_4H_5O$), the compound of adipic acid with oxide of ethyl. It is an oily body, possessing a powerful odour of rennet apples. Its sp. g. is 1·001, and it boils at 446°.

ADIT. [MINING.]

ADIPOCIRE, a substance so named from *adeps*, fat, and *cera*, wax, because it possesses the properties partly of fat and partly of wax. It is a body of a peculiar nature, being intermediate between fat and wax, and bearing a close resemblance to spermaceti. This name was given by M. Fourcroy in 1786 to the substance in question, which he discovered on examining a piece of human liver that had remained for ten years exposed to the air in the laboratory of M. Poultier de la Salle. In the same year Fourcroy had the opportunity of observing an accumulation of adipocire on a scale of prodigious extent, under circumstances of a peculiar nature, which are highly curious. There was in Paris an immense burial-ground, called La Cimetière des Innocens. This place had been the receptacle of the dead for a considerable part of the population of Paris for several centuries. On account of some improvements in the neighbourhood it was determined to remove this cemetery. The number of burials in this place had amounted to some thousands annually. The bodies were deposited in pits or trenches about thirty feet deep; each pit was capable of holding from twelve to fifteen thousand bodies; and as the pits became full they were covered with a few feet of earth. The extent of the whole area was about seven thousand square yards, and this space became at last occupied by a mass which consisted almost entirely of animal matter, rising several feet above the general level of the soil. Scientific men were especially charged by the government to direct the precautions requisite for securing the health of the workmen in removing this immense mass of putrefying animal matter; among whom were Fourcroy and Thouret,

* Tomlinson's 'Cyclopædia of Useful Arts,' &c., Article ADHESION.

the latter of whom has given a most interesting account of the circumstances attending the opening of the ground; and the former an analysis of the new and singular object that presented itself for investigation. The most remarkable change was found in the bodies that had been heaped together in the trenches. The first of these trenches opened in the presence of Fourcroy had been closed for fifteen years. The coffins were in good preservation; the covers being removed, the bodies were observed at the bottom, leaving a considerble distance between their surface and the cover, and flattened, as if they had suffered a strong compression; the linen which had covered them was slightly adherent to the bodies; beneath the linen was found nothing but irregular masses of a soft ductile matter of a grey-white colour, resembling common white cheese, the resemblance being more striking from the prints which the threads of the linen had made upon its surface. The bones, which were surrounded by this matter, had no solidity, but were readily broken by sudden pressure. The head was environed with this peculiar matter; the face was no longer distinguishable; the mouth was disorganised; no trace remained of the viscera of the thorax and abdomen, which were all confused together and converted into this fatty matter; and this was also invariably the case with the brain. None of this matter was found in bodies isolated from each other, but only in those accumulated in the common graves. From various observations it was found that this fatty matter was capable of enduring in these burying-places for thirty or forty years, but that ultimately it became corrupted and was dissipated.

This substance thus presented for examination under such remarkable circumstances, is considered by M. Fourcroy as an ammoniacal soap, formed of a peculiar oil combined with ammonia. Its properties are,—that it melts at about 130° Fahr.; by a strong heat it is decomposed with the evolution of ammonia; alcohol acts only slightly upon it at common temperatures, but when boiling dissolves about one-fourth of its weight, the greater part of which separates on cooling in small acicular crystals; lime, potash, and soda decompose it with the evolution of ammonia; it is decomposed by nitric acid with the production of nitric oxide, and by sulphuric acid with the development of carbon. M. Chevreul ('Recherches sur les Corps Gras') finds that adipocire consists of a large quantity of margaric acid, and a small quantity of oleic acid, combined with a little ammonia, potash, and lime.

A'DJECTIVE, in Grammar, the name of one of the parts of speech, or one of those great classes into which, for the sake of convenience, grammarians have distributed the words of a language. The term *adjective*, which is of Latin formation, signifies something that *adds to* precision in describing the nature of any object of which we are speaking. An adjective, in our language, is most commonly prefixed to the name of some thing, in order to mark some quality by which it is distinguished from other things belonging to the same class; thus, a *bad* man, a *good* man, a *fat* man, a *troublesome* man, &c., a *black* horse, a *white* horse, &c. Here the terms *man* and *horse* are the most general or abstract (ABSTRACTION) terms by which we can express the idea of man or horse: but, by prefixing to them such adjectives as *bad*, *good*, &c., we limit, in some degree, the class of which we are speaking. Thus, when we speak of a *white* man, we exclude the consideration of black men, or men of any other colour. In like manner, when we say an *English* man, we limit the signification still further; and in this way we may descend to a Cheshire man, a Chester man, until we come to individuals indicated by a common name, such as Thomson, Smith, &c. By the aid of other words prefixed, such as John, William, &c., we at last come to some certain individual. It appears, then, that in the expressions John Page, William Smith, &c., John and William may have the names of adjectives as well as the words *black*, *white*, &c. And this leads us to observe that frequently *nouns* or names of things can be used like adjectives; thus we can say, a *silver ring*, a *gold stick*, *salt water*, *sea water*. Many words in English are, in fact, used both as nouns and adjectives. In the expression 'John's book,' *John's* may be considered as an adjective for the reasons just given. Some grammarians have wished to introduce the term *adnoun* instead of *adjective*, but though the word *adjective* is not a very good name, *adnoun* is no better.

There are two ways in which an adjective can stand in a proposition: we can say 'the horse is bad,' or 'a bad horse.' In the first example, *horse* is called the 'subject,' *is* the 'copula,' or connecting link, and 'bad' is the 'predicate' or qualifying term. According to the true idiom of our language, an adjective can stand at the end of any simple proposition, as, he walks *slow*, he rides *quick*, he speaks *loud*. It is true that usage is now beginning to be opposed to this mode of expression, and the adverb in *-ly* is gaining ground; yet there are cases where it is not possible to use the termination in *-ly* without making the spoken language at least very stiff and formal. Some words are used both as adjectives and adverbs.

Many adjectives are simple *roots*, such as *good*, *bad*, *hot*, &c., while others are formed by adding an affix or suffix to a noun.

The following list of adjectives formed by affixes, or by adding a complete word, belong to the Saxon part of our language:—

glad-some	care-less	for-ward
play-ful	child-ish	god-like
weight-y	holl-ow	man-ly
wood-en	fork-ed	out-er

The following terminations are of Latin and Greek origin

act-ive	coher-ent	period-ical
passion-ate	attend-ant	station-ary
adamant-ine	habit-able	transit-ory
sulphur-ic	aud-ible	Belgi-an
angul-ar	luc-id	humor-ous
duc-tile	autumn-al	verb-ose

There are other terminations of less importance, such as *ether-eal*, *advent-itious*, &c., which agree with the examples already given, as to the *last* syllable, but differ in having an additional syllable or syllables between the first part of the word and the termination.

ADJUDICATION, in the law of Scotland, is a process by which real property and its accessories is transferred by law from the debtor to the creditor, from the heir to the devisee, or from the vendor who refuses or has failed to convey, to the vendee. The origin of this process is to be found in an ancient practice called Apprising, by which the debtor who refused to satisfy his creditor, either with money or land, might be compelled to part with so much of the land as was commensurate with the debt. It was the object of legislation so early as 1469, when feudal superiors or lords were compelled to give the proper investiture to those who acquired lands by such procedure, which was again amended by the Act 1672, c. 19. The debtor is now to make over to the creditor land to the value of his debt and one-fifth more, redeemable within five years; or the property in general against which the process is directed adjudged to the creditor, liable to be redeemed within ten years, on payment of the debt, interest, &c. The latter alternative is universally adopted. The lands do not pass into the absolute property of the adjudger at the end of the ten years, without judicial intervention, in what is called "an action of declarator of expiry of the legal," whereby the creditor has the right of redemption in the debtor declared to have expired and ceased altogether.

There are arrangements for preserving equality among adjudgers, and preventing active creditors from carrying off all the estate. (Acts 1661, c. 62; 1672, c. 19; 54 Geo. III. c. 137, ss. 9—11.) When there are many adjudications against an estate, and when the debtor does not come within the class of persons liable to mercantile bankruptcy, it is usual to sweep all the operations into one process, called a 'Judicial Ranking and Sale.' A factor is appointed, by whom, under judicial inspection, the property is realised and distributed. (Acts 1681, c. 17; 1695, c. 24; 54 Geo. III. c. 137, ss. 6, 7; Act. Sed., 22nd Nov., 1711; 17th Jan., 1756; 11th July, 1794.) Where sequestration has been awarded against a person liable to bankruptcy, the sequestration involves an adjudication of all the bankrupt's property from him, and vests it in the trustee (official assignee). (19 & 20 Vict. c. 79 20 & 21 Vict. c. 19.)

This form of action has long been in use for the completion of defective titles to landed property, and when so employed, it is called 'adjudication in implement;' as for instance when the heir declines to convey an estate left to a devisee in a will.

ADJUSTMENT, in marine insurance, is the ascertaining the exact amount of indemnity which the insured is entitled to under the policy, after all proper allowances and deductions have been made. The contract of insurance is an agreement to indemnify the insured against such losses as he may sustain by the occurrence of any of the events expressly stated or by implication of law contained in the policy. When a ship is lost, or any of those contingencies arise against which the insurance provides, the owner of the ship or of the goods insured, as the case may be, or his authorised agent, reports the circumstance to the insurers or underwriters. In London, this notice is given by an insertion in a book kept at Lloyd's Coffee-House in the subscription-rooms, where the greater part of marine insurances are effected.

Before any adjustment is made, the underwriters require to be informed of all particulars, that they may be satisfied the loss has occurred through circumstances against which the insurance was effected. In ordinary cases the task of ascertaining these facts, and of examining the correctness of the demand made by the assured, rests with the underwriter who first subscribed the policy. In complicated cases of partial or average losses, the papers are usually referred to some disinterested party (generally a professional referee), to calculate and adjust the per centage rate of loss. Where the ship is wholly lost, of course little difficulty occurs in this part of the inquiry; but in cases of partial losses, where the insured has not exercised his right of abandonment [ABANDONMENT], very minute and careful examination is often necessary. The quantum of damage being ascertained, the amount which each underwriter has made himself liable to by subscribing the policy is settled; and this being done, it is usual for one of the underwriters, or their agent, to indorse on the policy, "adjusted a partial loss on this policy of so much per cent." To this indorsement the signature of each underwriter is affixed, and this process is called the 'adjustment' of the loss.

After an adjustment has been made, it is not usual in mercantile practice for the underwriter to require further proof, but at once to pay the loss. The reason for which adjustments have been introduced into the business of maritime insurance is, that upon the underwriter signing an adjustment, time is given him by the assured to pay the money. In law, however, it seems to be as yet undecided how far the adjustment is conclusive and binding upon the underwriters. The better opinion is that the adjustment is merely *primâ facie* evidence against an insurer; so that where an adjustment has taken place, and the liability to pay the loss is disputed, while the adjustment, without further proof, will be sufficient to entitle the insured to recover in an action on the policy, the underwriter will not be debarred from showing facts which may have the effect of relieving him from liability. (Arnould on the *Law of Marine Insurance.*)

ADJUTAGE, or AJUTAGE, is a name given to a tube, generally not exceeding a few inches in length, which may be applied to a vessel or reservoir, in order to facilitate the discharge of a fluid from such vessel. [HYDRODYNAMICS.]

ADJUTANT. } [STAFF, MILITARY.]
ADJUTANT-GENERAL. }

ADMINISTRATION AND ADMINISTRATOR. An administrator is a person appointed to administer or distribute the goods of a person who has died without making a will. The right of appointment, which had for centuries been lodged in the ordinary or bishop of the diocese, has by a recent statute (20 & 21 Vict. c. 77) been transferred to the Queen's Court of Probate. In very early times, the king, in his character of *pater patriæ*, was supposed entitled in such a case to seize upon the goods, in order to apply them to the burial of the deceased, the payment of his debts, and the making of a provision for his family. This power of the crown was doubtless abused; for, by Magna Charta, "if a freeman shall die intestate, his chattels shall be distributed by the hands of his near relations and friends, under the inspection of the Church." This probably formed the foundation upon which the prelates afterwards built their right to administer by their own hands the goods of an intestate. At all events, the power of taking possession of the goods of an intestate was, at a later period, transferred from the crown to the bishops. The property was, in the first instance, placed in the custody of the bishop of the diocese in which the intestate died; and after the deduction of what were technically called *partes rationabiles* (two-thirds of the whole, which the law gave to the widow and children), the remaining third part vested in the bishop upon trust to distribute in charity to the poor, or in what were then termed "pious uses," for the benefit of the soul of the deceased. This trust was greatly abused by the prelates, who unscrupulously converted the whole residue of the property to the use of their order, without even paying the just debts of the deceased; to remedy which the statute of Westminster the Second was passed in the reign of Edward I., providing that the debts of the deceased should be paid by the ordinary in the same manner as if he had been an executor appointed by a will. The remainder, after payment of debts, continued applicable to the same uses as before. Farther to prevent abuse of the power still retained by the ordinary, and to take the administration entirely out of his hands, the statute 31 Edward III. c. 2, directed the ordinary, in case of intestacy, to depute "the nearest and most lawful friends" of the deceased to administer his goods; and these administrators are put upon the same footing with regard to suits and to accounting, as executors appointed by will.

This is the origin of administrators: they were merely the officers of the ordinary, appointed by him in pursuance of the statute, which selects the nearest and most lawful friend of the deceased; these words being interpreted to denote the nearest relation by blood who is not under any legal disability. The subsequent statute of 21 Henry VIII. c. 5, enlarged the power of the ecclesiastical judge, and permitted him to grant administration either to the widow or the next of kin, or to both of them. Where several persons were equally near of kin, he was empowered to select one at his discretion. If none of the kindred were willing to administer, a creditor was permitted to do so; and in the absence of any person entitled to demand letters of administration, the ordinary might appoint whomsoever he might think proper. The powers and discretion of the ordinary are now vested in the judge of the Court of Probate.

Administrators may be nominated even in a case where a will has been made, if by the will no executors are appointed, or if the persons named refuse, or are not legally qualified to act. In these cases the administrator only differs from an executor in the name of his office and mode of his appointment. In practice, when the executor *refuses*, administration is granted to the residuary legatee; that is, to the person to whom, by the will, the residue of the property, after payment of debts and legacies, is given.

In the case of a complete intestacy, it was formerly much doubted whether an administrator appointed under 31 Edward III. could be compelled to distribute the effects which remained in his hands after payment of debts; for though the administration had been transferred from the ordinary to him, he stood in the same position as the former had occupied, and was consequently not legally bound to administer. The spiritual courts endeavoured to enforce distribution by taking bonds from the administrator for that purpose, but these were declared void by the common law courts. The Statute of Distributions (22 & 23 Charles II. c. 10), which now regulates these matters, enacts that the surplus effects, after payment of debts, shall, after the expiration of one year from the death of the intestate, be distributed in the following manner: One-third to the widow, and the remainder in equal proportions to the children of the intestate, or, if dead, to their legal representatives—that is, their lineal descendants; or, if there be no children, or children's legal representatives, one moiety to the widow, and the other moiety to the next of kin, in equal degrees of relationship, or to their representatives: if no widow, the whole to the children or their representatives in equal portions: if neither widow nor children, the whole amongst the next of kin or their representatives.

By the same statute, it is directed that no child of the intestate (except it be his heir at law) on whom he settled in his lifetime any estate in lands or pecuniary portion, equal to the distributive share of the other children, shall have any part of the surplus to be administered; but if the estate given by way of advancement is not equivalent to the others' share, the child so advanced shall have enough to put him on an equality with his brothers and sisters. The 29 Charles II. c. 3, gives administration to the husbands of women dying intestate.

The Statute of Distributions expressly reserved the customs of the city of London, of the province of York, and of all other places having peculiar customs of distributing intestates' effects. These customs have been abolished by the statute 19 & 20 Vict. c. 94, and the distribution of the estates of intestates is thus rendered uniform throughout England. ('Blackstone's Comm.' Mr. Kerr's ed. vol. ii. p. 554.)

For further information see EXECUTORS, and PROBATE, COURT OF.

ADMIRAL, the title of the highest class of naval officers. Various fanciful etymologies of the word have been given; but the word is said to be merely a corruption of the Arabic *Amir* or *Emir*, a lord or chieftain. The *al* is the Arabic definite article *al* (the), without the noun to which it belongs. Eutychius, patriarch of Alexandria, writing in the 10th century, calls the Caliph Omar *Amirol Mumenim*, which he translates into Latin *Imperator Fidelium* (Commander of the Faithful). To form the word Admiral the first two terms of some title similar to this have been adopted, and the third has been dropped. From this it appears that the word ought properly to be written, or rather ought at first to have been written, Amiral, or Ammiral, as we find it in Milton's expression:

> "The mast
> Of some great Ammiral."

Milton, holding to this principle of orthography, wrote in Latin *Ammiralatûs Curia* (Court of Admiralty). The French say *Amiral*, and the Italians *Ammiraglio*. The *d* seems to have got into the English word from a notion that Admiral was an abridgement of *Admirable*. The Latin writers of the middle ages sometimes, apparently from this conceit, style the commander of a fleet *Admirabilis*, and also *Admiratus*; the Spaniards say *Admirante* or *Almirante*.

Under the Greek empire, the term *Emir* or *Amir* (Αμηρ) was used most commonly to designate the governor of a province or district, which was itself called Αμηραδιας. Gibbon states that the Emir of the fleet was the third in rank of the officers of state presiding over the navy; the first being entitled the *Great Duke*, and the second the *Great Drungaire*. ('Decline and Fall,' ch. liii.) The holy wars of the 12th and 13th centuries seem to have introduced the term Admiral into Europe. The Admiral of Sicily is reckoned among the great officers of state in that kingdom in the 12th century; and the Genoese had also their admiral very soon after this time. In France and England the title appears to have been unknown till the latter part of the 13th century: the year 1284 is commonly assigned as the date of the appointment of the first French Admiral; and the *Amiral de la Mer du Roy d'Angleterre* is first mentioned in records of the year 1297. The person to whom the title is given in this instance is named William de Leybourne. Yet at this time England, although she had an admiral, had, properly speaking, no fleet; the custom being for the king, when he engaged in a naval expedition, to press into his service the merchant-vessels from all ports of the kingdom, just as it is still the prerogative of the crown to seize the men serving on board such vessels. This circumstance is especially deserving of notice, as illustrating what an admiral originally was. The King of England's Admiral of the Sea was not necessarily the actual commander of the fleet; he was rather the great officer of state who presided generally over maritime affairs. Sometimes he was not a professional person at all; at other times he was one of the king's sons, or other near kinsman yet in his nonage, on whom the office was bestowed, as being one of great dignity and emolument; the duties were performed by persons who acted in his name. But these duties were usually not to command ships in battle, but merely to superintend and direct the naval strength of the kingdom, and to administer justice in all causes arising on the seas. The former of these duties is now executed by the department of government called the Admiralty, and the latter by the legal tribunal called the High Court of Admiralty.

Anciently, two or more admirals used often to be appointed to exercise their powers along different parts of the coast. Thus, in 1326, mention is made of Admiral of the King's Fleet, from the mouth of the Thames northward, and of another officer, with the same title, commanding from the mouth of the Thames westward. Besides these, there were also Admirals of the Cinque Ports. There are still a vice-admiral and a rear-admiral of the United Kingdom, which places are now sinecures, and are usually bestowed upon naval officers of high standing and eminent services. They are appointed by royal patent, and it is said would exercise the authority of the Lord High Admiral in case of his death, until a successor was appointed. There is also a vice-admiral of the coast of Yorkshire, a nominal office, usually given to a nobleman. It is the opinion of some writers that the first admiral of all England was appointed in the year 1387. Even the officer bearing this title, however, was not then the person possessing the highest maritime jurisdiction. Above him there was the King's Lieutenant on the Sea (*Locum tenens super mare*). Also, before the term Admiral was used at all, there was an officer designated the Custos Maris, or Guardian of the Sea.

From the year 1405 (the sixth of Henry IV.) there is an uninterrupted series of Lord High Admirals of England, the office being always held by an individual, till the 20th of November, 1632, when it was for the first time put in commission: all the great officers of state were the commissioners. During the Commonwealth, the affairs of the navy were managed by a Committee of Parliament, till Cromwell took the direction of them himself. On the Restoration, the king's brother, the Duke of York, was appointed Lord High Admiral; and he retained the place till the 22nd of May 1684, when Charles took it into his own hands. On the duke's accession to the throne, in the beginning of the following year, he declared himself Lord High Admiral. On the Revolution the office was again put in commission; and it continued to be held in this form till 1707, when Prince George of Denmark was appointed Lord High Admiral, with a council of four persons to assist him. On his death in November, 1708, the Earl of Pembroke was appointed his successor, with a similar council. The earl resigned the office in 1709, since which time, till now, it has always been in commission, with the exception of the period of about sixteen months (from May 1827, till September 1828), during which it was held by King William IV., then Duke of Clarence. The Commissioners, styled the Lords Commissioners of the Admiralty, were formerly seven, and are now six in number; and the first lord is always a member of the cabinet. It is the first lord, indeed, who principally exercises the powers of the office. The patent constituting the commission is issued by writ of privy seal, in the king's name, and after mentioning the names of the commissioners, it appoints them to be "our commissioners for executing the office of our High Admiral of our said United Kingdom of Great Britain and Ireland, and of the dominions, islands, and territories thereunto belonging, and of our High Admiral of Jamaica, Barbadoes, Saint Christopher, Nevis, Montserrat, Bermudas, and Antegoa, in America, and of Guiney, Binny, and Angola, in Africa, and of the islands and dominions thereof, and also of all and singular our other foreign plantations, dominions, islands, and territories whatsoever, and places thereunto belonging, during our pleasure; giving, and by these presents granting unto you, our said commissioners, or any two or more of you, during our pleasure, full power and authority to do, execute, exercise, and perform all and every act, matter, and thing which do belong or appertain to the office of our High Admiral," &c., as well in those things which concern the navy as in the things which concern "the right and jurisdiction" of the High Admiral.

Till the reign of Queen Anne the salary of the Lord High Admiral was only 300 marks; and the emoluments of the place, which were very large, arose chiefly from perquisites, or droits, as they were called, of various descriptions. Prince George of Denmark resigned all these droits into the hands of the crown, and received in their stead a salary of 7000*l.* a year. The salary of the First Lord is 4500*l.*, and his official residence is the Admiralty, Whitehall. The salary of the junior lords is 1000*l.*, and they have official residences; or, in case of the government not appropriating to them an official residence, a sum of 200*l.* is allowed instead.

The title of Admiral is also given in modern times to naval officers of the highest rank; of which we have in England three classes, namely, Admirals of the Red, of the White, and of the Blue. Admirals bear their flag at the main top-gallant-mast head; vice-admirals, at the fore top-gallant-mast head; and rear-admirals, at the mizen top-gallant-mast head. After the union with Scotland in 1707, the use of the red flag was discontinued, the union-jack being substituted for it; but it was resumed at the naval promotion which took place in 1805, after the battle of Trafalgar. There are also vice-admirals and rear-admirals of each flag, the former ranking with lieutenant-generals, and the latter with major-generals in the army. A full admiral ranks with a general, and an admiral who is actually the commander-in-chief of a fleet with a field-marshal. The title of Admiral of the Fleet is merely an honorary distinction. The sea-pay of the two admirals of the fleet, is 6*l.* per day; admirals, 5*l.* per day; vice-admirals, 4*l.* per day; and rear-admirals, 3*l.* per day. In addition to this pay, every commander-in-chief receives a further sum of 3*l.* per day while his flag shall be flying within the limits of his station.

There is no officer with the title of admiral in the navy of the United States of America (one has just (1859) had this rank and title conferred for his life). The highest office is that of commodore, which is given to captains commanding on stations.

ADMIRALTY COURTS, in Law, are courts having jurisdiction over maritime causes, whether of a civil or criminal nature. In England, the Court of Admiralty is held before the Lord High Admiral or his deputy, who is the judge of the court: when there was a Lord High Admiral, the judge of the Admiralty usually held his place by patent from him; but when the office of admiral is executed by commissioners, he holds his place by commission under the great seal.

The Court of Admiralty is usually called the Instance Court, to distinguish it from the Prize Court. The commissions to the judges are perfectly distinct, but are usually given to the same person. The Prize Court is only constituted n time of war. Neither is a Court of Record.

The Instance Court is usually held at Doctors'-Commons. The law it administers is composed of such parts of the civil law as treat of maritime affairs, together with the laws of Oleron and other maritime laws, and such alterations or amendments as have been introduced by Acts of Parliament, or usage which has received the sanction of legal decision. Its practice has been improved and its jurisdiction extended by the stat. 3 & 4 Vict. c. 65. An appeal from its judgments lies to the Queen in Council.

In criminal matters the Court of Admiralty has, partly by common law, partly by a variety of statutes, sole cognisance of piracy and all other indictable offences committed either upon the sea or on the coasts, beyond the limits of any English county (13 & 14 Vict. cc. 26, 27.) Its proceedings were according to the civil and maritime laws, until the statute 28 Henry VIII. c. 15 enacted that its proceedings should be according to the common law. The statute 7 & 8 Geo. IV. c. 28, next directed all offences tried in the Court of Admiralty to be punished in the same manner as if committed on land. A similar provision was made by 9 Geo. IV. c. 31. Ultimately, the Central Criminal Court in London was, by 4 & 5 Wm. IV. c. 36, empowered to determine offences committed within the jurisdiction of the Admiralty. By 7 & 8 Vict. c. 2, authority was given to the judges of assize and commissioners of oyer and terminer to try all offences within the jurisdiction of the Admiralty; so that, practically, the ordinary criminal courts now determine all prosecutions for offences within the Admiralty jurisdiction.

The civil jurisdiction of the Instance Court extends generally to marine contracts, that is, to such contracts as are made upon the seas,—as where the vessel is pledged during the voyage for necessary repairs; and to some few others, which, though entered into on land, are executed entirely upon the sea,—such as agreements for mariners' wages. If part of a cause of action arise on the seas and part on the land, the jurisdiction of the Admiralty Court is excluded. In contracts made abroad, they exercise in most cases a concurrent jurisdiction with the Courts of Common Law. The Admiralty Court has no cognizance of contracts under seal, except where, from the nature of the subject matter, it has exclusive jurisdiction; as in the case of an hypothecation bond, under which a ship is given in pledge for necessaries furnished to the master and mariners. This security binds the vessel on which the money is advanced. It imposes no personal contract on the borrower, and so does not fall within the cognizance of the common law. The Instance Court likewise regulates many other points of maritime right, such as disputes between part-owners of vessels, and questions relating to wreck and salvage. (9 & 10 Vict. c. 99.) It has also power to inquire into certain injuries committed on the high seas, such as collision, and in such cases to assess the damages to be paid to the party injured.

The Vice-Admiralty Courts established in our colonies are regulated by the 2 Wm. IV c. 51. They have a jurisdiction as to seamen's wages, pilotage, collisions, &c. (9 & 10 Vict. c. 99.) There is an appeal to the Queen in Council, that is, to the Judicial Committee of the Privy Council. (3 & 4 Wm. IV. c. 41.)

Offences committed on the sea may be dealt with in the colonies, as if the offence had been committed on waters within the local jurisdiction of the courts of the colony (12 & 13 Vict. c. 96. s. 1); and questions relating to the attack and capture of pirates may now also be determined in the Vice-Admiralty Courts abroad. (13 & 14 Vict. cc. 26, 27.)

The Prize Court is the only tribunal for deciding what is lawful prize, and for adjudicating upon all matters relating to prize. By 'prize' is understood every acquisition made *jure belli* (by the law of war), which is either itself of a maritime character, or is made, whether at sea or by land, by a naval force. All acquisitions by right of war belong, by the law of war, to the sovereign power in the state, but are usually, by the law of each particular state (as in England by several acts of Parliament), distributed in certain proportions among the persons who took or assisted in taking them. But agreeably to the law of nations, the property in the thing captured is not considered to be taken from the original owners until, by the sentence of a properly authorised court, it has been condemned as lawful prize. We have, as it should appear, no court authorised to adjudicate on property captured by land forces, or *booty*, as it is commonly termed by writers on the law of nations; but, when occasion requires (as when property to an immense amount was captured by the British army in the conquest of the Deccan), commissioners are specially appointed for the purpose. The 3 & 4 Vict. c. 65 enacts that the High Court of Admiralty shall have jurisdiction to decide all matters and questions concerning booty of war, that is, property captured by land-forces, when referred to it by the Privy Council. But property captured by the naval force forms the peculiar province of the Prize Court of the Admiralty. "The end of a Prize Court," says Lord Mansfield, "is to suspend the property till condemnation; to punish every sort of misbehaviour in the captors; to restore instantly, if upon the most summary examination there does not appear sufficient ground to condemn; finally, if the goods really are prize, against everybody, giving everybody a fair opportunity of being heard." (Douglas's Reports, p. 572, &c.) The Prize Court has also jurisdiction in matters of capture in port or on land, when the capture has been effected by a naval force, or a mixed naval and military force.

From prize causes, whether in the Court of Admiralty in England, or in the Vice-Admiralty Courts, an appeal lies directly to certain commissioners of appeal in prize causes, who are appointed by the crown under the great seal.

Vessels taken under the treaties for the suppression of the slave-trade are adjudicated by a mixed commission, composed of English and foreign commissioners.

In 1840 an act was passed (3 & 4 Vict. c. 66) to make provision for the judge, registrar, and marshal of the Court of Admiralty. It fixes the salary of the judge at 4000*l.*, with a retiring pension of 2000*l.* after fifteen years' service, or on becoming permanently disabled from performing his duties. The salary of the registrar is 1400*l.*, without fees. The registrar is appointed by the judge, and must be a proctor of not less than ten years' standing. One of the duties of the registrar is to attend the hearing of appeals before the Privy Council, instead of the registrars of the Court of Chancery, on whom this duty devolved under 3 & 4 Wm. IV. c. 41. On the next vacancy in the office of judge of the Admiralty, or judge of the Probate Court, these offices are to be united (20 & 21 Vict. c. 77).

All sovereign states which are engaged in maritime war, establish Admiralty Courts, for the trial of prizes taken by virtue of the commissions which they have granted. In determining prize cases, the Admiralty Courts proceed on certain general principles which are recognised among civilised nations. Thus the commission which empowers the Prize Court to determine cases of prize, requires it to "proceed upon all and all manner of captures, seizures, prizes, and reprisals of ships and goods, which are or shall be taken, and to hear and determine according to the course of the Admiralty and the law of nations."

The Court of Admiralty for Scotland was abolished by 1 Wm. IV. c. 69. The cases in their nature civil, formerly brought before this court, are now prosecuted in the Court of Session, or in that of the sheriff, in the same way as ordinary causes. The Court of Justiciary is the tribunal for the decision of the more important maritime offences. The inferior jurisdictions not dependent on the High Court of Admiralty were not abolished by the above act. (Burton's 'Manual of the Law of Scotland.') There is an Admiralty Court in Ireland, but a prize commissioner has never been sent to it. By s. 108 in the Corporations Reform Act (5 & 6 Wm. IV. c. 76) all chartered Admiralty jurisdictions were abolished; but that of the Cinque Ports, attached to the office of Lord Warden, was expressly reserved. (Stokes 'On the Colonies,' p. 357.)

(Dr. Browne's *View of the Civil Law*, and the *Law of the Admiralty*; Comyns's *Digest*, tit. 'Admiralty;' Blackst. *Comm.* Mr. Kerr's ed. iii. p. 76; iv. p. 314.)

ADMIRALTY, DROITS OF. [DROITS OF THE ADMIRALTY.]

ADMISSIONS, in a suit in equity, are those facts necessary to support the case of a plaintiff, or of a defendant, the necessity of proving which is removed by the opposite party admitting them.

Admissions are either, 1, Upon the record; or, 2, By agreement between the parties.

1. Admissions upon the record, again, are either Actual or Constructive.

Actual Admissions are those which appear in the bill or in the answer. A plaintiff cannot read any part of his bill in evidence, unless it is corroborated by the answer.

Of *Constructive Admissions*, the most ordinary instance is when a plea has been put in either to the whole or part of a bill; in which case the bill, or that part of it pleaded to, and not controverted by the plea, is admitted to be true.

A plaintiff may rest satisfied with the admission, and need not prove the fact not controverted by evidence.

Again, the statement of facts contained in a plaintiff's bill is in equity (but not at law) constructive admission as against him of the facts as stated, when the allegation is positive, as of his own acts, or of facts within his knowledge, but not when they are stated hypothetically, for the purpose of raising an answer to an anticipated defence, with a protest against their being considered as admitted; and the bill may be read as evidence of the facts so positively averred, not only in the suit in which the bill is filed, but in another suit.

There is a difference between actual and constructive admissions, in the manner in which they are presented to the court. The former are read to establish the case of the party reading them, in the same manner as the other evidence in the cause; the latter are stated to the court when the pleadings are opened, for the purpose of showing what are the matters in issue between the parties, and what are the facts which by the form of the pleadings they are precluded from disputing.

In an answer, not only the simple admission of a fact, but the statement of a defendant that "he believes," or has been "informed, and believes" such a fact to be true, is sufficient, unless the statement be accompanied by some clause to prevent its being considered as an admission. The answer of an infant, being in fact the answer of his guardian, cannot be used against the infant. But the rule is different with respect to the answer of an idiot or lunatic put in by his committee, or that of a person of weak intellect put in by his guardian. In these cases, admissions in the answers are evidence against them. The joint answer of a husband and wife may be read against them in matters relating to the wife's personal estate; but neither the joint answer, nor the separate answer of the husband, with relation to her inheritance. The answer of one defendant is not evidence against a co-defendant, unless where a defendant makes it so by referring to a statement in the answer of his co-defendant.

The courts of equity permit the plaintiff to read any portion of the answer which he thinks will support his case, provided that, in reading the admission of a fact, he reads at the same time any admissions or qualifications with which it is accompanied, and the whole of the passage in which the admission is contained. The rule is different in courts of law, in which, if an answer in equity is offered in evidence against a party, he has a right to insist upon the whole being read.

2. Admissions by agreement between the parties are those which the parties or their attorneys or solicitors agree upon between themselves, for the sake of saving expense or preventing delay. They are usually made in writing, and signed by the parties or their solicitors, but not necessarily so. Agreements for admissions will not be sanctioned by the court if they violate any known principles of law. Thus, there can be no agreement to waive an objection to an instrument for want of a stamp.

(Daniell's *Chancery Practice*, by Headlam, 3rd. ed. vol. i. p. 669, et seq.)

ADMITTANCE. [COPYHOLD.]

ADOPTION (from *adoptare*) means taking by choice. By the Roman law, if a person had no children of his own, he might appoint any other person's, whether related to him or not, to be his children *by adoption*. In order to understand the ordinary mode of adoption and its legal effects, it must be remembered that the relation of father and son was very analogous to that of master and slave, both in the rights and duties attached to it, and in the manner in which it was dissolved. Hence, under the old law (that is prior to Justinian's time) if a person wished to adopt the son of another, the natural father sold the boy to him by a regular sale before a magistrate. In order that he might be emancipated from his father's authority, so as never to fall under it again, it was requisite that this sale should be repeated *three* several times. In strict accordance with the direction of the old law, which is thus laid down in the XII Tables, "Si pater filium *ter* venumduit filius a patre liber esto." [EMANCIPATION.] The father thus lost all his paternal rights over the child, who by this triple sale as regarded the purchaser, was put *in mancipio*, and did not become his filius familias until a fictitious suit or feigned recovery took place (called *cessio in jure*) when the child became, to all intents and purposes, a member of the family of his purchaser or adopter. If the person to be adopted was *sui juris*, that is, his own master, the mode of proceeding was by a bill (analogous to our private acts of parliament) proposed to the people in the comitia curiata. (Aul. Gell. 'Noct. Att.' v. 19, Cicero 'Pro Domo,' 29.) This was called *Arrogation*, from *rogare*, to propose a bill. In either case the adopted child became subject to the authority of his new father; passed into his family, name, and sacred rites, and succeeded to his property. Clodius, the enemy of Cicero, passed by this ceremony from the patrician to the plebeian rank, in order to qualify him to be tribune. (Cic. 'Pro Domo,' 12, 13; Suet. 'Tiber. Nero,' 2.)

The history of Rome abounds with instances of adoption. One of the sons of Paulus Æmilius, the conqueror of Macedonia, was adopted by the son of Scipio Africanus the Elder, and having thus passed from the *Æmilian* into the *Cornelian gens*, acquired the name of Publius Cornelius Scipio Æmilianus, to point out the family of his birth and adoption; when he destroyed Carthage in the third Punic War, he received, like his adoptive grandfather, the appellation of Africanus, and is usually spoken of as Scipio Africanus the Younger.

Under the emperors the mode of adoption became the subject of reform; and that which for many ages could be effected only by a circuitous course of arbitrary forms, founded upon legal fictions, was allowed to be done by a short and simple process before a magistrate.

There was also a custom of adopting children by will, which was not only in vogue in the days of the Republic, but was even known in very ancient times, when it was not unusual for the Romans to adopt (*adsci scere*) their *heredes sui* or children into their nomina. (Cic. 'de Offic.' iii. 18; Corn. Nep. 'Offic.' c. 5; Suet. 'Jul.' 83; Tacit. 'Annal.' 3, 30; and Ovid, 'Metamorph.' xv. 818.) Julius Cæsar thus adopted his great nephew Octavius, who was thenceforth called Caius Julius Cæsar Octavianus, but is generally known under the appellation of Augustus, which he afterwards assumed. (Heineccius, 'Antiquitates Romanæ,' lib. i. tit. xi.) In like manner, several emperors adopted their successors; for instance, Augustus adopted his grandson Agrippa, and his step-son Tiberius. (Tacit. 'Ann.' i. 3; Suet. 'Aug.' 65.) So Tiberius, by the order of Augustus, adopted his nephew Germanicus, who died in the lifetime of Tiberius; and on the death of Tiberius, Caligula, the son of Germanicus, became emperor. At a subsequent period, Claudius went so far as to adopt his step-son Domitius, afterwards the Emperor Nero, to the exclusion of his own son Britannicus. Tacitus remarks, that Nero was the first stranger in blood ever adopted into the Claudian family. (Tacit. 'Annal.' xii. 25.) At various periods of Roman history so great inconvenience was experienced in consequence of the general disinclination to marriage, that rewards were held out for its encouragement, and penalties imposed upon celibacy. Immunities from state burdens were given to those who possessed many children; and to obtain these, the adoption of children became a great abuse. Aulus Gellius, in his short notice of the legal forms and effects of adoption, cites an oration of P. Scipio the Censor, who complains of the custom prevalent in his time, that "an adoptive son should entitle his adoptive father to privileges in the state." (Aul. Gel. 'Noct. Att.' v. 19.) Under Julius Cæsar, after the wars, laws for the encouragement of population were proposed, but not carried into effect; but under Augustus the Julian law was proposed, A.U.C. 736, which contained heavy penalties upon celibacy, and proportionate rewards for the possession of children. This law was so unpopular, that, Suetonius says, it could not be executed. (Sueton. 'Aug.' 34.) Afterwards however a law passed, called from the consuls who introduced it, 'Lex Papia Poppæa,' by which, among other privileges given to those who possessed children, it was declared that, of candidates for prætorships and other offices, those should have the preference who had the greatest number of children. This occasioned what Tacitus calls, in speaking of the time of Nero, a "pestilent abuse, which was practised by childless men, who, whenever the election of magistrates was at hand, provided themselves with sons by fraudulent adoptions; and afterwards, when in common with real fathers they had obtained prætorships, instantly released themselves from their adopted sons." The genuine fathers petitioned for relief, which produced a decree, that in the pursuit of any public employment whatever, no feigned adoptions should be of any avail, nor in taking estate by will. (See Tacit. 'Annal.' xv. 19.)

The eleventh title of the first book of Justinian's 'Institutes' relates to adoption. There were then two kinds of adoption, one called *arrogatio*, when by a rescript of the emperor (*principali rescripto*), which had, it will be recollected, replaced the authority of the comitia, a person adopts another who is *sui juris;* the other, when by authority of the magistrate (*imperio magistratûs*), he who is under the control of his parent (*alieni juris*) is made over to another person, and adopted by him either as his son, his grandson, or a relation in any inferior degree. Females might be adopted in the same manner. But when a man gave his child to be adopted by a stranger, the parental authority did not pass from the natural to the adoptive father; the only effect was, that the child succeeded to the inheritance of the latter if he died intestate. It was only when the adopter was the child's paternal or maternal grandfather, or otherwise *in loco parentis*, so that the right of nature concurred with that of adoption, that the new connection became the same as an original one. The adopter must in all cases have been at least eighteen years older than the person he adopted. Women, according to the laws of Justinian, were not entitled to adopt; but after having lost children by death, they might, by the indulgence of the emperor, be permitted to receive those of others in their place. A slave, on being named a son by his master before a magistrate, became free, but acquired no filial right.

The intimate connection between the *Patria potestas* and *adoptio* must never be lost sight of; because that explains the importance of the subject now under discussion, and the reason why its rules were so carefully and accurately developed; for adoption really was the act by which an individual was received into the position of a son or grandson, not so much from motives of affection on the adopter's part as from those of policy, enabling the adopter to acquire a *patria potestas*, and thus conferring by a fictitious parentage civil and agnate rights. Hence we may see the force of the expression, "Filios familias non solum natura verum et adoptiones faciunt" (D. 1, 7, 1); and "Adoptio non jus sanguinis, sed jus agnationis affert" (D. 1, 7, 23).

The German system of adoption is derived from the Roman law, though it cannot be said, according to the proper meaning of the word, to have been in force before the 15th or 16th century. Any adoption, in order to be strictly and properly a legal process, must take place before a court, or be confirmed by the proper authorities. The adopted son retains his family name, and prefixes or adds to it that of his adoptive father; but in case a nobleman adopts a commoner, the son does not succeed to the rank, unless it is confirmed by the sovereign. The more modern German institutes still keep to the principles of the Roman system of adoption, though the whole is modified so as to be more in harmony with German usages. The Prussian law does away with all distinction between *adoption* and *arrogation;* and allows the adopted son who is of age to manage his own property. The Austrian law does the same. Both also agree in requiring the age of the adoptive father to be fifty at least. The Prussian law, with respect to the adopted son, merely requires him to be younger than the father; while the Austrian code requires him to be eighteen years younger than the adoptive father. (Ersch and Gruber's 'Encyclopädie,' art. 'Adoption.')

The French law is to be found in the eighth title of the first book of the 'Code Civil.' Adoption is permitted to persons of either sex, provided they are above the age of fifty, having neither children nor other legitimate descendants, and being at least fifteen years older than the individual adopted. It can only be exercised in favour of one who has been an object of the adopter's constant care for at least six years during minority, or of one who has saved the life of the adopter in battle, from fire, or from drowning. In the latter cases, the only restriction respecting the age of the parties is, that the adopter shall be older than the adopted, and shall have attained his majority, or his twenty-first year, but he or she must also be without children or lawful descendants, and if married must obtain the consent of the conjunct. In every case the party adopted must be of the age ef twenty-one. The form is for the two parties to present themselves before the local judge (*juge de paix*) for the place where the adopter resides, and in his presence to execute an act of mutual consent; after which the transaction, before being accounted valid, must be approved of by the next superior court, the *tribunal of first instance*, within whose jurisdiction the domicile of the adopter is. The adopted takes the name of the adopter in addition to his own; and no marriage can take place between the adopter and either the adopted or his descendants, or between two adopted children of the same individual, or between the adopted and any child who may be afterwards born to the adopter, or between the one party and the wife of the other. The adopted acquires no right of succession to the property of any relatives of the adopter; but as to the property of the adopter he has the same rights as a child born in wedlock, and that, even although there should be other children of the latter description born after his adoption. It has been decided in the French courts that aliens cannot be adopted.

Adoption is still practised among the Turks, and other eastern nations. It is common for a rich Turk, who has no children of his own, to adopt as his heir the child of persons even of the poorest class. The bargain is ratified before the Cadi, and their mutual consent recorded; after which the child cannot be disinherited by his adoptive father. D'Herbelot states, that, according to the law of Mohammed, a person becomes the adopted son of another by undergoing the ceremony of passing through his shirt; whence the expression, to draw another through one's shirt, signifies to adopt him for a son. In India the same thing is said to be frequently done by the two parties merely exchanging girdles. In the Code of Gentoo Laws published by Mr. Halhed, the 9th section of the 21st chapter is entitled 'Of Adoption.' The law permits a child under five years of age to be given up for adoption by its father for a payment of gold or rice, if he have other sons, on the parties going before a magistrate and having a *jugg*, or sacrifice, performed. A woman, however, it is added, may not adopt a child without having her husband's consent; and there is even some doubt if she may with that. "He," concludes the law, "who has no son, or grandson, or grandson's son, or brother's son, shall (may?) adopt a son; and while he has one adopted son, he shall not adopt a second."

There is no *Adoption* in the English or Scottish system of law: though we find mention of it in Bracton l. 2 c. 29 n. 4, 5 (but see Coke, 2 'Inst.' 97). The courts have, however, recognised it as a matter of feeling and affection, in the case of seduction allowing an adopter to stand *in loco parentis*, and a compensation to be given, not only for mere loss of services, but also for the aggravated injury done to the object of affection. (Edmonson *v.* Machell, 2 T. R. 4; Irwin *v.* Dearman, 11 East. 23.)

ADULT-SCHOOLS are establishments for instructing in reading and other branches of knowledge, those persons who had not been educated in their youth. They were designed to meet the wishes of people who were no longer contented to remain uninstructed, and who did not think that the privation of an early education should necessarily entail upon them the evil of perpetual ignorance.

The first school avowedly established for the purpose of instructing adults, was formed in 1811, through the exertions of the Rev. T. Charles, a clergyman in Merionethshire. Some grown-up persons had previously attended his parish Sunday-school, but they showed a disinclination to learn with children, and this circumstance led to the adoption of more extended views for their benefit. Considerable success both in the number and progress of the pupils, and their improved conduct and character, caused the establishment of other adult-schools throughout Wales.

About the same time, and without any concert or connection with the schools in Wales, a school was established at Bristol through the instrumentality of W. Smith. This person, "who collected the learners, engaged the teachers, and opened the two first schools in England for instructing adults exclusively, in borrowed rooms, and with borrowed books" (Pole's 'History and Origin of Adult Schools'), was the door-keeper to a dissenting chapel. He devoted three out of eighteen shillings, his weekly earnings, to defray the expense of giving to his brethren the means of studying the Scriptures, and of obtaining knowledge from other sources. A short time after these first efforts were made, a society was formed for the furtherance of his benevolent views. In the first report of this society, dated April, 1813, it was stated, that 222 men and 231 women were already receiving education. Adult-schools were soon afterwards established in different parts of the kingdom, at Uxbridge, Norwich, Ipswich, Sheffield, Salisbury, Plymouth, and other places.

The extension, however, and the great improvements made in the education of the young, seems to have interfered very materially with such schools as are mentioned above. Few, except under particular circumstances or the patronage of some benevolent individuals, now exist. What may now be called adult-schools are of a far higher character, and have been instituted to enable young men who have received the rudiments of an early education to continue their progress, either in particular departments or in general knowledge, in the hours which they can spare from their business occupations. Of such a nature are the classes in various Mechanics' Institutes, the Crosby Hall evening classes for young men, at the Working Men's Colleges in Sheffield, at Salford, at Wolverhampton, and in Great Ormond Street, London; by the lectures to working-men given at the Geological Museum in Jermyn-street, the Edinburgh Apprentice Schools, and various other places of a similar character. These are very numerous, and productive no doubt of great advantage, not only to individuals but to society; there is, however, no record by which we can ascertain the numbers. The evening classes at King's College, London, are of a somewhat higher character, as giving the privilege of an university examination, and they are numerously attended. A great portion of those attending are young men, but not a few are men of middle age.

But though progress has thus far been made, there is yet a lamentable deficiency of education among the labouring classes. In 1856, there were 29 per cent. of the men, and 40 per cent. of the women, who could not write their names on their marriage. Still, this is an improvement: in 1841, the per centage was 33 of the men, and 49 of the women. As the improvements in education are of course among the more youthful, it is to be expected that even the later numbers will now rapidly decrease. The number of persons who could not write their names in the marriage register of 1856, indicates the state of education some twelve or fifteen years earlier.

ADULTERATION (from the Latin *Adulteratio*) is the use of ingredients, in the production of any article, which are cheaper and not so good, or which are not considered so desirable by the consumer, as other or genuine ingredients for which they are substituted. The sense of the Latin word is the same. (Pliny, 'Hist. Nat.' xxi. 6.) The law does not consider adulteration generally as an offence, but relies apparently on an evil of this nature being corrected by the discrimination and good sense of the public. The selling of unwholesome provisions, as meat or fish, is generally punishable under local acts. The 51 Hen. III. st. 6 prohibited the sale of unwholesome flesh, or flesh bought of a Jew, under pain of fine and imprisonment. In Paris, malpractices connected with the adulteration of food are investigated by the Conseil de Salubrité, acting under the authority of the prefect of police. In this country, strict regulations have been resorted to in order to prevent adulteration.

Tobacco-manufacturers are liable to a penalty of 200*l.* for having in their possession sugar, molasses, honey, roots of malt, ground or unground roasted grain, ground or unground chicory, lime, ochre, or other earths, sea-weed, ground or powdered wood, moss or weeds, or any leaves, or any herbs or any substance, syrup, liquid or preparation, capable of being used as a substitute for, or to increase the weight of, tobacco or snuff (5 & 6 Vict. c. 93, § 5). Any person engaged in the preparation of articles to imitate tobacco or snuff, or who shall sell such articles to any tobacco-manufacturer, is liable to a penalty of 200*l.* (§ 8). The penalty for adulterating tobacco or snuff is 300*l.* (§ 1); and for having such tobacco or snuff in possession, 200*l.* (§ 3). The t ade in tobacco as to licences, &c., is regulated by the above-mentioned statute, and the 3 & 4 Vict. c. 18.

The ingredients used in the adulteration of beer are enumerated in the list of articles which brewers or dealers in beer are prohibited from having in their possession under a penalty of 200*l.* (56 Geo. III. c. 58, § 2). These articles are—molasses, honey, liquorice, vitriol, quassia, cocculus Indicus, grains of Paradise, Guinea pepper, and opium. Preparations from these articles are also prohibited. They are used as substitutes for hops, or to give a colour to the liquor in imitation of that which it would receive from the use of genuine ingredients; § 3 of the act imposes a penalty of 500*l.* upon any chemist, or other person, who shall sell the articles mentioned to any brewer or dealer in beer. The penalties against dealers are extended to beer-retailers under the 11 Geo. IV. and 1 Wm. IV. c. 64, and 4 & 5 Wm. IV. c. 85, which contain special provisions against adulteration applicable to this class of dealers. These provisions are continued and extended by the 3 & 4 Vict. c. 61. The 5 & 6 Vict. c. 30, makes regulations for the preparation and use of roasted malt in brewing, and the 10 Vict. c. 5, 13 & 14 Vict. c. 67, and 17 & 18 Vict. c. 30 allow sugar to be used, subject to regulations of the Commissioners of Inland Revenue.

Selling 'corrupted wine' is punishable under the 51 Hen. III. st. 6. By the 12 Car. II. c. 25, the adulterating of wine is punishable with a fine of 100*l.* on the merchant, 40*l.* on the vintner; and additional regulations are made by 1 Wm. & M. st. 1. c. 39.

Tea, another important article of revenue, is protected from adulteration by several statutes. The act 11 Geo. I. c. 30, § 5, renders a teadeal r liable to a penalty of 100*l.* who shall counterfeit, adulterate, or manufacture any tea, or mix with tea any leaves other than leaves of tea (§ 5). Under 4 Geo. IV. c. 14, tea-dealers who dye, fabricate, or manufacture any sloe-leaves, liquorice-leaves, or the leaves of tea that have been used, or other leaves in imitation of tea; or use terra japonica, sugar, molasses, clay, logwood, or other ingredients, to colour or dye such leaves; or sell or have in their possession such adulterated tea, are liable to a penalty of 10*l.* for every pound of such adulterated tea found in their possession (§ 11). The 17 Geo. III. c. 29, also prohibits adulteration of tea (§ 1).

The adulteration of coffee and cocoa is punished under 43 Geo. III. c. 129. Any person who manufactures, has in his possession, or sells burnt, scorched, or roasted peas, beans, grains, or other grain or vegetable substance prepared as substitutes for coffee or cocoa, is liable to a penalty of 100*l.* (§ 5). The object of § 9 of 11 Geo. IV. c. 30, is similar. Chicory is extensively used in the adulteration of coffee. This root came into use on the Continent in consequence of Bonaparte's decrees excluding colonial produce, and coffee with which a fourth or a fifth part of chicory has been mixed is by some persons preferred as a beverage to coffee alone. The Excise has for some time permitted the mixture of chicory with coffee. Besides the quantity imported, chicory is also grown in England.

The manufacturer, possessor, or seller of adulterated pepper is liable to a penalty of 100*l.* (59 Geo. III. c. 53, § 22).

The act 9 Geo. IV. c. 44, § 4, extends the various acts relative to the excise on tea, coffee, cocoa, pepper, &c., to the United Kingdom.

All penalties prosecuted by the Excise are by § 2 of the same statute to be recovered according to 8 Geo. IV. c. 53 (see 12 & 13 Vict. c. 1); but if they are incurred within the limits of the chief office of Inland Revenue in London, the information may, by the 15 & 16 Vict. c. 61, be determined by justices of the peace.

As regards the important article of bread, the act 6 & 7 Wm. IV. c. 37 (which repealed the several acts then in force relating to bread sold beyond the city and liberties of London, and ten miles of the Royal Exchange), was also intended to prevent the adulteration of meal, flour, and bread beyond these limits. No other ingredient is to be used in making bread for sale except flour or meal of wheat, barley, rye, oats, buckwheat, Indian corn, peas, beans, rice, or potatoes, mixed with common salt, pure water, eggs, milk, barm, leaven, potato or other yeast, in such proportions as the bakers think fit (§ 2). Adulterating bread, by mixing other ingredients, is punishable by a fine of not less than 5*l.* nor above 10*l.*, or imprisonment not exceeding six months: and the names of the offenders are to be published in a local newsp per (§ 8). Adulterating corn, meal, or flour, or selling flour of one sort of corn as flour of another sort, subjects the offender to a penalty not exceeding 20*l.* and not less than 5*l.* (§ 9). The premises of bakers may be searched, and if ingredients for adulterating meal or flour be found, the penalty for the first offence is 10*l.* and not less than 40*s.*; for the second offence 5*l.*, and for every subsequent offence, 10*l.*; and the names of offenders are to be published in the newspapers (§ 12). There are penalties for obstructing search (§ 13). Any miller, mealman, or baker acting as a justice under this statute, incurs a penalty of 100*l.* (§ 15).

The above act did not apply to Ireland, where the baking trade was regulated by an act (2 Wm. IV. c. 31), the first clause of which, relating to the ingredients to be used, was similar to the English act just quoted. In 1838 another act was passed (1 Vict. c. 28), which repealed all former acts relating to the sale of bread in Ireland. The preamble recited that the act 6 and 7 Wm. IV. c. 37, had been found beneficial in Great Britain; and the clauses respecting adulteration are similar to the English act.

The several acts for regulating the making of bread within ten miles of the Royal Exchange (which district is excluded from the operation of 6 & 7 Wm. IV.) were consolidated by the act 3 Geo. IV. c. cvi. Under this act any baker who uses alum, or any other unwholesome ingredient, is liable to the penalties mentioned in § 12 of 6 & 7 Wm. IV. c. 37. Any ingredient or mixture found within the house, mill, stall, shop, &c. of any miller, mealman, or baker, and which shall appear to have been placed there for the purpose of adulteration, renders him liable to similar penalties.

Other articles besides those which have been mentioned are adulterated to a great extent, and there is scarcely an article, from arrowroot to guano, which escapes. The interference of Government with the practice of adulteration, except in the case of bread and drugs [APOTHECARIES' COMPANY], has had no other object than the improvement of the revenue.

Adulteration and the deceitful making up of commodities attracted the attention of the legislature in the 16th century, and several acts were passed for restraining offences of this nature.

ADULTERY, the offence of incontinence between two married persons, or between two persons, one of whom is married. In the latter case it is called *single*, in the former, *double* adultery. (Cowel, 4.)

This crime was punished by the Jewish law with death; but the adultery which by the Mosaic law constituted a capital crime, was not every violation of chastity of which a married person might be guilty, but only the sexual connection of a wife with any other man than her husband. This distinction was part of the Jewish marriage-law, by which the husband and wife had not an equal right to restrain each other from infidelity. The former might marry other wives, or take concubines and slaves to his bed, without giving his first wife a right to complain of any infringement of her matrimonial rights. The punishment, however, of incontinence in a married woman with a stranger, was, by the Levitical law, death by stoning, both in the case of the stranger and the adulteress. (Levit. xx. 10, and Michaelis, 'Mosaisches Recht.') By the Athenian law, the husband might kill the adulterer, if he detected him in the act of dishonouring him. (Lysias's 'Oration on the Death of Eratosthenes.')

The Roman corresponds with the Hebrew law. Civilians define adultery to be the violation of another man's bed (*violatio tori alieni*); so that the infidelity of a husband could not constitute the offence. The more ancient laws of Rome, extremely severe against the offence of the wife, were silent as to that of the husband. By an old law, an adulteress was to be slain by her husband and his relations (*adulterii convictam vir et cognati uti volent necanto*). At a later period, by the Lex Julia (Dig., l. 48, t. 5; Paulus, Sentent. Recept. ii. 26), passed in the time of Augustus, about 17 B.C., adultery in the wife was punishable by banishment; she forfeited half her dowry and a third part of her property. The adulterer forfeited half his goods to the public use, and was also banished. But although by the Julian law adultery was not punishable with death by legal sentence, the father, natural or adoptive, of the adulteress was in some cases permitted to kill both her and her paramour; and in some cases the husband had the same power. A constitution of Constantine made adultery a capital offence in the male. (Cod. ix. t. 30.) Justinian (Novel. 134, c. 10) confirmed the law of Constantine, and added confinement in a convent as the punishment of the adulteress, after she had been whipped.

By the canon law, now more or less interwoven into the municipal laws of most Christian countries, adultery is defined to be the violation of conjugal fidelity. Consequently, incontinency in the wife or the husband stand on the same foundation. Hence arises the distinction between single and double adultery, already alluded to, which are punishable in various ways in most of the countries of modern Europe, but in none of them, at the present day, is either of these offences capital, and in few of them, in fact, is the public offence punished at all.

There are faint traces of the punishment of adultery as a crime in the early periods of the history of English law. Lord Coke says that in ancient times it was within the jurisdiction of the sheriff's tourns and court-leet, and was punished by fine and imprisonment (3 Inst. 306); but at the present day adultery is not the subject of criminal prosecution. Till quite recently it was only cognisable as an offence in the Ecclesiastical Courts; but instances of criminal prosecutions there are extremely rare. If instituted and followed out to the conviction of the parties, the infliction of a slight fine or penance "for the benefit of the offender's soul" (*in salutem animæ*), as it is termed, would be the only result. In 1604 (2 James I.) a bill was brought into Parliament "for better repressing the detestable crime of adultery," but it was dropped. (Parl. History, vol. v. p. 88.) During the Commonwealth, adultery in either sex was made a capital felony (Scobel's 'Acts,' part ii. p. 121); at the Restoration this law was discontinued.

Adultery however, till the erection of the Court for Divorce [DIVORCE], came under the cognisance of the temporal courts in England as a private injury to the husband. A man might maintain an action against the seducer of his wife, in which he might recover damages as a compensation for the loss of her services and affection in consequence of the adultery. This was felt to be a scandal and a reproach to the law of England, and the action of *crim. con.* was accordingly abolished (20 & 21 Vict. c. 85), "but by an unpardonable omission in legislation, this is accomplished in words only, whilst in effect—indeed in words equally plain—a similar right of action is given to the husband through the instrumentality of the Court, but to be tried by a jury. A man may now recover damages for his wife's infidelity without seeking for a divorce, but may continue to live with her upon the damages recovered from the paramour, which may be settled upon her and upon the children. Even when a divorce is obtained, the damages may be settled upon the children of the marriage; and the father may live with his children whilst they are maintained and educated with the price of their mother's dishonour." (Lord St. Leonard's, 'Handy Book,' p. 77.)

In Scotland, the Act 1563, c. 74, punished the notorious and habitual adulterer, man or woman, with death. The latest instance of sentence of death in Scotland for adultery is perhaps that of Margaret Thomson, May 28, 1677. All the statutes on the subject have, according to the peculiar practice of Scotland, expired by long desuetude. In the 17th and the commencement of the 18th century, the church courts were very active in requiring the civil magistrate to adjudicate in this offence; but this means of punishment was rendered nugatory by the 10th Anne c. 7, § 10 (the Toleration Act), which prohibited civil magistrates from giving effect to ecclesiastical censures. Of late years the doctrine has been admitted by Scottish lawyers, that the seduction of a wife is good ground for an action of damages; but such prosecutions are wholly unknown in practice. Adultery alone is in Scotland a good ground on which to obtain a divorce. (Hume, 'On Crimes,' i. 452–458; Stair's 'Institutes,' b. i. tit. 4, s. 7; Erskine's 'Institutes,' b. i. tit. 6, s. 43.)

The French law (Code Pénal) makes it excusable homicide if the husband kill the wife and the adulterer in the act of adultery in his own house. The punishment of a woman convicted of adultery is imprisonment for not less than three months, and not exceeding two years; but the prosecution can only be instituted at the suit of the husband; and the sentence may be abated on his consenting to take back the wife. The paramour of a wife convicted of adultery is liable to imprisonment for not less than three months, or for a period not exceeding two years; and to a penalty of not less than 100 francs, or not exceeding 2000 francs.

In the state of New York, the Court of Chancery is empowered to pronounce a complete divorce in the case of adultery, and in no other cases, upon the complaint either of the husband or the wife. The process is by bill filed by the complaining party. If a divorce is pronounced, the defendant is disabled from marrying during the lifetime of the other party.

ADVENT, literally, the approach or coming, is the space of four weeks preceding Christmas, appointed in the English and other Christian Churches to be kept holy in celebration of the approach of our Saviour's nativity or manifestation. Anciently, the season of Advent consisted of six weeks, and, commencing therefore about Martinmas, used to be called the *Sancti Martini Quadragesima*, or the Forty Days' Lent of St. Martin. It is still of this duration in the Greek Church. The first Sunday in Advent, commonly called Advent Sunday, is now the Sunday, whether before or after, which falls nearest to St. Andrew's day (the 30th of November).

ADVENTURE, BILL OF, a writing signed by a merchant, stating that the property of goods shipped in his name belongs to another, the adventure or chance of which the person so named is to stand, with a covenant from the merchant to account to him for the produce. In commerce an 'adventure' is a speculation in goods sent abroad under the care of a supercargo, to dispose of to the best advantage to his employers.

ADVERB, in grammar, the name given to a class of words employed with verbs, adjectives, &c., for the purpose of qualifying their meaning, just as the adjective itself is attached to substantives. In the English language a very large majority of adverbs are distinguished by the termination *ly*, which in the Anglo-Saxon has the fuller form *lice*, and in German, *lich*. Our own language possesses the same suffix in the form *like*, as *godlike, gentlemanlike*. These, however, and many other words in *ly*, are adjectives, as *manly, ugly*; and it is difficult to draw the line between these two classes, many words, especially in the older writers, being used indifferently for both [ADJECTIVE]. The word to which the adverbial suffix *ly* is added is generally an adjective, but occasionally the adjective has become obsolete in the present form of our language, and must be sought in the Anglo-Saxon. Thus *early* is derived from the Anglo-Saxon *aer*, which indeed still appears in the now poetical forms *ere*, and the superlative *erst*. But though the termination *ly* is derived from the Teutonic portion of our language, it has been applied most freely to adjectives of Latin origin, as *publicly, privately*; and with these may be classed the adverbs from adjectives in *ble*, as *horribly, agreeably*, in which the liquid belongs at once to the adjective and the suffix. An important class of adverbs are formed by prefixing the old Saxon preposition *an* or *on* to nouns, in which a careless pronunciation afterwards left nothing but the vowel *a*, as *on fote*, now *a-foot*. Lastly, we have an interesting though ludicrous formation depending upon alliteration, *helter-skelter, hurry-skurry, pell-mell, higgledy-piggledy*, &c. The same love of alliteration, which is said to have formed an important element in Anglo-Saxon versification, has also given rise to some adjectives and substantives, as *hum-drum, slip-slop, tip-top, tittle-tattle, hurly-burly*.

ADVERTISEMENT, from the French *avertissement*, which means an announcement or notice of any kind, is the general name of those announcements published in newspapers, magazines, and other works appearing periodically, whatever be their peculiar character. The first English advertisement which can be found, is in the 'Impartial Intelligencer,' for 1649, and relates to stolen horses. In the few papers published from the time of the Restoration to the imposition of the Stamp Duty, in 1712, the price of a short advertisement appears seldom to have exceeded a shilling, and to have been sometimes as low as sixpence. [Nichols's 'Literary Anecdotes,' vol. iv.] The practice of advertising soon began to increase, till the tax was imposed upon advertisements in 1712. This might check, but could not stop, the increase of a practice found to be so advantageous in all commercial transactions as well as in many other affairs. Advertisements continued to multiply, not only in number, but in the organs through which they were diffused, and soon began to be not only a considerable means of support to the medium in which they appeared, especially to the newspapers, but a source of revenue to the country. The tax on each advertisement, whatever its length, was formerly 3*s*. 6*d*.; and in the year 1832, the total number of newspaper advertisements in the United Kingdom was 921,943, viz., 787,649 in England, 108,914 in Scotland, and 125,380 in Ireland—the duty amounting to 172,570*l*. But the tax was felt to be an unfair and an oppressive one, and the number and the amount continued nearly stationary for several years. In 1833, therefore, the act of 3 and 4 Wm. IV. cap. 23, passed June 28, reduced the duty to 1*s*. 6*d*. on each advertisement in England, and to 1*s*. in Ireland, the loss to the revenue being estimated by the Chancellor of the Exchequer at 70,000*l*. Advertising again took a start, and in 1841 the total number of advertisements in the United Kingdom amounted to 1,778,957, and the duty to 128,318*l*. The income thus derived to the newspapers was largely expended in improving them; their size was universally enlarged, in some cases doubled; and as the number of newspapers did not materially increase, the circulation also doubled. The 'Times,' which had been for many years a large advertising paper, contained 1474 superficial square inches of print on each side, and in 1836 it commenced issuing supplementary sheets, frequently of equal size, and at other times of half that size. In 1845 during nine weeks from Sept. 6 to Nov. 1, it was stated in an interesting article on the curiosities of advertising, in Vol. xcvii. of the 'Quarterly Review,' that the receipts of the 'Times' for advertisements were 44,056*l*. On Aug. 4, 1853, by the 16 &

17 Vict. cap. 63, the duties on advertisements were remitted altogether. In the year ending Jan. 5, 1851, there had appeared in English and Scotch newspapers 2,016,422 advertisements, and 236,128 in Irish newspapers, producing together a revenue from the tax of 326,075*l.* 11*s.* In June 1855 the compulsory stamp on newspapers was also remitted, the stamp being used solely for postage purposes. This has given a fresh impulse to advertising, by occasioning the establishment of extremely cheap newspapers, many of which contain a printed superficies of about 1300 square inches on each side, and are sold for a penny. To give an example of the extent of advertising, we may state that the double number of the 'Times' for January 5, 1859,—being an average number—contains 2305 advertisements. In nearly every case advertisements supply the fund out of which newspapers are supported, as the price, even of the higher-priced papers, is insufficient to pay the cost of the paper, the printing, the editing, the collecting of news—a most important and heavy item, and the management. The prices charged for advertisements vary according to the amount of circulation of the paper, and in some degree according to the character of the advertisement, short advertisements, not exceeding three lines, of persons wanting situations, being charged in some cases as low as 1*s.* Now the duty is off, there are no returns made for fiscal purposes, and it has become nearly impossible to ascertain the exact number of advertisements published annually, but it may be confidently stated that they have at least doubled; that is, they now amount to upwards of four millions in the United Kingdom. In the United States of America, where no duty is imposed, they are estimated to amount to ten millions. It was certainly wise to remove all obstructions, in our complicated state of society, to the means of informing the public of new improvements, of inventions, of the wants of some, and of the resources for supplying them possessed by others; in short, of bringing together, from the most distant parts of the empire, the information calculated to promote both the individual and public advantage.

ADVICE, in its legal signification, has reference only to bills of exchange. The propriety of inserting the words "as per advice," depends on the question whether or not the person on whom the bill is drawn, is to expect further directions from the drawer. Bills are sometimes made payable "as per advice;" at other times "without further advice;" and generally without either of these words. In the former case the drawer may not, in the latter he may, pay before he has received advice.

Advice, in commercial language, means information given by one merchant or banker to another by letter, in which the party to whom it is addressed is informed of the bills or drafts which have been drawn upon him, with the particulars of date, &c., to whom payable, &c., and where.

ADVOCATE, from the Latin *advocatus*. Among the Romans, an advocate was a person skilled in the laws. Advocates in Rome owed their origin to the institution of *patron* and *client*, by which every head of a patrician house had a number of dependents, who looked to him as a protector, and in return owed him certain obligations. It was the principal, and one of the most ordinary duties of the patron, to assist the client in his suits by advice and advocacy, so that the relation was gradually contracted to this extent.

Though the word 'advocate' is now used to express a person who manages a case in court, this is not the meaning of the Roman word. The Advocatus was any person who gave another his aid in any business, as a witness, for instance, or otherwise. It was used in a restrictive sense to signify one who gave his aid in a cause. The Advocatus of the republican period was not the modern Advocate. He who appeared for plaintiff or defendant was termed Orátor or Patronus. Ulpian, however, who wrote in the beginning of the third century, A.D., defines Advocatus to be one who assisted another in the conduct of a suit (Dig. b. 50, tit. 13), and under the Empire we find Advocatus used as synonymous with Orátor. Hadrian established an Advocatus Fisci, whose functions were to look after the Fiscus, or imperial revenue.

In the early period of the Roman republic, the Advocate was held in high estimation. It was then the practice to plead gratuitously; those who aspired to honours in the state taking this course to render themselves distinguished. As the simplicity of ancient manners disappeared, the services of advocates became venal. At first, presents were given, as acknowledgments of gratitude for services rendered; but these gradually assumed the character of debts, and at length became a kind of stipend periodically payable by clients to those of the patrician order who devoted themselves to pleading. In this form it became an abuse; so much so, that the Tribune Cincius, about 200 years before Christ, procured a law, called from him Lex Cincia, prohibiting advocates from taking money or gifts from their clients. In the time of Augustus this prohibition had become obsolete; for the Cincian law was revived, and advocates commanded to plead gratuitously, under a penalty of four times the amount of the fee they received. Notwithstanding these restrictions, the tendency was always to recur to a pecuniary remuneration; for in the time of Claudius we find a law restraining advocates from taking exorbitant fees, and fixing as a maximum the sum of 10,000 sesterces, equivalent to about 80*l.* sterling, for each cause pleaded. (Tacit. Ann. xi. 5.) Some years afterwards, Pliny mentions a decree passed in his time, that all litigants in courts of justice, previously to the hearing of their causes, should take an oath that they had neither given, promised, nor secured, any reward of money to any person employed as their advocate.

In later periods, as the Roman law diffused itself over Europe, these restrictions upon the remuneration of advocates entirely disappeared in practice. In form, however, the fee was merely an honorary consideration (*quiddam honorarium*), and was generally, but not necessarily, *prenumerated*, or paid to the advocate before the cause was pleaded. It was a rule that, if once paid, the fee could never be recovered, even though the advocate was prevented by death or accident from pleading the cause; and where an advocate was retained by his client at an annual salary (which was lawful and usual), the whole yearly payment was due from the moment of the retainer, though the advocate died before the expiration of the year. (Heineccii, 'Elementa Juris Civilis.' p. 132.) Manifest traces of this practice are still to be found in all countries into which the civil or Roman law has been introduced, and are also discernible in the rules respecting fees to counsel at the present day in England.

In countries where the Roman law prevails, pleaders in courts of justice are still called advocates; their character, duties, and liabilities being extremely various under different governments. [ADVOCATES, FACULTY OF; BARRISTER.]

ADVOCATE, LORD, the name given to the principal counsel for the crown, and the public prosecutor in Scotland. He is asisted by a solicitor-general and some junior counsel, generally four in number, who are termed Advocates-Depute. He appears as prosecutor when any person is tried for an offence, and in all actions where the Crown is interested. The inferior courts have their respective public prosecutors, called Procurators Fiscal, who act under his instructions. This officer generally makes the preliminary inquiries as to crimes committed in his district; and after transmitting the papers to the office of the Lord Advocate, he, or one of his assistants, either directs the case to be prosecuted before the superior court, that is, the Court of Justiciary, or leaves it to the conduct of the Procurator Fiscal in the inferior court. When a private party prosecutes, which is of very rare occurrence, it is part of the formal practice for him to obtain the concurrence of the Lord Advocate. The Lord Advocate sat in the Scottish Parliament in virtue of his office as one of the officers of state. Like any other party to a cause, he never acts as a magistrate in his own person, but obtains such warrants as he may require from the Court of Justiciary. He and his assistants are always members of the ministerial party, and it is their practice to resign when there is a change of ministers. The Lord Advocate is virtually Secretary of State for Scotland. His duties in this capacity are multifarious, and the extent of his power not clearly defined.

ADVOCATES, FACULTY OF. The Faculty of Advocates in Edinburgh constitute the Bar of Scotland. It consists of about 400 members, but only a small portion are practising lawyers. It is usual for country gentlemen to acquire the title of advocate, in preference to taking a degree at the Scottish universities. The members may plead before any court in Scotland where the intervention of counsel is not prohibited by statute, in the House of Lords, and in parliamentary committees. Their claim to act as counsel is generally admitted in the colonial courts; and in those colonies where the civil law is in use, such as the Cape of Good Hope and the Mauritius, it is usual for those colonists who wish to hold rank as barristers to become members of the Faculty of Advocates. A candidate, who must at the outset either possess a degree at one of the Universities, or pass an easy preliminary examination, is next examined in Justinian's 'Institutes,' and required to translate passages from the 'Pandect.' After the lapse of a year he is examined in the municipal law of Scotland, and he then prints a thesis or essay on some title of the 'Pandect' assigned to him by the Faculty, the conclusions of which he must defend in a public meeting of the Faculty held to impugn them, after the method formerly followed in the universities. The thesis and impugnation are however mere forms. He is then admitted by ballot, which has likewise become a mere form, and on taking the oaths, is formally admitted to the privileges of the bar by the Court of Session. The expense of becoming a member of the Faculty, including stamp duty, subscription to the widows' fund, the subscription to the library, &c., amounts to about 380*l.* The Faculty choose a dean or chairman annually, but the office is generally held until the dean is promoted to the bench, a step which nearly always follows his election by the Faculty. The Lord Advocate, the Dean of Faculty, and the Solicitor-General, are the only persons who have precedence at the Scottish bar, independent of seniority. The Lord Advocate and Solicitor-General alone wear silk gowns and sit within the bar.

ADVOCATES' LIBRARY. The idea of establishing a library, for the use of the Faculty of Advocates in Scotland, seems first to have been entertained a few years before the Revolution. The author and active promoter of the plan was Sir George Mackenzie of Rosehaugh; but the precise date when Sir George's scheme was first approved and adopted by the faculty cannot be fixed. Mr. Alexander Brown, who was librarian to the Faculty of Advocates in 1772, says in the preface to 'Ruddiman's Catalogue,' which he edited, "The plan of forming a public library appears to have been adopted by the Faculty of Advocates about the year 1680."

At first, the Advocates' Library had no fixed fund, but subsisted and increased by means of donations, not from advocates only, but also from other individuals, and from such sums as the faculty, from time to time, placed at the disposal of the curators. Thus then it happened that, although the Advocates' Library, strictly speaking, belonged to the Faculty of Advocates as an exclusive body, it still was early considered as a public library, and was open to the public. This characteristic has rendered the institution very popular, and at the same time promoted its increase. In the year 1700 the greater part of the collection was consumed by fire. During the first nine years after its restoration the library must have increased considerably, since, in the eighth year of Queen Anne's reign, it obtained the privilege of receiving a copy of every new book which, by chapter 19 of the Acts of Parliament of that year, was conferred on it, with eight other libraries. Of these, five were Scotch libraries; and the disproportionate privilege may have originated in the desire of the legislature to grant some benefit to Scotland at the time of the Union. Shortly after the Union with Ireland, the same privilege was granted to two Irish libraries. This privilege has now ceased.

In Great Britain there are probably only two libraries, namely, the British Museum and the Bodleian, that out-number it. As might be expected, the collection of law books is very large, but far more complete in ancient than in modern works. Many important modern works of foreign jurisprudence are still wanting. The historical collection is exceedingly valuable, containing almost every work of importance that has been published in England, France, Italy, Spain, Portugal, Denmark, and Sweden. The collection of Greek and Roman classics is choice and extensive; the same may be said of that of modern poetry and *belles lettres*; there is also a very considerable divinity collection, and one of voyages and travels. Science has, however, been much neglected. There is a collection of MSS., by no means a large one; several of them are said to be important and available for Scottish history. They are, however, chiefly of local interest. In the year 1825, about 100 vols. of Icelandic MSS. were purchased from Professor Magnuson of Copenhagen. In the following year, Mr. Erskine, late of Bombay, made a donation to the library of a few valuable Persian and Sanscrit MSS. There are also a few MSS. of Latin classics, but of no great importance. There is a beautiful MS. of the Hebrew Bible, in two large folio volumes: the Pentateuch has, besides the Original, also the Chaldaic paraphrase.

The building which contains the Advocates' Library is not only confined, but dark and inconvenient, being distributed in several rooms, for the most part vaults or cellars below the old parliament-house, in which the Court of Session is now held. Some of these rooms are completely dark, and lighted by lamps; others have only borrowed light; and only three are properly lighted.

The Advocates' Library is governed by five curators, of whom one goes out of office by rotation every year, and one is chosen in his stead from among the body of the Faculty of Advocates. Under the curators there are, a keeper of the library, an assistant keeper, and two or three assistants. When the funds of the Faculty had somewhat increased, by raising the fees of entrants, the Faculty during a considerable period set apart 100*l.* from the fees of each entrant, and placed the amount at the disposal of the curators. The average of entrants each year has been stated to be seventeen, but this number is considerably above the average for many years past; and thus the annual income of the library at the period here alluded to, along with some additional fees, amounted to 1780*l.* In the year 1728, this system was altered, and the treasurer of the Faculty was ordered to pay 600*l.* annually out of the Faculty's income to the curators for the use of the library. This system still continues.

As to *ease of access*, there is no public institution in Great Britain, and very few in Europe, managed with greater liberality than the Advocates' Library; but we ought in candour to admit, that this is a somewhat equivocal compliment. It is however surprising that, although it has become almost a sort of bazaar, or a common lounging-place for a number of idle people, the library has suffered very little in consequence. Any stranger arriving in Edinburgh is admitted without introduction; but some introduction is required for habitually resorting to and reading in the library. Even borrowing of books is subject to very slight restriction. Each advocate enjoys the privilege of borrowing twenty volumes at a time; if he wishes to favour an individual who is not a member of the Faculty of Advocates with the loan of a book, he has only to sign the initials of his name in the journal or receipt-book, as a security. As there commonly are about two hundred advocates residing in Edinburgh, and as they are almost without exception remarkably liberal in lending books, it is in that city by no means difficult to obtain a free use of a very extensive library.

While the Court of Session sits, the Advocates' Library opens at nine o'clock in the morning, and shuts at four o'clock, p.m.; during vacation it is open from ten till four.

ADVOCATION, in the Law of Scotland, is the process by which a judgment in an inferior court is brought under the review of the Court of Session. In giving judgment, the court begins formally by advocating the cause.

ADVOWSON. The right of presenting a fit person to the bishop to be by him instituted to a certain benefice within his diocese which has become vacant. The person enjoying this right is called the patron, and the right is termed an advowson (*advocatio*), because the patron is bound to advocate or protect the rights of the Church, and of the incumbent whom he has presented.

This patronage might be liable to be misused by the intrusion of improper persons into the Church, so the law has provided a check, by giving to the bishop a power of rejecting the individual presented, for just cause. The ground of rejection is however not purely discretionary, but is examinable at the instance, either of the clergyman presented, or of the patron, by process in the ecclesiastical and temporal courts. [DUPLEX QUERELA; QUARE IMPEDIT.]

According to the best authorities, the appointment of the religious instructors within any diocese formerly belonged to the bishop: but when the lord of a manor, or landowner, erected a church, and set apart land or tithe for an endowment, it was the practice to give to the founder and his heirs the right of nominating a person in holy orders to be the minister as often as a vacancy should occur, the right of judging of the spiritual and canonical qualification of the nominee being reserved to the bishop. (Du Cange, 'Gloss.' tits. 'Advocatus,' 'Patronus.')

This seems to be the most satisfactory account of the origin of advowsons and benefices, and it corresponds with many historical records still extant, of which examples may be seen in Selden's 'History of Tithes.' It also serves to explain some circumstances of frequent occurrence in the division of parishes, which might otherwise appear anomalous or unaccountable. Thus the existence of detached portions of parishes, and of extra-parochial precincts, and the variable extent and capricious boundaries of parishes in general, would seem to indicate that they owe their origin rather to accidental and private dotation, than to any regular scheme for the ecclesiastical subdivision of the country. It is observable, that the boundaries of a parish either coincide with, or have a manifest relation to, manorial limits, and numerous instances are to be seen in different parts of England, in which the parochial place of worship is closely contiguous to the ancient mansion of its founder and patron, sometimes within the immediate inclosure of his demesne. As an illustration of the respect inculcated to the patron, we find also that the canons of the Church permitted him alone to occupy a seat within the chancel or choir, at a time when that part of the building was partitioned off from the nave, and reserved for the exclusive use of the clergy. (Kennett's 'Paroch. Antiq.' Glossary, tit. 'Patronus.')

An advowson which has been immemorially annexed to a manor, is called an *advowson appendant*, and is transmissible by any conveyance which is sufficient to pass the property in the manor itself. It may however be detached from the manor, and is then termed an *advowson in gross*, after which it can never be re-annexed, so as to become appendant again.

An advowson is regarded by law in the double light of a temporal property, and a spiritual trust. In the former view, it is a subject of transfer by sale, by will, or otherwise, and is available to creditors in satisfaction of the debts of the patron. It may be aliened for ever, for life, or for a term of years; or the owner may grant one, two, or any number of successive rights of presentation on future vacancies, subject always to certain restrictions imposed by the law, for the prevention of corrupt and simoniacal transactions.

On the other hand, the spiritual trust is guarded and enforced by very jealous provisions. The appointment of a duly qualified incumbent is secured, as far as the law can secure it, by requiring the sanction of the bishop. And in order to guard against the danger of a corrupt presentation, the immediate right to present is absolutely inalienable, if a vacancy has actually occurred. On a similar principle, a purchase of it during the mortal sickness of the incumbent is equally prohibited. [SIMONY.]

When the patron exercises his patronage, three persons are immediately concerned: the patron, the clergyman presented, or *clerk*, and the bishop in whose diocese the living is situate, or *ordinary*. The presentation is usually a writing addressed to the bishop, alleging that the party presenting is the patron of a church which has become vacant, and requesting the bishop to admit, institute, and induct a certain individual into that church, with all its rights and appurtenances. A period of time, limited to twenty-eight days, is allowed to the bishop for examining the candidate, at the expiration of which he is admitted and instituted to the benefice by formal words of institution read to him by the bishop, from an instrument to which the episcopal seal is appended. A mandate is then issued to the archdeacon or other officer to *induct*, that is, to put the new incumbent into the actual possession of the church and its appurtenant rights; and then, and not before, his title as legal *parson* becomes complete.

It sometimes happens, that two of the three characters of patron, clerk, and ordinary are united in one person. Thus the bishop may himself be the patron; in which case presentation being superfluous, institution alone is necessary. The bishop is then technically said to *collate* to the benefice, and the advowson is said to be *collative*.

So the clerk may be patron, in which case he may pray to be admitted by the bishop; or he may transfer to another the right of presentation, *pro hâc vice*, before the vacancy occurs, and then be presented.

The patronage and the parsonage are sometimes united in *appropriations*. Where the advowson, together with the church, its revenues and appurtenances, were in former times conveyed to some ecclesiastical body, they became both patrons and perpetual incumbents of the living, the immediate duties being devolved on a *vicar*, or a stipendiary *curate*.

There are advowsons, the patrons of which have power to appoint an incumbent without any resort to the bishop. These are called *donative*, because the patron exercises a direct and unqualified privilege of *giving* his church to a clerk selected by himself. The only check upon the incumbent in such cases, is the power of the patron to visit, and even to deprive him, when the occasion demands it; and the right in the bishop to proceed against him in the spiritual court for any ecclesiastical misdemeanour. Donatives are said to have their origin in the king, who had authority himself to found any church or chapel exempt from the episcopal jurisdiction, and might also, by special licence, enable a subject to do the same.

Sometimes the *nomination* is distinct from the right to present: thus, the owner of an advowson may grant to another the right to nominate a clergyman, whom the grantor and his heirs shall be thereupon bound to present. Here the person to whom the nomination is given, is substantially the patron, and the person who presents merely the instrument of his will. Where an advowson is mortgaged, the mortgagee is bound to present the person nominated by the mortgagor.

This species of property is coupled with a trust, in the faithful performance of which the public are deeply interested. If, therefore, upon the vacancy of a living, no successor, or an insufficient one, shall be presented, it is put under *sequestration* by the bishop, who must provide for the spiritual wants of the parish by a temporary appointment, the profits of the benefice being secured after deducting expenses, until another incumbent shall be inducted. If a vacancy of six months occurs by the default of the patron, the right to present *lapses* to the bishop himself; on default by him, to the archbishop, and from him to the king as paramount patron; six calendar months being allowed to pass in each case before the right is forfeited. A donative advowson, however, is excepted from this rule; for there the right never lapses by reason of a continued vacancy; the patron is only compellable to fill it up by the censures of the ecclesiastical court.

When the incumbent of a living is promoted to a bishopric, it is thereby vacated, and the king, in virtue of his prerogative, has a right to present to it in lieu of the patron. This claim on the part of the crown appears to have grown up since the Reformation, and was the subject of complaint and discussion down to as late a period as the reign of William and Mary. It is difficult to reconcile it to principle, although it has been urged by way of apology, that the patron has no ground to complain, because the king might, if he pleased, enable the bishop to retain the benefice, by the grant of a *commendam*; so that the patron sustains no other injury than what may result from the substitution of one life for another. It is certain that, by successive promotions, the crown may deprive the patron of his right for an indefinite time, and an instance actually occurred wherein the patron of the metropolitan parish of St Andrew was prevented by several such exertions of the royal prerogative, from presenting to his own living more than once in 100 years. ('Shower's Reports,' vol. i. p. 468.) So that, as was truly observed by the counsel in that case, the safest course that could be adopted by an unconscientious patron, with a view to retain in his own hands the future enjoyment of his right, would be to present a clergyman whose qualities are not likely to recommend him to higher preferment.

If a man marries a female patron, and a vacancy happens, he may present in the name of himself and wife.

Joint tenants and tenants in common of an advowson must agree in presenting the same person; and the bishop is not bound to admit on the separate presentation of either. Co-heiresses may also join in presenting a clergyman; and if they cannot agree in their choice, then they shall present in turn, and the eldest shall have the first turn.

When the patron dies during a vacancy, the right to present devolves to his executors. Where the patron happens to be the incumbent, his heir, and not his executor, is entitled to present.

When the patron is a lunatic, the lord chancellor presents; and he usually exercises his right in favour of some member of the lunatic's family, where it can with propriety be done.

An infant of the tenderest age may present to a living in his patronage, and his hand may be guided in signing the requisite instrument. In such a case the guardian who dictates the choice or directs the pen, is the real patron.

As to presentations to livings by the crown, see CHANCELLOR.

(Burn's *Ecclesiastical Law*, tits. 'Advowson,' 'Benefice,' 'Donative;' Selden's *History of Tithes*; Gibson's *Codex*, vol. ii.; Blackstone's *Commentaries*, Mr. Kerr's ed. vol. ii. p. 18.)

ADVOWSONS, VALUE OF. The following plain rules for estimating the value of advowsons, may be of use. The bargains which are usually made with respect to advowsons are, either for the advowson itself, that is, the right of presentation for ever, or for the right of presenting the next incumbent, that is, the next presentation. In both these cases there may be circumstances peculiar to the living itself, which fall under no general rule, but which must be considered and allowed for in valuing the advowson as a property. For example, a curate may be necessary; the parsonage-house may be in a state which will entail expenses on the next incumbent; and so on. Again, the property itself is of a nature more likely to be altered in value by the act of the legislature than the fee-simple of an estate. The following rules, therefore, give the *very highest value* of the advowson, and any purchaser should think twice before he gives as much as is found by them:—

To find the value of the perpetual advowson of a living producing 1000*l*. a year, the present incumbent being forty-five years of age, and money making four per cent., we must first find how many years' purchase the incumbent's life is worth, and here we should recommend the use of the government, or Carlisle tables [ANNUITIES], in preference to any other. Taking the latter, we find the annuity on a life of forty-five at four per cent., to be worth fourteen and one-tenth years' purchase; but at four per cent. any sum to be continued annually for ever is worth twenty-five years' purchase. The difference is ten and nine-tenths years' purchase, or for 1000*l*. a year, 10,900*l*, which is the value of the advowson.

In finding the value of the next presentation only, other things remaining the same, the seller will presume that the buyer means to make the best of his bargain by putting in the youngest life that the laws will allow, that is, one aged twenty-four. The value of an annuity on such a life at four per cent. according to the Carlisle tables, is seventeen and eight-tenths years' purchase. And as we are giving the highest possible value of the advowson, omitting no circumstance which can increase it, we will suppose the next incumbent to come into a year's profits of the living immediately on his taking possession. The present value of the next presentation is the value of an annuity for 17·8 years, beginning from the present year. The rule is this: Take four per cent. of the value of the incumbent's life, or 14 1 × ·04, which gives ·564; subtract this from 1, which gives ·436; divide by 1 increased by the rate per cent., or 1·04, which gives ·419; add one year's purchase to the presumed value of the next incumbent's life (17·8), which gives 18·8; multiply this by the last result, ·419, which gives 18·8 × ·419, or 7·88 nearly—the number of years' purchase which the next presentation is now worth—which, if the living be 1000*l*. a year, is 7880*l*.

We have thus given the very highest value: we will now state some of the circumstances which reduce it. If a curate must be kept, the yearly expense must be deducted from the income of the living. Again, expenses at entry, first fruits, &c., may be expected, one case with another, to swallow up the first year's income; accordingly, at least the year's purchase added in the above rule may be left out. But even when these deductions are made, there is *another curate* who has not been mentioned; the incumbent himself, whose mere salary for the work done must be put at the value for which a curate could be found to do it. A person who buys a living on which a curate must be kept, and deducts only for *one* curate, pays the salary of the rector or vicar out of his own pocket. By deduction of all the salaries (the incumbent's included), and expenses of entry, the lowest value is found. What it may be worth the while of any particular buyer to give, must depend upon a variety of circumstances which no actuary can value.

For all necessary tables, we may refer to Jones on Annuities.

A'DYTUM, ἄδυτον, a Greek term signifying *a place that may not be entered*, and applied to the innermost and secret chamber of a temple.

In the ancient Egyptian temple, the adytum is placed at the end of a series of propylæa, porticoes, and vestibules, and surrounded by galleries and chambers which afforded every facility for concealing the mysteries of the interior. In the temples of the Greeks there was sometimes an adytum, but nothing has been found corresponding to the adytum of the Egyptian temples, unless it be the chamber which, in the Parthenon at Athens, has been called the treasury. The temples of the Romans, also, are without obvious adyta, though the exhumation of Pompeii has discovered to us, in the temple of Isis there, a small chamber behind and under the altar and statue of the goddess, with means of secret access, from which probably the oracular responses were delivered.

The 'most holy place,' or the Sanctum Sanctorum, the holy of holies, was the adytum of the temple of Solomon at Jerusalem.

ÆDI'LES, from *ædes*, a building; the name given to certain magistrates in ancient Rome. They were four in number, two entitled *curule* ædiles, and two *plebeian*. It is difficult to mark the limit between the duties of these magistrates. The former however must have been originally connected with the patrician order, and elected by the *comitia curiata*. Their insignia of office were the same as those of the kings had been, namely, the purple robe called the *toga prætexta*, and the chair ornamented with ivory, or *sella curulis*. They had the care of the temples, baths, porticoes, aqueducts, sewers, and roads of the city. They presided at the religious celebrations, of which theatrical exhibitions formed an important part; and, in performing this duty, the ædiles under the republic were often guilty of the most lavish expenditure, with the view of acquiring popularity, and thus paving their way to the higher offices of the state. The plebeian ædiles were, as their name imports, specially magistrates of the *plebes* or commonalty. They were subordinate to the tribunes of the *plebes*, and acted as judges in such causes as were referred to them by their superiors. The temple of *Ceres*, which constituted the treasury of the commonalty, was under their peculiar guardianship. They here received the fines paid for offences against the plebeian magistrates, and made a distribution of bread among the poor of their order. In the same temple, too, they preserved the public records connected with their own body, and the decrees of the senate. The care of the public buildings and streets on Mount Aventine and in the immediate neighbourhood, which in early times formed the chief residence of the commonalty, and was without the limits of the city, must have been, we may infer from their title, entrusted to the plebeian ædiles. Their persons, like those of the tribunes, were inviolable. There were other duties connected with the office of ædile, whether curule or plebeian, such as the inspection of the markets, and the superintendence of the corn trade, the examination of weights and measures, the registration of courtesans, and perhaps the general management of all matters of police in Rome and the suburbs: they had, of course, their courts for inquiring into and punishing offences connected with their office. The curule ædileship was the second in the series of honours through which the Roman candidate proceeded to the consulship; and the laws required an interval of a whole year after the close of the quæstorship, before any one could be a candidate for the ædileship. The title of ædile was known also in the municipal towns of Italy.

ÆGINE'TAN ART. Several ancient writers, particularly Pliny and Pausanias, make frequent mention of Æginetan works of art; and in such a manner, as to show that the productions of the school of Ægina, to use a modern and well-understood phrase, were highly esteemed. Many names of Æginetan sculptors had thus come down to us as almost synonymous with excellence in their art, but the works of none of these could be recognised among those which had escaped the ravages of time and the desolation of barbarism; so that their merits and reputation rested on report alone. The discovery of the sculptures which adorned the tympana of the supposed Panhellenium, the national temple of the Æginetans, was believed, however, to have furnished us with undoubted specimens of Æginetan art, and of that period too in which the most celebrated Æginetan sculptors flourished. This conclusion there is reason to think was too hastily adopted. That the sculptures referred to are of great beauty and merit, and are for many reasons highly interesting, will be admitted by all; but that they are of the class and date from which the school of Ægina derived its celebrity, may fairly be questioned. It may now be regarded as beyond doubt that the building was a temple of Minerva and not of Jupiter (Müller, 'Archaeologie der Kunst,' s. 90; Wordsworth, 'Greece,' p. 190, ed. 1859), and it is highly probable that it was wholly, or in part, rebuilt by the Athenians when in possession of Ægina. The sculpture is evidently of different dates, and it may be, as has been suggested (Scharf, in Wordsworth, p. 46), that the figures of the western pediment, which are of a smaller size and less advanced in style than those in the eastern, are really Æginetan works; while those in the eastern pediment are by Athenian sculptors.

The figures principally consist of perfect statues, or statues in the round, as they are termed; those in the eastern pediment about the size of life, those in the western somewhat smaller, of men armed with spears, swords, shields, and bows. The bowmen have quivers of arrows suspended from their waists; most of the figures are helmed or bonneted, some with greaves on the legs, and two or three with armour on the body, or close-fitting garments on the body and limbs; but for the most part they are naked, except the head, and all are either engaged in active combat or have fallen from the effect of wounds. Besides the male combatants, one helmed and draped female figure, with a spear and a shield in her hands, and the helmed head of another, evidently belonged to the groups. These were all so distributed on the ground with reference to the temple, and are of such peculiar attitudes with respect to one another, and to the places they occupied, that there appears to have been no great difficulty in determining their original arrangement in groups, after the fragments into which many of the figures were broken, were once brought together; especially as the frames which inclosed the pictures they formed, were otherwise determinable, and thus assisted materially in fixing the relative positions of the parts composing the groups. Thus, the perfect female figure, evidently a statue of Minerva, standing upright and in full face, occupied the central position under the highest part of the tympanum of the western pediment; and the combating warriors of that end arranged themselves on her right and left, in attitudes upright and advancing, kneeling, stooping, and falling, until the inner acute angles terminated in the wounded and recumbent. The goddess stands in quiet dignity, prepared, nevertheless, for action, while the battle, of which she appears to be the umpire, rages around her. Of this picture or group, the arrangement is so fitting and complete, and the action so perfect, that there is no reason to think, that any essential portion of it is undiscovered. But unfortunately it is not so with the group of the eastern or principal front; a few only of these figures can be restored, and it is only from the analogy afforded by the western group, that their arrangement can be aptly determined. As far as the figures can be made out, the persons seem to be nearly, if not quite, identical, and another period of the same action appears to be represented. The helmed female head is that of Minerva again, and Mr. Cockerell restores her figure as in the act of raising her spear and extending her vest, as if to stop the contest, or to protect the fallen. The exact subject or subjects intended by these groups, is not known: though all the critics who have offered opinions seem to agree that they represent some actions of the distinguished Æginetan family of heroes, the Æacidæ, or descendants of Æacus, the mythological founder of the nation. Colonel Leake's opinion, as given by Mr. Cockerell ('Journal of Science and the Arts, No. 12, p. 334, note), is that they represent two periods in the contest over the body of Patroclus, from the 'Iliad,' in which Ajax (one of the Æacidæ) and Hector were the principal combatants: that this was the subject of the western pediment, there can be little doubt. That something connected with the Trojan war is intended in each, seems very evident, from the Phrygian bonnet worn by one of the warriors; and the greaves on the legs of those who may be supposed to be Greeks, in the eastern group, especially, and the absence of this covering on the figures of the opposite party, seem clearly indicative of their national difference. Thiersch's opinion is, that the group on the eastern pediment represents the expedition of Telamon, the son of Æacus, and Hercules, against Laomedon, king of Troy. The archer he considers to be the representation of Hercules. The other group, he thinks, may represent the death of Achilles, and the struggles of Ajax to save his body from the Trojans. (Thiersch's 'History of Greek Sculpture,' p. 249, note.) The sculptures are now in Munich, having been purchased by the late king of Bavaria, when crown prince. Such of the statues as were capable of repair were very carefully put together, and the deficient parts supplied by Thorwaldsen. Casts of the figures, as restored, are placed in the Phigalian Saloon of the British Museum, within two tympana of exactly the same form and dimensions as those of the eastern and western ends of the temple at Ægina, in which they originally stood.

There is scarcely anything in the combination of sculpture and architecture more admirable than the manner in which the various actions and attitudes, in the western group of the figures, have been adapted to the situations which they occupied; and this too, without the slightest appearance of constraint; they are all natural and graceful, and in perfect keeping with the design of the subject, and the character of the architecture. The energy of action, the grace of attitude, and the truth of proportion displayed in these works, are also admirable, and the expression of many of the figures is excellent. But there is a degree of dryness and rigidity observable in the bodies and limbs, which give the works an archaic character, whilst the countenances, the hair, and the draperies, clearly betoken their near approach to, if not absolute connection with, the archaic period. The faces are almost entirely devoid of expression, the lips are thick, the nose is short, but angular and prominent; the eyes are protruded, the forehead is flat and retiring, and the chin is long and pointed; the hair is formally laid in tiers with convoluted ends, and the draperies, though not devoid of grace, are heavy and monotonous. (Lyon's 'Outlines of the Ægina Marbles.') Now these are peculiarities which could scarcely have existed in the works of men whose names are mentioned with those of Phidias and his compeers and immediate successors; but they pretty clearly mark a more remote period. The comparative fulness of form, and freedom of action of the bodies and limbs of the figures in the eastern pediment, indicate, on the other hand, a date not far removed from excellence. On every part of the figures, except the face, traces of colour are plainly discernible; there are holes in many of the figures for affixing bronze armour, and the hair was partly of wire.

The temple of Ægina is described and figured at the end of the article ÆGINA, in the GEOGRAPHICAL DIVISION of the ENGLISH CYCLOPÆDIA, vol. i. col. 72, &c.

ÆNEID, the most celebrated epic poem of antiquity, after the 'Iliad' and 'Odyssey.' It was written by Virgil in the time of Augustus Cæsar; and relates the wanderings of Æneas after the siege of Troy, his arrival in Italy, and his adventures previous to his marriage with Lavinia, with his final establishment in Latium. The poem, however, does not carry its hero so far as this, but closes with a single combat between Æneas and Turnus, and the death of the latter. In some respects Virgil has deviated from the legend related in the article ÆNEAS. [BIOG. DIV. ENG. CYCL., vol i. col. 46.] He has multiplied the Trojan ships and increased the number of the Trojans; he has carried his hero to Carthage, though we do not know whether Carthage existed at the supposed date of Æneas's wanderings: he has made the death of Turnus precede the marriage of Æneas and the foundation of Lavinium, and has allowed Latinus to survive, instead of making his daughter wed the author of her father's death. The poem consists of twelve books, of which the first six are occupied in relating the wanderings of Æneas, and seem to be modelled on the 'Odyssey;' the last six contain his descent into Italy, and the war which ensued between the Trojans and the natives, and seem to be modelled on the 'Iliad.' In the minute details of ornament as well as in the general notions of his work, Virgil has borrowed largely from Homer. This poem was written later than his other works, the 'Eclogues' and 'Georgics.' It was commenced about A.U.C. 724, or B.C. 30; and the author continued to labour on it till his death, in B.C. 20; at which time he was so little satisfied with the state of his production that, it is said, he gave earnest injunctions on his death-bed that it should be burnt. The order was not fulfilled, at the desire of Augustus, who intrusted the publication to two learned friends of the author, Tucca and Varus. Many lines are left imperfect; some suppose this to be one proof that the finishing hand of the master was never applied; but we doubt whether it is, and think it possible that they were purposely left so. This great work of Virgil called forth the enthusiastic admiration of his contemporaries. Propertius wrote—

"Yield, Roman poets; lords of Greece, give way;
The Iliad soon shall own a greater lay;"

and some writers, even in modern times, have expressed the same opinion. It is enough to say that, compared with the 'Iliad,' the 'Æneid' is wanting in originality and power; it is the laboured performance of a learned man, possessed of an elegant mind, who has availed himself freely of the labours of those who preceded him. Virgil is characterised by Niebuhr as possessing "a genius barren for creating, great as was his talent for embellishing." The characters of the 'Æneid' are deficient in the individuality and freshness which mark the description of those who have mingled in scenes and been familiar with characters such as they portray. The brave Gyas and the brave Cloanthus are hardly distinguishable, except by name: Achates, the friend of Æneas, is a mere shadow, always attending on his chief; and, indeed, with the exception of Dido, no character is well defined. Æneas himself, though the hero of the poem, neither excites any strong interest nor leaves any powerful impression. In this respect Virgil is immeasurably inferior to Homer. The strength of Virgil lay in the pathetic rather than in the sublime; and many passages of the 'Æneid,' which admitted of the former quality, are exquisitely beautiful.

The 'Æneid' has been frequently translated into most European languages. In our own, we may notice one peculiarly interesting to the literary antiquary; a translation, by Gawin Douglas, Bishop of Dunkeld, of the whole 'Æneid' into the old Scottish dialect, about 1512; and said by Warton to be the first translation of a classic into the language of Britain. The Earl of Surrey translated the second and fourth books, printed in 1577. There are complete translations by Ogilby, Pitt, &c., but the energetic version of Dryden has nearly superseded all others.

ÆNI'GMA, a Greek term for what is commonly called a Riddle. It is the description of a thing by certain of its qualities selected and disposed, with the object of hiding what the thing is, and of occasioning its discovery to come as a surprise.

An ænigma differs from a definition or other direct statement, not in being false, but only in being obscure and misleading. The one is an instance of the application of language to make known our thoughts, and the other of its application to the purpose of concealing them; but the words of a good ænigma, when properly understood, are as true as those of a good definition. It is also an indispensable quality of the latter, as well as of the former, that it shall be intelligible, in its whole import, only in one sense.

The object of a direct statement is to convey information; that of an ænigma is to exercise the ingenuity. The former, in its simplest and most legitimate form, has only to be received by the mind; the latter demands to be solved. An ænigma, therefore, may be regarded as one of the complex or ornamented modes of composition, that is to say, one of those which do not merely appeal to the apprehension, but excite and gratify other intellectual faculties.

In very ancient times, accordingly, the ænigma was a common and favourite medium for the conveyance even of truths of the highest importance. Formal composition in the earliest state of society, that it might be the better distinguished from ordinary speech, naturally affected an elaborately artificial character; and the ænigma or riddle presented itself among other devices for that end. It had, besides, the peculiar recommendation of giving an air of mystery to the sentiment which it involved, and so making it seem to be something still more remote than it might really be from common experience and speculation. The term ænigma, indeed, was probably used originally to describe any short composition, such as apologue, or fable, or other portable sample of wisdom or entertainment. Ænigma is something dark and obscure, and the corresponding verb (αἰνίττεσθαι) always means *to speak ænigmatically*, according to our meaning of the word, or to speak with a certain degree of mystery and obscurity.

In the progress of civilisation and literature, it came to be felt that obscurity and difficulty were qualities which, whatever pleasure they might convey to those who tried to master them, were inconsistent with all the higher and more appropriate objects of speaking and writing. Whether the purpose be simply to communicate information, or whether it be to appeal also to the imagination and the passions, a style is good exactly in proportion as it is expressive, that is to say, as it conveys directly and completely the thoughts of the writer or speaker. The ænigma, therefore, the very end and nature of which is the reverse of this, instead of being an ornament, must be regarded as one of the worst faults of style. Whatever approaches towards the ænigmatical, is, for the same reason, a fault in writing—whatever figure, for example, is introduced in poetry or rhetoric more in order to surprise the reader by its ingenuity than for any other purpose. Amongst those writers who have vitiated their works by what may be called an ænigmatic turn of phraseology, Young is an instance, in his 'Night Thoughts.'

ÆO'LIAN HARP, a musical instrument, the sounds of which are drawn from it by a current of air acting on the strings. In the last century, the Æolian Harp was brought forward in London as a newly invented instrument; and Dr. Anderson, in a note to Thomson's 'Ode on Æolus's Harp,' ascribes the invention of it to Mr. Oswald. However, it is possible that an instrument of the kind was very anciently known; for the Talmudists say that the *kinnor*, or harp of David, sounded of itself when the north wind blew on it. But the merit of the invention in the form it now takes, is due to Athanasius Kircher, who describes it in his 'Musurgia Universalis' (lib. ix. 352).

The following are detailed directions for the construction of the Æolian harp: Let a box be made of as thin deal as possible, of a length exactly answering to the width of the window in which it is intended to be placed, four or five inches in depth, and five or six in width. Glue on it, at the extremities of the top, two pieces of oak, about half an inch high and a quarter of an inch thick, to serve as bridges for the strings; and withinside, at each end, glue two pieces of beech about an inch square, and of length equal to the width of the box. Into one of these bridges fix as many pegs, such as are used in a pianoforte, (though not so large), as there are to be strings; and into the other, fasten as many small brass pins, to which attach one end of the strings. Then string the instrument with small catgut, or *first* fiddle-strings, fixing one end of them, and twisting the other round the opposite peg. These strings, which should not be drawn tight, must be tuned in unison. To procure a proper passage for the wind, a thin board, supported by four pegs, is placed over the strings, at about three inches distance from the sounding-board. The instrument must be exposed to the wind at a window partly open; and to increase the force of the current of air, either the door of the room, or an opposite window, should be opened. When the wind blows, the strings begin to sound in unison; but as the force of the current increases, the sound changes into a pleasing admixture of all the notes of the diatonic scale, ascending and descending, and these often unite in the most delightful harmonic combinations.

A curious suggestion was made in 1857, for playing the Æolian harp by the sun's heat instead of a current of air. Provide a leather case, which should be so made as to join the harp in the form of a trough, extending from one end to the other. This case must be air-tight, and must have at its furthest extremity a valve opening inwards. The sun's heat, expanding the air in the case, will (according to this supposition) cause it to act upon the strings, and produce the sound; while the pressure of the external atmosphere will open the valve, to supply the case with air.

Dr. Matthew Young entered fully into the principle of the Æolian harp in his 'Enquiry into the principal Phænomena of Sound.' In what way different sounds can be heard from the same string, without any fingering or pressure, he thus explains: "Let us consider what will be the effect of a current of air rushing against a stretched elastic fibre. The particles which strike against the middle point of the string will move the whole string from its rectilineal position; and as no blast continues exactly of the same strength for any considerable time, although it be able to remove the string from its rectilineal position, yet, unless it be too rapid and violent, it will not be able to keep it bent: the fibre will, therefore, by its elasticity, return to its former position; and by its increased velocity, pass it on to the other side, and so continue to vibrate and excite pulses in the air, which will produce the tone of the entire string. But if the current of air be too strong and rapid, when the string is bent from the rectilineal position, it will not be able to recover it, but will continue bent and bellying like the cordage of a ship in a brisk gale. However, though the whole string cannot perform its vibrations, the subordinate aliquot parts may; which will be of different lengths in different cases, according to the rapidity of the blast. Thus when the velocity of the current of air increases, so as to prevent the vibration of the whole string, those particles which strike against the middle points of the halves of the string, agitate those halves as in the case of sympathetic and secondary tones; and as these halves vibrate in half the time of the whole string, though the blast may be too rapid to admit of the vibration of the whole, yet it can have no more effect in preventing the motion of the halves, than it would have on the whole string were its tension quadruple; for the times of vibrations in strings of different lengths, and agreeing in other circumstances, are directly as the lengths; and in strings differing in tensions, and agreeing in other circumstances, inversely as the square roots of the tensions, and, therefore, their vibrations may become strong enough to excite such pulses as will affect the drum of the ear; and the like may be said of other aliquot divisions of the string."

ÆO'LIAN MODE, in ancient music, one of the five principal modes of the Greeks, which derived its name from Æolia, a country of Asia Minor. Authorities differ most essentially as to the character of this mode. Rousseau says it was grave; the Abbé Feytou contradicts him; Sir F. Stiles tells us that this mode was the same as our E flat; Dr. Burney makes it F minor; and Rousseau says F, meaning, of course, F major. [MODE.]

ÆOLI'NA, a very small musical instrument, consisting of a number of short, elastic, metallic laminæ, or springs, fixed in a frame, and acted on by the breath of the performer. The best of the kind comprise three octaves of diatonic sounds, and are also capable of giving the three simple harmonies of the key. This instrument was the first formed on such a principle that appeared in England, and became exceedingly popular for a time; but was superseded by a much more perfect thing of the kind, the accordion, in which the impulse of air is managed by bellows or a wind-chest instead of by the breath. [ACCORDION; CONCERTINA.]

ÆOLIPYLE, ÆOLIPILE, *Æoli pila, the ball of Æolus*, an instrument made use of formerly in experimenting, consisting of a hollow ball, with a small orifice in which a tube might be screwed. It served to boil water in, for the purpose of creating steam. This instrument is mentioned by Des Cartes, in his treatise on 'Meteors,' chap. iv., as used in his time. It is now entirely out of use, unless we choose to consider the boiler of a steam-engine as an ælopile. This is by no means the first instance in which a philosophical toy has been made of use to the arts.

ÆRA, a point of time from which *subsequent* years are counted, and in some instances *preceding* years, as in the Christian æra. The origin of the word *æra* is very doubtful.

All nations who have any history to record have fixed their æra at some remote period, in order to embrace in their annals as large an extent of time as practicable. The creation of the world would most naturally present itself to those who might have any means of ascertaining the time of its occurrence, and the Bible would be the source from whence the information might be obtained. But, unfortunately for chronology, the Bible is not sufficiently explicit on the subject; and, although the Jews and some Christian nations do date from the Creation, their computations of the period at which this event took place differ to the extent of nearly 2000 years. Those whom this uncertainty has deterred, or who have had no knowledge of the Scriptures, have contented themselves with more recent periods. The ancient Romans adopted the epoch of their first supposed political existence, and the Greeks that of the first celebration or revival of the Olympic Games, which were with them an important national festival. Many nations have assumed some event closely connected with their religious faith: thus, the early Christians of the East dated from the persecution under the Emperor Diocletian, and those of Europe and America, at the present day, from the birth of Christ. All the followers of Mohammed have adopted, as an æra, the retreat of their prophet from Mecca to Medina, which they call the Hegira.

Many of these æras are arbitrarily and incorrectly fixed, and even our own is erroneous by four years. But an error at the commencement will not invalidate the dates of events recorded subsequently, as any æra once assumed will be sufficient to show the succession of time, however incorrectly assigned to the period whose name it bears.

With one or two exceptions, all nations have reckoned time in accordance with the course of the seasons; they have always begun their year at the same season, sometimes perhaps a little earlier, and sometimes later, but invariably keeping near the original commencement.

Here follows a list of the æras which have been or are most in use among the civilised nations of the world, with the year of the Christian æra in which they began:—

1. The year of the world according to the reckoning of Constantinople, which was used in Russia until the beginning of the 18th century, and is still employed by the Greek Church . . . . B.C. 5509
2. The year of the world as reckoned at Antioch, now used in the Abyssinian Church . . . . . B.C. 5492

[The Church of Alexandria originally assumed the year B.C. 5502 as the year of the Creation, but in the year A.D. 285 they discarded ten years, and thus acceded to the computation of Antioch.]

3. The year of the world used by the Jews . . . . B.C. 3761
4. The Caliyuga, employed by the learned throughout India, may be called an æra of the Creation, being considered by the Hindoos as the commencement of the present state of the world, or 'Iron Age' . . B.C. 3102
5. The Olympiads; the æra of the victory of Corœbus at the Olympic games, used chiefly by the Greek historians after the age of Alexander . . . . . B.C. 776

[N.B. An Olympiad is a period of four years.]

6. The Building of Rome: this is generally called the Varronian æra . . . . B.C. 753
7. The Catonian æra of the building of Rome is* . . B.C. 752
8. The æra of Vicramaditya, in common use throughout India . . . . B.C. 56
9. The Spanish æra, from the Conquest of Spain by Augustus, was employed in Spain, Portugal, Africa, and the South of France. In some provinces this æra was in use until the middle of the 15th century. B.C. 38
10. The æra of Salivahana, in common use through the southern and western states of India . . . . A.D. 78
11. The æra of Martyrs, or of Diocletian, so called from the persecution of the Christians in the reign of that emperor, was much used by the early Christians, and is still employed in the churches of the East . . A.D. 284
12. The Hegira, used by all Mohammedans, dates from the flight of Mohammed to Medina . . . . . . A.D. 622
13. The Christian æra dates from the birth of Christ; the year in which he was (erroneously) supposed to be born is called 1 B.C., the following year 1 A.D. Many authors call the year of our Lord's birth 0, and consequently make the dates of all preceding events one year less than by the common practice.

* See Ideler's 'Chronology,' p. 334.

The following rules will serve to show the year of the Christian æra corresponding with that of any given æra:—

1. When the commencement of the given æra precedes the birth of Christ, subtract from the given year the number affixed to the æra in the above list, and the remainder will be the year of Christ in which the given year began.

If the given year be less than the affixed number, subtract it from that number, adding one; the result will be the date before Christ.

Examples.—Required the Christian date answering to the year of Rome 1754.

From 1754
Deduct 753

The year 1001 A.D. corresponds with the year 1754 A.U.C.

Required the year B.C. answering to 707 A.U.C.

From 753
Deduct 707

46
Add 1

The year 47 B.C. coincides with 707 A.U.C.

The reason is this: A.U.C. 707 means that an event took place *in* that year: and therefore 753—706 or 47 years B.C. remain, and as all the years B.C. *before* B.C. 47 have expired, the event must take place *in* the year B.C. 47.

Required the year of Christ in which the year of the Jews 5613 began.

From 5613
Deduct 3761

Answer A.D. 1852

2. When the commencement of the given æra follows the birth of Christ, add to the given year the number affixed to the æra in the list, less one. The sum will be the year of Christ in which the given year began.

Example.—Required the Christian year in which 1031 of Martyrs began.

To the given year 1031
Add the number in the list less one 283

The year A.D. 1314 answers to the year 1031.

All the above dates may be reduced to the Christian æra by the same formula, except that of the Hegira, as the Mohammedans allow only 354 days to the year. Mohammedan reckoning is thus at variance with the course of the seasons; their year now (1859) begins in July, and gains at the rate of a little more than three years in a century. It will, therefore, be necessary to prepare any given date from the Hegira by subtracting three years for every hundred, before reducing it to the Christian æra.

Required the year of the Hegira 1268.

From 1268
Subtract 3 years for every hundred 38

1230
Add the number in the list less one 621

1851
The year of the Hegira 1268 began in the year 1851 A.D.

3. The computation by Olympiads may be thus explained: for instance, Ol. lx. 3 means that an event took place *in* the *third* year of the *sixtieth* Olympiad, and consequently *in* the year that followed the expiration of 59 Olympiads (or 59 periods of 4 years each), and 2 more years belonging to the 60th Olympiad; or after the expiration of 238 years, and therefore *in* the year B.C. 538.

AËRATED WATERS. The term mineral waters has generally been applied to those drinks in which water is combined, naturally or artificially, with mineral ingredients having medicinal qualities; but when the water is simply impregnated with gases, the term aërated waters becomes preferable.

Bakewell's apparatus is one among many contrivances for producing such liquids, for effervescing, aperient, tonic, and other purposes. Let us select the manufacture of soda-water, as one example: The apparatus employed consists of an upright vessel supported on a stand, and furnished with pipes and valves. In the lower part of the apparatus is a vessel called the generator, divided into two compartments by a horizontal partition. Sulphuric acid is placed in the uppermost of these compartments, and carbonate of soda in the lower. While the vessel is at rest, the two substances are kept wholly separate; but when a working motion is given to it by making it oscillate on two pivots whereby it is suspended, the acid drops at regular intervals through a hole in the side of the upper compartment, and falls into the lower one, where it mixes with the carbonate. A chemical interchange immediately takes place; the soda leaves the carbonic acid and combines with the sulphuric; so that, instead of sulphuric acid and carbonate of soda, we obtain carbonic acid and sulphate of soda. The carbonic acid assumes the gaseous form, and ascends to an earthenware vessel in the upper part of the apparatus. This vessel contains water; and as the apparatus is kept oscillating, the water is sufficiently agitated to absorb the gas passed up into it. With a small apparatus capable of holding a gallon at a time, a quarter of an hour's oscillation will suffice to impregnate the water with gas to a pressure of five atmospheres. The apparatus must of course be strong to resist this pressure; it is made of iron, and there is a pressure gauge at the top, to measure the amount of the pressure. There is a tap for draining off the aërated liquids. Dr. Venables states that for a gallon of water to be impregnated to the extent of five atmospheres, would require about six ounces of carbonate (or rather sesqui-carbonate) of soda and four ounces of sulphuric acid. The apparatus admits of being used in many ways; for the aërator or upper vessel may be either filled with pure water, and modified only by the gas which ascends from the generator, or the water may previously be made acid or alkaline, and receive a further change by the aëration. The resulting beverage will thus depend, not only on the aëration, but also on the state of the water before aëration.

Numerous other machines have been introduced for making and bottling soda and other aërated waters. Messrs. Cooper and Bursell, Messrs. Mayo, Messrs. Tylor and Son, Messrs. Tyler and Hayward, Messrs. Masters, and Mr. Cox, are all patentees of apparatus of this kind; and M. Savaresse and other manufacturers in France have displayed their ingenuity in a similar direction. The first-named manufacturers have patented an aërating machine and a carbonating machine, adapted to the manufacture of aërated waters. Messrs. Mayo's patent siphon vase, for containing aërated waters, and made by a combination of metal and pottery, affords the means of withdrawing at pleasure such quantity of the beverage as may be required, and keeping the rest in a state fit for effervescence. Messrs. Tylor and Son have invented a small fountain soda-water machine, a double soda-water machine (with a gasometer similar to those used in gasworks), and a bottling or corking machine. Messrs. Tyler and Hayward have a double soda-water machine for two bottles, capable of making 300 dozen per day.

There are two or three of these machines which deserve a little attention for the ingenuity displayed in them. In Cox's apparatus the impregnating gas may be sustained at a pressure sufficient to cause its absorption by the liquid to be aërated without the aid of force-pumps. The machine can aërate 50 gallons in an hour. There is a vessel called a generator, in which lime-water is placed; another vessel containing dilute sulphuric acid; a third vessel, the purifier, containing water; and a fourth, containing the liquid which is to be aërated. The acid is admitted into the generator, where it is kept agitated or stirred with the lime-water; carbonic acid gas is formed by the decomposition of the lime, and is admitted into the purifier, where it is cleansed from some of its impurities by passing through the water; the gas then passes into a cylinder containing the liquid to be aërated, where a constant agitation is kept up to facilitate the aëration. The gas is generated under such circumstances as to give it an intense pressure, which renders necessary great strength in the apparatus. There are contrivances in the cylinder for facilitating the bottling of the aërated liquid.

Messrs. Masters's aërating apparatus is very simple in construction, and is adapted for domestic rather than for manufacturing uses. It consists of two globular-shaped glass vessels, the upper one of which receives the water to be aërated, while the lower is that in which the gas is generated. The machine can hold about liquid enough for six ordinary tumblers or goblets. To make soda-water, the upper globe is filled with the proper liquid, and the materials for generating carbonic acid are introduced into the lower; there is a connection between the two globes, which are in other respects air-tight. The aëration or carbonating is speedily effected, and the soda-water can then be drawn off at pleasure by means of a patent siphon tap worked by a spring. Any kinds of beverage, such as wine, lemonade, nectar, ale, beer, &c., can be brought into an effervescing state in a similar way; and the ready mode in which this is effected constitutes a recommendation of the machine.

M. Savaresse's machine aërates from 300 to 3000 bottles per day, according to its size. It is intended for the aëration or effervescing of drinks generally; it is somewhat complex in arrangement, but can be worked by one person. Belonging to but detached from this is a vessel called a *siphoid*, to transfer the aërated liquid to a glass; the siphoid is filled from the large machine, and may then be emptied by glassfuls without any deterioration of quality.

Messrs. Knight patented an air-tight stopper in 1844, for flasks intended to contain the aërated water, when required to keep it some time for further operations, or to transfer it to the common glass-bottles. It is an ingenious piece of apparatus, strong enough to resist the expansive force of the gas, yet easily adjusted for the entrance or exit of liquids.

AËRIAL IMAGES is a term applied to those images which are caused by the convergence of reflected or refracted rays of light, when they appear to be suspended in the air. [LIGHT; MIRAGE.]

AËRIAL PERSPECTIVE, a term in painting, implies, in its simple definition, the receding of objects into distance, as seen through the medium of air. In its general application, however, it is to be understood in a more enlarged sense. Linear perspective may be considered the material guide of the artist, originating in, and governed by, mathematical science; but aërial perspective is, in whatever relates to *effect*, amenable to no positive law or established rule, and depends for its application on the perceptions and capacity of the artist. Although entering into every variety of subject, in graphic representation, it is in open scenery that aërial perspective is exhibited in its proper sphere. To feel this, it will only be necessary to recollect in how different an aspect the same scenery may present itself under different modifications of the atmosphere. A prospect, which at noon day, or in a clear and bleak morning, appears tame and uninteresting, will often assume an ideal character, and start into combinations of beauty, if seen at sunrise or at sunset, or under the influence of any atmospheric phenomenon favourable to the development of picturesque effect.

It is, of course, in those schools of painting, wherein the study of external nature, especially of landscape, has been most cultivated, that we are to look for the finest examples of aërial perspective. The Roman and Florentine masters, whose object, almost exclusively, was human form and character, seem to have felt or understood but little of it. The Dutch and Flemish painters exhibit very considerable excellence in this particular, as is shown in the works of Rubens, Rembrandt, Cuyp, Ruysdael, &c. France, however, has the glory of having produced the artist Claude Lorraine, who, in this great quality of art, bore off the palm from all competitors. He rarely painted any other effects than those of the rising or the setting sun; but whatever be his subject, an ancient port, or ruins, or temples, the great and presiding charm of Claude is his consummate skill in aërial perspective; but the aërial perspective of a calm and placid atmosphere. If there be any of the older masters who, in the treatment of aërial perspective, can compete with Claude, that competitor, perhaps, is Cuyp. His pictures are direct portraits of the scene before him,—the willowy lake, the marsh, the meadow, the drowsy shepherd, and the ruminating cow. But, in spite of the simplicity of these materials, and an horizon, in general, perfectly flat, he communicates to his works an effect of air and distance, and consequently of reality, which must rank them among the most remarkable efforts of art. To these may be added the English Wilson, whose mastery in the practice of aërial perspective, gives him a right to rank with Claude and with Cuyp in this quality; and Turner, whose representations of a wide expanse of country under the influence of atmospheric phenomena, are unequalled by any painter, ancient or modern, for the almost unlimited variety of their range, and the brilliancy and accuracy of their aërial effects. Indeed, in his numberless oil paintings and water-colour drawings, nearly every variety of aërial effect, from the calmest and most unruffled sky to the fiercest tempest, may be found represented with the most surprising force and fidelity—allowance being made for occasional exaggeration of colour—the accurate perception of the relative distances of the various objects, and whatever is understood under the term aërial perspective being still strictly maintained.

AËRO-DYNAMICS, signifies the science which treats of the motion of the air, or of the mechanical effects of air when in motion. In its widest sense, it might be taken to include the effects of the motion of any gaseous substance or vapour; and even the properties of steam might be considered as a part of the science. We shall however confine ourselves to the explanation of the few general principles which can be relied upon, with regard to air *alone*, leaving the others for their proper places, with their chief applications, such as ANEMOMETER, WIND-MILL, AIR-GUN, SAIL, STEAM-ENGINE, RESISTANCE, GUNNERY, &c.

If there be one part of dynamical science more abstruse than another, it is the doctrine of the propagation of motion in fluids, especially elastic fluids, like the air. In this case, the acting forces may be said to consist (1) in local dilation of parts of the atmosphere by the sun's heat during the day, and contractions by cold during the night; (2) in the permanent difference in temperature of the equatorial and polar regions; (3) in evaporation from some parts of the earth's surface, by which the air, being entangled, so to speak, in the meshes of the vapour, is displaced upwards, and in condensation as rain, &c., in other parts, by which air is carried downwards with a large quantity of transferred latent heat; (4) in the effect of the diversities of land and sea, mountains and valleys, lakes and rivers, all of which forces act so as to cause *motion* in the aërial ocean; (5) in the rotation of the earth on its axis. Vapour introduced into the air by evaporation acts as a moving power in *two* ways: (1) By a simple addition of volume. The tension of the vapour is, by Dalton's law, added to the elastic force of the air. (2) Since vapour of water is of a less specific gravity than air, in the ratio of 0·6235 : 1, being the lightest of vapours, and, except hydrogen and ammonia, the lightest of gases, its upward diffusion is much more rapid than its horizontal, and acts in producing ascensional motion in the air itself.

The dilatation of the air by heat acts rather differently. Air is only dilated by $\frac{1}{10}$th of its bulk by an increase of 50° F., so that its effect in producing up-rushing currents is very small, unless it be violently heated. It, however, acts chiefly by upheaving the superincumbent strata, and causing them to flow over on other cooler regions. For aërial motions caused by the earth's rotation, see WIND, TRADE-WINDS.

For the tide-waves produced in the atmosphere, by the attraction of the sun and moon, see PNEUMATICS; METEOROLOGY.

As soon as we begin to move, we feel more or less the resistance of the air. At an ordinary rate of motion this is not very perceptible; but the jockey, who rides at the rate of from thirty to forty miles an hour, feels it sensibly, and is obliged to wear a cap which may *cut* the wind, as the bow of a ship *cuts* the water, or otherwise it would be blown off his head, although, in the common sense of the word, there might be no *wind* stirring at the time. Whenever we attempt to put any matter in motion, we feel what is denominated *pressure*, or *resistance*, which is the greater, the greater the quantity of matter which we attempt to move, and the velocity which we attempt to communicate to it. Thus, two violent pressures, of equal force, applied for an instant to weights of ten and twenty pounds, will make the weight of ten pounds move twice as fast as that of twenty; or, if we would have the two move equally fast, we must apply twice as much pressure to the twenty pounds weight as to that of ten pounds. If we now conceive a number of equal balls placed in a line, along which we move the hand uniformly, so as to set them all in motion one after the other, we might at first imagine that if we move the hand at the rate of two feet in a second, and afterwards at the rate of four feet in a second, that we exert twice as much force, and encounter twice as much resistance, in the second case, as in the first; because, we say, we move each ball in the second case twice as fast as in the first. But there is another consideration: we not only move each ball twice as fast, but we meet with twice as many balls in a second, so that not only the velocity which we communicate in a second is doubled, but also the quantity of matter to which we communicate that velocity is doubled, or, there is four times as much resistance to twice the velocity, as there was to the single velocity. Similarly, at three times the rate of motion, we meet with three times as much matter, and communicate to each portion three times the velocity: whence we meet with three times three, or nine times the quantity of resistance. If we transfer this reasoning to the case of a body moving through the air, we should infer, that the resistance is, to speak mathematically, as the *square* of the velocity: that is, if the velocity be suddenly made ten times as great, the resistance is made ten times ten, or a hundred times as great. And this, which was the first theory proposed on the subject, is sufficiently near the truth for practical purposes, when the velocities are not very great; for example, up to eight or nine hundred feet in a second.

But one or two circumstances have been neglected. (1) The successive particles of air which the moving body strikes, instead of being moved out of the way completely, are forced upon those in front, so that there is a condensation of air before the moving body; which condensation, as we have seen in ACOUSTICS, is propagated onwards at the rate of about 1125 feet in a second. (2) In the meanwhile, the space through which the body moves, or has moved, is, or has been, entirely cleared of air; and though the air is forced with great rapidity into the vacant space, yet this is not done instantaneously, as we shall presently see from experiment. Therefore though, when at rest, the atmospheric pressures before and behind the body counterbalance each other, yet, when in motion, there is an increase of the pressure before the body, and a diminution of that behind it; both which circumstances increase the resistance.

From theory, tolerably well confirmed by experiment, it appears, that if air of the ordinary pressure be allowed to rush into a *vacuum*, or space entirely devoid of air, it will be driven in at first with a velocity of about 1340 feet per second; or, to avoid an appearance of accuracy of which we are not actually in possession, we may say between 1300 and 1400 feet per second. If now, instead of rushing into a vacuum, the air which comes through the orifice meets with other air of a less density, say one-fourth of its own density, the velocity above-mentioned will be diminished in the proportion of 1 to the square-root of $(1 - \frac{1}{4})$, or of 1 to $\sqrt{\frac{3}{4}}$, or of 2 to $\sqrt{3}$, or of 100 to 87, very nearly. By a similar process any other case may be computed. Let us now imagine a ball, *a b* (Fig. 1), to move forwards in the direction BA, with an initial velocity less than 1000 feet per second.

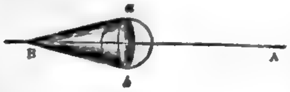


Fig. 1.

Let B be the last point of its track at which the air has completely recovered its former state. The air in the cone B*ab* will not have entirely recovered its state, but will all be more or less rarefied; so that in addition to the loss of motion arising from communication to the particles of air, there is a part of the atmospheric pressure on the front of *ab*, not counterbalanced from behind. The condensation in front of *ab* is propagated [ACOUSTICS] quicker than the ball moves; so that the air in front continues, if not entirely, at least very nearly, in its natural state. We cannot say that the cases of air rushing through an orifice into a vacuum, and of air filling up the space left by a ball, have any decided similarity; nor can we say the contrary, owing to the very imperfect state of the mathematical analysis of this part of the subject. We may however conjecture that when the ball moves with a velocity greater than that of sound, thereby condensing the air before it, and leaving a perfect vacuum behind it, or nearly so, the resistance will be much greater than the theory already stated would lead us to expect. And this proves to be the case at even less velocities than the one just specified; for though up to 1000 feet per second, or thereabouts, the resistance increases very nearly with the square of the velocity, yet from that point it increases in a much quicker ratio; so that to a ball moving at the rate of 1700 feet per second, it is three times as great as we should obtain from our first hypothesis. The resistance to an iron ball of twelve pounds weight, moving at the rate of twenty-five feet per second, is equivalent to a pressure of half an ounce avoirdupois; if we increase twenty-five feet per second to 1700 feet per second, or multiply the first sixty-eight times, the square of which is 68×68 or 4624, we might, from what has been stated, expect a resistance of 4624 half ounces, or $144\frac{1}{2}$ pounds; instead of which it was found to be $433\frac{1}{2}$ pounds; about three times the preceding, as we said. At a velocity of 1600 feet per second, the resistance was found to be more than twice that given by the theory. Without entering further into details, for which the reader may consult the article GUNNERY, to which they particularly apply—and also without considering the effect which the different forms of bodies have upon the RESISTANCE (to which we refer),—we give some of the conclusions to which Dr. Hutton was led by a long and careful repetition of the experiments of Mr. Robins, his predecessor in the same track. For the method of conducting these experiments, see WHIRLING MACHINE; BALLISTIC PENDULUM.

1. The resistance is nearly in the same proportion as the surface exposed, but a little greater than this proportion on the larger surface. That is, if we take two bodies of the same figure and material (two iron spheres for example), the surface of the second being twice that of the first, the resistance to the larger sphere is a little more than twice that of the smaller, the velocities being the same in both.

2. The round ends and sharp ends of solids suffer less resistance than the flat ends. Thus, the sharp end or vertex of a cone is less resisted than the flat end or base.

3. Two solids, having the parts presented to, or which push the air, the same, are not equally resisted unless the hinder parts are also the same.

Though we have hitherto considered the resistance offered to a body moving against still air, and the pressure which is necessary to maintain it at a given velocity, yet the problem is exactly the same, if we suppose the body to remain still, and the air, or as we now call it, the *wind*, to move against it with the same velocity. Suppose the body to move 100 feet in a second, and that the spectator is carried along without his knowledge at the same rate. He will, therefore, always be in the same place with respect to the body, and will at the same time imagine that the air or wind is coming towards him at the rate of 100 feet per second. The force which, when he imagined the body moving, he called the pressure necessary to maintain its velocity, he will now say is the pressure necessary to steady it against the wind.

If we suppose both the wind and the body to be in motion, the resistance is variously modified, according to the direction of the motions of the two. If the wind and the body move in the same direction, with the same velocity, there is no resistance; for no air is displaced by the body. If the wind move 50 feet per second, and the body 100 feet, the pressure on the body is the same as if it were at rest, with a *contrary* wind of 50 feet per second blowing on it. If the wind and the body move in contrary directions, with velocities of 100 feet, the resistance is that of a wind of 200 per second; and so on. If the spectator move with the body unknowingly, the magnitude and direction which he will assign to the wind is that which will produce such a pressure on the body *at rest*, as it really sustains when in motion. [APPARENT MOTION.]

The following well-known table, first given by Mr. Smeaton in the 'Philosophical Transactions' for 1759, and confirmed by the experiments of Dr. Hutton, shows, in pounds avoirdupois, the pressure which different winds will exert upon a square foot of surface exposed directly against them. The first column is a rough representation of the second.

Velocity of Wind.		Force on one square foot in pounds avoirdupois.	Character of the Wind.
Miles per Hour.	Feet per second.		
1	1·47	·005	Hardly perceptible.
2	2·93	·020	Just perceptible.
3	4·40	·044	
4	5·87	·079	Gentle, pleasant wind.
5	7·33	·123	
10	14·67	·492	Pleasant, brisk gale.
15	22·00	1·107	
20	29·34	1·968	Very brisk.
25	36·67	3·075	
30	44·01	4·429	High winds.
35	51·34	6·027	
40	58·68	7·873	Very high.
45	66·01	9·963	
50	73·35	12·300	Storm or tempest.
60	88·02	17·715	Great storm.
80	117·36	31·490	Hurricane.
100	146·70	49·200	Destructive hurricane.

For the method of obtaining these results see ANEMOMETER.

Let us suppose the square foot of surface to be placed obliquely, so as to make an angle A B C (Fig. 2), with the direction A B of the wind. Let D B represent the velocity of the wind per second. Then, if D E be drawn perpendicular to B C [COMPOSITION OF VELOCITIES] the wind which strikes the plane at B does not strike it directly with its whole velocity, but only with the velocity D E; it being the same thing as if we supposed the wind to be carried directly against the plane with the velocity D E, and at the same time shifted on the surface from C towards B with the velocity E B. This last will only make different particles of air strike the point B, but not with different forces. This line D E is in trigonometry proportional to the *sine* of the angle D B E. Again, if we draw E F perpendicular to D B, the whole of the velocity D E is not in the direction of the wind, A B, but only the part of it D F; the other component, F E, being employed in moving the plane in a direction perpendicular to that of the wind. This line, D F, which represents the *effective* velocity of the wind in the direction A B, is, as the *square* of the sine of the angle D B E, since D F = D E sin D E F = D E sin D B E and D E = D B sin D B E. The line, D F, is a third proportional to D B and D E, so that if we suppose the wind to move at the rate of 100 feet in a second, and the plane to be so inclined that the wind strikes it directly with only 80 feet of velocity, we have, for the real effective velocity 100 : 80 :: 80 : 64, or we must consider this plane as resisting a wind of only 64 feet of velocity. This theory is liable to the objections of the former one, as it does not allow for any condensation, but supposes the particles to disappear after they have struck the plane. Nevertheless, it is found in practice to answer well enough when the plane is not very oblique to the wind. For the mathematician, we may state that the following empirical formula is found from Smeaton's experiments to be much nearer the truth, which, as he will see, is nearly equivalent to the square of the sine of the angle of inclination, when the latter is nearly a right angle. Let the angle of inclination of the surface be θ, and the velocity of the wind V, then the effective velocity is

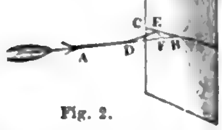


Fig. 2.

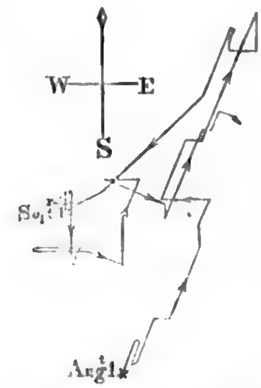
$$V \sin \theta^{1\cdot 842 \cos.} \text{ nearly.}$$

Every meteorological observatory is furnished with an instrument called an *anemometer*, which registers the *direction*, the *duration*, and the *force* of the wind. Hitherto it has not been possible to obtain sufficient data for accurately determining the mean monthly or annual direction and force at a large number of different stations, by reason of the costliness of the apparatus required. Meanwhile, it has been the practice to assume that the force of all winds may be regarded, on the average, as measured by the frequency of their occurrence. Kämtz and Dove have computed the mean annual force and direction, and their monthly variarions, for many stations in Europe and America, of which the following Table is a synopsis :—

	Direction.	Force.
England	S 66° W	0·198
France and Holland . . .	S 88° W	0·135
Germany	S 76° W	0·177
Denmark	S 62° W	0·170
Sweden	S 77° W	0·228
Eastern Europe	N 87° W	0·167
N. of United States . . .	S 86° W	0·182

The mechanical means by which these results are obtained will be described under ANEMOMETER; but we may here state the value of those recorded results in furnishing the *integral* of the wind for each point of the compass; or, in other words, the entire quantity of wind which has blown from each point during a given period. If the force of the wind were constant, the integral would be obtained by multiplying the length of time that the wind blows by the rate at which it travels. The integral is proportional to both these quantities taken jointly, just as the area of a rectangle is proportional to its length and breadth taken jointly. If we were to construct a figure the length of which should represent the *duration* of the wind, and its breadth the *force*, the latter being a constantly varying quantity, the breadth of the figure must vary, in order that its area may represent the integral of the wind correctly. The results furnished by Mr. Osler's anemometer enable us to construct such a figure; but in Dr. Whewell's anemometer the integral is represented simply by the depth which the pencil descends. Whewell's instrument is so far defective that it makes no attempt to record the *time* during which each wind blows, the times of its *changes*, or its *force* at any given moment; but only the order of its changes of direction and the integral or entire quantity that blows from each point, or rather from each rhumb of 11¼° : this is known by the length of the pencil-mark in each vertical division of the cylinder measured vertically and not following the windings of the track, for these must be neglected so far as they are confined to one rhumb, the centre of which corresponds with one of the points of the compass. Hence, any wind which does not deviate from any one of those points more than 5⅝°, if the cylinder be divided into 32 parts, or 11¼° if it be divided into 16 parts, is regarded as blowing exactly from that point; which is a serious defect common to wind-registers. But, supposing that we are in possession of the lengths of line described by the pencil in each division of Whewell's cylinder during a certain period, such lengths or proportionate ones may be laid down in their proper order with directions so as to form a crooked line expressive of all the quantities and changes of the wind for that particular place and period. This is called the *type* of the wind. For example, Fig. 3 represents the type

Fig. 3.

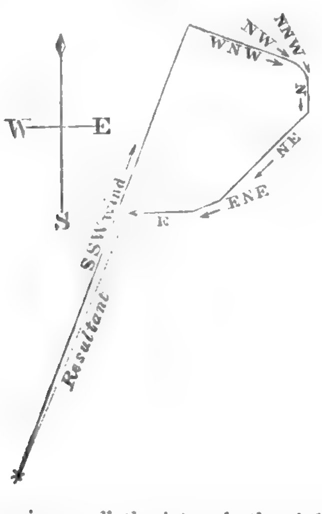


of all the wind that blew over Plymouth during August and part of September 1843. If the two ends of this line be joined by a straight line we shall get the direction of the *resultant* or average effect of all the winds which blew over Plymouth during that period, which, in the case before us, is about N. 23° E. or about equivalent to a S.S.W. wind. This average direction is not, necessarily, the *prevailing* direction or the direction in which the wind most commonly blows; since the prevailing winds may be gentle and the greater force of those from the opposite quarter may more than compensate for their shorter duration, so that the average direction with respect to time and intensity, considered jointly, may differ greatly from the average direction as regards time alone. In England, however, both these averages have nearly the same direction : the time average is equivalent to a wind blowing from some point between S. and W., and the true average, however variable on a comparison of the resultants of different months or seasons, exhibits in the type for a whole year a general northward direction, mostly eastward from the starting point. Whewell's instrument places the mean direction for three years nearer N. than E., while, according to Osler's, it is nearer E. than N.; but when it is considered that in Whewell's instrument the velocity of the fly does not bear a constant ratio to that of the wind, but is more than proportionally quicker in a quick than in a slow wind, while the distance which the pencil descends is proportional to the revolutions of the fly, the traces of the pencil cannot correctly represent the integrals of the wind. In fact, it is necessary to *drive* the instrument by means of a clock, leaving the direction or regulation of the instrument to the wind, as in Osler's instrument.

It will be seen by reference to Fig. 3, in the article ANEMOMETER, that the upper pencil makes a trace on the register paper which represents the pressure of the wind, while the trace made by the middle pencil represents its direction. Now the ordinates of the upper trace are proportional to the wind's velocity; or in other words, the ordinates at any two different moments should bear the same ratio to each other, as did the velocities of the wind at those two moments. Hence, the total amounts of wind passing over the instrument during different periods, will be proportional to the areas of the portions of curve traced during those periods, and it is only by measuring and comparing these areas that we can obtain the proportion of the integrals of wind during different periods of time. To draw a type of the wind by Osler's instrument, such as is so easily done by Whewell's, the periods must be so divided that during each period the direction of the wind may have been confined within certain limits, such as two rhumbs (22½°), or one rhumb (11¼°). To do this that part of the register-paper devoted to direction must be divided by 16 or 32 longitudinal lines, such that when the vane points to any one of the 16 or 32 principal points, the direction-pencil may rest midway between two of these lines; then, by noting all the points where the pencil-track intersects these lines, and from every such intersection raising a perpendicular to the top of the paper, such perpendiculars will divide the upper curve, or that of force, into portions each of which may be regarded as belonging to one wind only; for during its description the wind did not deviate more than 5⅝° or 11¼° (according as we use 32 or only 16 points) on either side of a certain point. By ascertaining the areas of these different portions, and drawing lengths of line proportional to them, placing those lines in their proper direction and in their proper order, we obtain a more correct type of the wind than by the method previously described. The integrals of the wind have not only a relative, but also an absolute value. If the pressure-plate be correctly graduated, as by whirling it through the air at known rates of velocity, and noting the several amounts of compression in the spring, we get similar results to those obtained by having wind at various velocities acting upon the fixed plate. Suppose that the pencil is one inch from the top of the paper when the wind is blowing at the rate of ten miles an hour, two inches when it is blowing at the rate of twenty miles an hour, and so on, and that the paper is moving at the rate of one inch an hour, then every square inch of surface included between the curve of force and the top of the paper denotes that ten lineal miles of air have blown over the instrument; so that by measuring the area of any portion of this surface included between any two ordinates, the *absolute integral* is obtained in miles or the number of miles of air that have passed over the place during the period in which that portion of the curve was traced. Hence absolute values in miles may be assigned to all the lines which form any type of wind, and measuring by the scale thus obtained the length of the resultant or the line which joins the two ends of the type, we obtain not only the *direction* but also the *extent* in miles of the entire movement of air produced by the combined effect of all the winds that have blown during the period for which the type was constructed. " For instance, it was found that the resultant of all the winds that blew over Greenwich, during 1841, was equivalent to the passage of 47,900 miles of air towards E. 28° 30′ N. In the same way the direction of the resultant for 1842 was found to be E. 27° N., and its length 36,750 miles. By dividing these numbers by the number of hours in a year, we see that the total effect of the wind in 1841 was equivalent to a constant current towards E. 28° 30′ N., at the rate of 5·4 miles an hour; and in 1842 towards E. 27° N., at the rate of 4·2 miles an hour; or, in other words, as if there had blown during these two years a constant wind from W.S.W.¼S. at 4¾ miles an hour." The average velocity of the wind at Greenwich during 1841 was 18·7, and during 1842 18·3 miles an hour, while the whole integrals of wind for those years, as shown by the length of their type-line measured along all its windings, was in 1841 167,322 miles, and in 1842, 159,950 miles; showing that the whole movement of the air in this country, is about four times as great as its resultant or effective movement.

The resultant for any given period may, however, be obtained without constructing such a type as Fig. 3. Such a figure may be simplified by

Fig 4.



collecting and summing up all the integrals that belong to the same wind, and then drawing lines proportional to the 16 or 32 sums thus obtained, when, by arranging them in their proper directions, we may get the same resultant as if the whole type had been drawn. The figure may be still further simplified by taking the difference between parallel lines, or subtracting each non-effective wind, or each one that is less than its opposite from that opposite, and retaining only the remainder; thus, Fig 4 contains all the effective lines of Fig. 3, and yet by a great saving of labour gives the direction and length of resultant.

The resultant may also be found by calculation; but for the method of doing so we refer to Sir W. Snow Harris's 'Report on the Working of Whewell's and Osler's Anemometers, presented to the British Association for 1844,' and also to the 'Reports of the Meteorological Observatory at Greenwich. The working of Dr. Robinson's Anemometer at the Kew Observatory also presents some points of interest, which will be noticed under ANEMOMETER. We may also refer to Sir John Herschel's able article on METEOROLOGY, recently published in the new edition of the *Encyclopædia Britannica*.

AERONAUTICS. }
AEROSTATICS. } [BALLOON.]
AEROSTATION. }

ÆSTHETICS (*Æsthetik*) is the designation given by German writers to a branch of philosophical inquiry, the object of which is a philosophical theory of the beautiful, or, more definitely expressed, a philosophy of poetry and the fine arts, and which has by them been raised to the rank of a separate science. The word *Æsthetik* is derived from the Greek verb *αἰσθάνομαι I feel*, or *I am sensible*, and was first used as a scientific term by Alexander Baumgarten, a disciple of Christian Wolf, who in his 'Æsthetica' (Frankfort, 1750-1758, 2 vols. 8vo.) considered beauty as a given property of objects, of which we are "becoming sensible." We perceive beauty, says Baumgarten, wherever we meet with perfection manifested in reality, and a thing is perfect if it is adequate to its notion: beauty, accordingly, is the perfectness of an object manifested in its appearance. The impulse to a deeper research into the essence of beauty was given by Winkelmann, who, without embodying his views in a regular system, developed them chiefly in reviewing and appreciating the remains of ancient sculpture. He adopted neither Baumgarten's "adequateness of an object to its notion," nor the material principle of pleasing the senses, which had been proposed in various times by other authors, and more elaborately evolved by Edmund Burke as the criterion of beauty; but considered the idea of beauty as dwelling in the divine mind, and as passing over from that source into individual objects. Kant denied the possibility of a strict science of beauty, inasmuch as beauty, according to him, is not a property of objects, but has its origin in the disposition of our mental faculties. We presuppose, says he, that some notion is contained in the apparent object, though we are unable abstractedly to express that notion; we assume that a tendency towards some purpose has presided over the formation of the manifold variety displayed before us, though we cannot precisely define that purpose,—and this supposition or assumption forms the basis of our perception of beauty. Schelling's view of beauty and art it is difficult to state concisely. His 'System of Transcendental Idealism,' establishes the principle, that mind and nature, or conscious and unconscious existence, are primarily identical; that the laws discoverable in nature must accordingly be traceable to the laws of consciousness, whilst, *vice versâ*, the laws of consciousness must admit of being recognised as being likewise the laws of nature: in the divine mind both exist in absolute identity. The artist is to produce in his mind an intellectual intuition analogous to this identity, and the expression which he gives to the identity thus arrived at, is the work of art. This theory was to some extent opposed by one of his most eminent scholars, Heydenreich, who regarded the recognition of beauty or taste, as dependent on an original disposition or condition of the mind, which, elevated to a science, might educe canons of taste, at least so far as related to the fitness of objects for giving pleasure or displeasure, or as objects generally or necessarily considered as pleasing; and which might therefore be properly called æsthetical laws. Beauty, according to Schelling, is that manifestation of the principle of art where the infinite appears contained in or represented by the finite, or where, in the very object, the difference between the conscious and the unconscious (mind and nature) is annulled.

But this formal definition of beauty, an objectiveness without the representation of the object, was insufficient to satisfy the growing desire for a more living and actual notion of the beautiful than that which Kant seemed to recognise. The widening of the domain of art through the exertions of men of genius made this want constantly more felt. Göthe, Schiller, Lessing, Heinse, and others, partly through their poetical works, and partly through their discussions of the principles of poetry and art, gave a wider extent and a more genial feeling to the science, as it is called. The two Schlegels (but especially Friedrich Schlegel, in his 'Philosophy of Life,' lecture xii. and in his various papers on Art, first began to form these views into a system, and they were followed by Solger, Trahndorff, and Lommatsch, who published 'Die Wissenschaft des Ideals, oder der Lehre vom Schönen,' at Berlin in 1835. Hegel's views as to æsthetics were first published, after his death, by Hotho, in 1835-1838, and they are distinguished by the vast and varied richness of his illustrations, whilst they possess in full measure his obscurity of expression. Hegel considers the Beautiful as a representation of the Absolute, and indeed, as that which has only philosophy and religion above it. Hegel's 'Æsthetik,' published from his lectures by Hotho (Werke, b. 10), is divided into three parts:—

1. The Idea of the Beautiful, or the Ideal.
2. The development of the Ideal in the peculiar forms of the Beautiful in the Fine Arts—Classical and Romantic Art.
3. The system of the individual Arts; concluding with Poetry, classical and romantic.

Hegel says, "It is an error to suppose that the Beautiful—because it is beautiful—is an idea not to be seized and apprehended, but is to remain, therefore, for the thought an intangible object." The Beautiful is only another name for the True (and Schiller, in like manner, wished it were possible "to banish the notion, and even the very word Beauty from use, and, as is right, put Truth, in its complete sense, in its place.")

The finite spirit feels an irrepressible desire for the true, and laboriously attains thereby to its infinity. This truth of the finite spirit is the absolute.

This is the basis—for the beautiful in Art, is neither the logical idea, the absolute notion as it is developed in the pure element of thought, nor the merely natural idea, but it belongs to the internal or spiritual dominion, without, however, being fixed by the perceptions and acts of the finite spirit.

Forms divide themselves into three classes: 1. A direct and, therefore, a sensible (sinnlichen) perception, a knowledge of the form and figure of the thing itself as conveyed objectively by the senses; 2. A represented consciousness; and, 3. The free and absolute creation of the mind itself.

If we would rightly understand the place which Art occupies in the collective domain of natural and spiritual or intellectual life, we must consider the entire purport of our being; when we at once find that not alone must the physical and social wants be satisfied, and the religious feeling which is implanted in man, find its proper object; but that the intellectual faculties—the totality of knowledge and perception, in short, which all are conscious of in themselves—must find their adequate occupation. And within this totality comes the desire for the fulfilment of its perception in Form.

As the ideal of the Beautiful in Art, Hegel believes that he has established that there are—First, an abstract form or inner notion (Inhalt): secondly, the expression, or the reality of this significance: and thirdly, that both these must be so interpenetrated by each other, that the outward form becomes only a representation of the inner; and is otherwise non-existent, except as a necessary clothing of the abstract form, idea, or conception (Inhalt). For this, he says, which we call the Inhalt, is the object itself in the simplest form, even when brought back by surrounding definitions in opposition to actual representation. This simple conception, this thesis, as we may say, which forms the basis of all actual representation, is the abstract; as the actual representation, the full development on the contrary, is the concrete.

Thus, as Müller expresses it ('Handbuch der Arch. der Kunst') "Art is a representation, or activity, by means of which, something internal or spiritual is revealed to sense. Its only object is to represent, and it is distinguished by its being satisfied therewith from all practical activities which are directed to some particular purpose of active life." Under the influence of Hegel's ideas many works of considerable merit have appeared, such as 'Neue Vorschule der Æsthetik,' published at Halle in 1837 (which is modelled on the form of J. P. Richter's work of the same title), and Vischer's work, 'Ueber das Erhabene und Komische.' Darmstadt, 1837.

The above meagre definitions may serve in some measure to characterise the points from which some of the principal German philosophers have started in their respective systems of æsthetics. We think it not irrelevant to remind our readers that it is almost impossible to condense within a few words what it would require a dissertation fully to explain and to discuss; and also, that the opinions of any philosopher reported in a foreign language are always apt to appear to disadvantage, but more particularly so when the language in which they were originally expressed affords such wonderful facilities for the utterance of speculative thought as the German.

Many German writers have, with greater or less independence, followed the principles laid down by Baumgarten, Kant, Schelling, or Hegel. They commonly divide their systems into a general part, or a discussion of the essence of beauty and art, and a special one, or an inquiry into the peculiar character and predominant principles of the several branches of poetry on the one hand, and the fine arts (chiefly sculpture, architecture, painting, and music) on the other.

In a wider and more general meaning, æsthetical is often used in opposition to logical, as expressing the feeling of pleasure given by viewing an object, without reference to its utility.

ÆTHERS. [ETHERS.]

AFFEERERS. [LEET.]

AFFETTUO'SO (Ital. *affectionate*), in Music, signifies a tender, expressive style; and slowness is invariably implied. In regard to movement it may be considered as equal in degree to larghetto.

AFFIDA'VIT is a statement of facts in writing, on oath. The word is the perfect tense of the barbarous Latin word *affido*, to pledge faith to, and is taken from the old Latin form of a declaration on oath, which commenced thus: *"Affidavit J. S.,"* "J. S. hath sworn," &c. By the practice of our tribunals, affidavits are necessary in many cases, in order to bring facts under the cognisance of courts of justice. All evidence of facts must be given on oath, or affirmation, either by oral testimony or by affidavit. Where evidence is to be acted upon by juries, it is given as oral testimony; where it is to inform a court or judge, it is often put in the form of an affidavit.

An affidavit is usually made as follows: If made in a cause, the name of the court in which the cause is pending, and the names of the plaintiff and defendant, are written at the head of the paper. The name, description, and residence of the deponent, or person making the affidavit, are written at length, and the individual who makes the affidavit signs his name at the foot of it. The paper is then read over to him, and he is requested to swear that the contents of the paper are true. And lastly, the *jurat* (a term derived from the Latin word *juratum*, 'sworn') expressing the officer [judge, commissioner, magistrate, or other person] before whom, and where, and when, the affidavit is made, is signed by that officer. If the affidavit be sworn in open court, that circumstance is mentioned in the *jurat*, and no officer is named.

The forms of affidavit are generally regulated by the rules of the particular courts in which they are to be used, great strictness being in all cases required in their preparation.

AFFINITY (from the Latin *adfinitas*) means a relationship by marriage. The husband and wife being legally considered as one person, those who are related to the one by blood are related to the other in the same degree by *affinity*. This relationship being the result of a lawful marriage, the persons between whom it exists are said to be related *in law*; the father or brother of a man's wife being called his *father-in-law* or *brother-in-law*. Affinity is of importance in one respect, that by law it may be an impediment to marriage, for persons related by affinity are forbidden to marry within the same degrees as persons related by blood. This rule which excludes from marriage those who are within certain degrees of affinity is supposed to be founded on the Mosaic law. The degrees of relationship, both of consanguinity and affinity, within which marriages are prohibited, are contained in Archbishop Parker's 'Table of Kindred and Affinity, wherein whomsoever are related are forbidden in Scripture and our laws to marry together.' Parker, of his own authority, ordered this Table to be printed and set up in the churches of his province of Canterbury. The Constitution and Canons Ecclesiastical, which were made in the reign of James I., 1603, confirmed Parker's Table, which thus became part of the marriage law so far as that law is administered by the Ecclesiastical Courts. Marriages within the prohibited degrees could formerly only be annulled by the Ecclesiastical Courts, and only during the life of the husband and wife. The 5 & 6 Wm. IV. c. 54 (1835) however declares that all marriages celebrated *before* the passing of that Act between persons within the prohibited degrees of affinity shall not be annulled for that cause by any sentence of the Ecclesiastical Court; but that all marriages which shall hereafter be celebrated between persons within the prohibited degrees of consanguinity or affinity shall be absolutely null and void. This Act does not define what are the prohibited degrees, and this part of the enactment must be interpreted by a reference to Parker's Table, and the canons, if the question arises before courts spiritual; and by statute or judicial decisions, if it arise in the civil courts. The principal statute is the 25 Hen. VIII. c. 32. (Black. 'Comm.,' Mr. Kerr's ed. vol. i. p. 452.)

There are certain cases of prohibition, such as the prohibition against a man marrying his deceased wife's sister, which are considered by many persons to rest on no good reasons.

The general rules on this subject are the same in Scotland as in England; but the 5 & 6 Wm. IV. c. 54, does not extend to Scotland.

The distinction between affinity and consanguinity is derived from the Roman law. The kinsfolk (*cognati*) of the husband and wife became respectively the *adfines* of the wife and husband. We have borrowed the words affinity and consanguinity from the Roman law, but we have no term corresponding to *adfines*. The Romans did not reckon degrees of *adfinitas* as they did of consanguinity (*cognatio*); but they had terms to express the various kinds of *adfinitas*, as *socer*, father-in-law; *socrus*, mother-in-law.

AFFINITY IN CHEMISTRY. [CHEMICAL AFFINITY.]

AFFIRMATION, in Law, is the solemn asseveration made by Quakers, Moravians, and Separatists, in cases where an oath is required from others. This indulgence was first introduced by 7 & 8 Wm. III., c. 34, which enacts that the solemn affirmation of Quakers in courts of justice shall have the same effect as an oath taken in the usual form. The provisions of this statute were extended by 8 Geo. I. c. 6, and 22 Geo. II. c. 46, s. 36; but in all there is a clause restraining Quakers from giving evidence on their affirmation in criminal cases. This exception, which Lord Mansfield called "a strong prejudice in the minds of the great men who introduced the original statute" (Cowper's 'Reports,' p. 390), was removed by 9 Geo. IV. c. 32. Quakers, Moravians, and Separatists (3 & 4 Wm. IV. cc. 49, 82), may now give evidence in all cases, upon their solemn affirmation. The Act 1 & 2 Vict. c. 77, allows the same privilege to persons who have been at any time Quakers, Moravians, or Separatists, and have ceased to be such, but still have conscientious objections to the taking of an oath. Now, however, *every person* who has conscientious objections to taking an oath, may be permitted to make a solemn affirmation in lieu thereof, the effect of which is the same as if the testimony were given on oath. (Common Law Procedure Act, 1854.)

In the session of Parliament of 1833, a question arose respecting the sufficiency of the affirmation of a Quaker, instead of the customary oaths, on his taking his seat in the House of Commons. The subject was referred to a committee, on whose report the House resolved that the affirmation was admissible. This was more than once attempted to be made a precedent for permitting a Jew to take the oaths, without adding the words "on the true faith of a Christian." Ultimately the statute 21 & 22 Vict. c. 49, was passed, to enable either House of Parliament to dispense with these words.

AF'FIX, a term in grammar, to which the name of *suffix* also is sometimes given. It signifies a *syllable* attached to the *end* of a word by which the form and signification of the word are altered. This will be best explained by some examples from our own language. Thus in the words *wealth-y*, *weight-y*, *bulk-y*, and in *god-ly*, *odd-ly*, &c., the syllables *y* and *ly* are the affixes, which qualify the meanings of the words to which they are attached, and fit them for a new and different use; as 'This man loves *wealth*;' 'That is a *wealthy* merchant.' Verbs are in this way made from adjectives, as from the adjectives *sharp*, *quick*, *thick*, we have *sharpen*, *quicken*, *thicken* respectively; and adjectives and adverbs from nouns, as in the examples just given. The *'s*, which marks our possessive case, is an affix, having originally been a distinct syllable, as we see from our old books in such expressions as

Goddes will; *mannes* duty. Some persons are of opinion that this *'s* has arisen from the possessive pronoun *his*, as in such a phrase *God his will, man his duty;* but we are of opinion that this final *'s* is to be referred to the German and Anglo-Saxon genitive termination *es.* When we hear people vulgarly say *hisn, hern*, for *his, her*, the *n* is the remnant of the syllable *en*, which in these instances marks a kind of pronominal adjective, akin to the genitive or possessive case; as we may still observe in the German forms *dessen*, &c.

In the Latin and Greek, and many other languages, there is the same system of affixes of which we have given examples in the words *weighty, bulky;* and in these languages the different cases of nouns, and adjectives, and the different tenses and persons of the verbs, are also formed by affixes. Thus the nominatives *Pindaru-s, Homeru-s, Liviu-s, Antoniu-s*, are the true Roman forms of these names, which, in the accusative, form *Pindaru-m, Homeru-m*, &c., respectively, and so on in the other cases. With the English it is the common practice to shorten all these words to Pindar, Homer, Livy, Antony; and yet we are not consistent in this practice, for we say *Tibullus, Æmilius*, &c., keeping, in these instances, the genuine form just as it is in the language to which these names belong. The irregularity depends upon the greater or less familiarity of the names. With the French, the changes are still more violent.

AFRICAN ASSOCIATION, a society which was formed in London, in the year 1788, with the design of encouraging men of enterprise to explore the interior of Africa; of acquiring by their means a knowledge of the character of the native inhabitants; and of being enabled to introduce among them the arts of civilisation. The association, during the period of its labours as a distinct body, commissioned for their objects several travellers, whose zeal and ability have furnished the best evidence of the correctness of the association's choice.

The first person thus commissioned was John Ledyard. While preparing himself for his undertaking, in August 1788, Mr. Ledyard was seized with a bilious fever, and died at Cairo. His successor was Mr. Lucas.

The next person engaged by the association was Major Houghton. He arrived at the mouth of the river Gambia in November 1790, and after various adventures attended with severe privations, died at Jarra, in September 1791, not without strong suspicions of having been murdered. Without being discouraged by these repeated disappointments, the association sought for some other person to prosecute their plans, and were fortunate in meeting with Mungo Park, who sailed in May 1795. The second journey of this adventurous traveller, in 1804, was undertaken at the expense of Government.

The association subsequently engaged Mr. Hornemann, a German; Mr. Nicholls; and a young German named Roentzen. The last missionary of the association was John Lewis Burckhardt. He sailed for Aleppo in March 1809, and died at Cairo in 1817.

Repeated failures appear at length to have discouraged the association from engaging other missionaries. A great deal of information, connected with the geography of Africa, was collected by them from various sources during the period of their active labours; and this information was communicated to the public in the occasional printed reports of their proceedings. The association has merged in the Royal Geographical Society, into which body its few remaining members were admitted in 1831.

(*Proceedings of the Association*, from 1794 to 1805; Leyden's *History of Voyages and Discoveries in Africa*, edited by H. Murray; and *Journal of the London Geogr. Soc.* vol. i. p. 257.)

AFRICAN COMPANY, a regulated trading company, established by the act 23 Geo. II. c. 31 (1754). In the course of time it happened that the whole expense of the Company came to be defrayed by the public, and for this reason the charter of its incorporation was recalled by Parliament in 1821 (1 & 2 Geo. IV. c. 28). The possessions of the Company on the west coast of Africa were by this act annexed to and made dependencies upon the colony of Sierra Leone.

AFRICAN INSTITUTION, a society established in London, in April, 1807, the declared objects of which were to collect accurate information respecting the African continent and its inhabitants, to cultivate friendly relations with the African people, and to introduce among them the arts of civilisation. As an important instrument for promoting these objects, the members of the institution were invited to devote their individual attention and united influence to obtain the enforcement of the law, then recently passed, for abolishing the African slave trade, and to expose all attempts to evade its provisions. In this part of its functions the vigilance of the institution was unceasing; and the exertions of the directors were successfully applied towards obtaining an Act of Parliament declaring the trading in slaves to be felony.

The British and Foreign Antislavery Society, and the Church, the London, and the Wesleyan Missionary Societies, which have each established missions and schools in various parts of Africa, were established at various periods, and made the civilisation of the Africans one of the chief objects of their organisation. In 1839, was founded in London the Society for the Extinction of the Slave Trade and the Civilisation of Africa, whose first public meeting was presided over by Prince Albert in June 1840. The object of the society was to seek and make known the best means of civilising Africa, but they did not undertake to send out missions, though it was on its recommendation that the unfortunate expedition to explore the Niger was undertaken in 1841. One of its principal members was Sir T. F. Buxton; and its organ 'The Friend of Africa,' published monthly, which first appeared in January 1841, placed before the world several plans for the amelioration of the negro.

In the United States of America, likewise, several societies have been established for similar purposes. In 1774, Rush and Pemberton formed a society in Pennsylvania, for the abolition of slavery, and to relieve helpless and oppressed negroes; and which, after some interruption, was re-established in 1787, under the Presidency of Franklin, with renewed vigour; and another was formed with the same object, in 1785, by President Jay. In 1791, an association was formed for transporting the slaves to Sierra Leone; but their right to do this was resisted by the English government, and it resulted eventually in the establishment of Liberia. Whatever might have been the motives of the founders, it is certain that the effect has not been to lessen slavery or its ill consequences within the limits of the United States, but rather to perpetuate it, by giving opportunities of getting rid of sickly, turbulent, or dangerous individuals; and nothing has been done to decrease or ameliorate the state of slavery within the home dominions of the States.

AFTER-MATH is the grass which grows after the hay has been made; it is also called latter-math, rowen, or rowett, and when left long on the ground it is called fogg in some places. Where the land is rich and hay valuable, the after-math is often mown and made into hay. This hay is inferior in value and nourishment to the first crop, which contains the flower-stalks of the grass. It is not good for horses, especially those which are driven fast and work hard; it is thought injurious to their wind. Cows and sheep are fond of it, and with them it is not liable to the same objection. Whether it be more profitable to cut a second crop of hay, or to feed off the after-math, must depend on circumstances and situations. Unless the meadows can be irrigated, or well manured, taking off two crops of hay in one year exhausts them, and is apt to produce moss, which the tread of sheep and cattle prevents.

There is a practice with some farmers to leave the after-math on the ground from hay-making time till the next spring; this is then called *fogg;* and the young grass, springing up through the old, makes it palatable to young cattle. Arthur Young mentions this practice with some commendation, as a resource in spring; but it does not accord with a well-regulated system of husbandry, in which all food should, if possible, be given in its most perfect state. The fogg, half rotten by a wet winter, cannot be wholesome food; besides, slugs and various insects breed in it. The after-math should be fed off clean before winter. A good farmer should have hay, straw, and roots sufficient for his stock. Swedish turnips, mangel wurzel, carrots, &c., can be stored in winter, and strewed upon the pastures in spring, by which the stock will be better fed, and the land improved.

AGA, the name of a dignity, and also an epithet of respect, among the Turks. The word is said to be of Tatarian origin, and signifies literally a great man, a lord, or a commander. In Turkey, the Aga of the janissaries, while that corps subsisted, was their commanding officer or colonel, whose place was one of high authority and dignity in the state. There is also the spahilar-aga, that is, the colonel of the spahis, or cavalry; the topd-schilar-aga, or commander of the artillery; and the kisslar-aga, or guardian of the harem. Aga is likewise the common epithet of civility used in addressing or speaking of the eunuchs employed in the seraglio; and their chief is distinguished by the title of Capi Aga. The Capi Aga, or Capi Agassi, as he is often called, is one of the principal officers of the court of Constantinople.

AGAPÆ (ἀγάπαι), the plural of the Greek ἀγάπη, which signifies love, or charity. In the history of the Christian church, the agapæ were those meetings of the early believers, where they sat and ate, at a common table, of food which had been provided by the voluntary contributions of the members of the society, the entertainment being concluded with the holy kiss. These meetings, which were usually held in the same house or apartment in which they assembled for divine worship, are mentioned in the 12th verse of the epistle of Jude, where it is said of certain unworthy brethren "these are spots in your feasts of charity." It is probable also that St. Paul alludes to them in 1 Cor. xi. 20, where his language would seem to imply that the agapæ were connected with the sacrament of the Lord's Supper. They arose from that charity towards the poorer brethren which was so strongly inculcated upon the first followers of Christianity, both by the religion they professed and the circumstances in which they were placed. Even in the days of the apostles, however, these meetings had been occasionally perverted from the purpose of their institution, and in time they gave occasion of scandal to the enemies of the faith. The reader may find an account of the accusations of which they were made the groundwork by some of the pagan writers in the 16th chapter of Gibbon's History. They seem to have been generally celebrated for several centuries. Ecclesiastical writers mention three kinds of them: first, those which took place at marriages, called the nuptial or connubial agapæ, to which the bishop or pastor was usually invited; second, the anniversary, or, as they were called, natal agapæ, which were held in the churches on the festivals of the martyrs; and, third, the funeral agapæ, at the interments of members of the congregation. The celebration of the love-feasts in the churches was at length expressly forbidden by the 25th canon of the council of Laodicea, in A.D. 364; although the enactment for a considerable time was not quite effectual, since we find it repeatedly renewed by subsequent councils. Indeed the practice under improved regulations appears to have been continued in certain circumstances by the heads of the church. In the 6th century, as we are informed by Bede, Pope Gregory, in his instructions to Austin when he sent him to Britain to convert the Saxons, advised him to allow the new converts to feast together on saints' days, and the anniversaries of the dedication of the churches, not in the churches themselves, but in sheds fashioned with green boughs close by them, to the glory, he says, of God, as they had formerly done to the honour of the devil. A great deal of ingenious speculation has been expended in the attempt to discover traces of the Christian agapæ, both among the Jews and pagans before the institution of our religion, and in the latter times of the Church. But the only thing in modern times corresponding to the primitive love-feasts, is the practice which has been introduced under the same name by certain sects, especially the Moravians and the Sandemanians. The Methodists also have 'love-feasts,' but they bear very little resemblance to the ancient agapæ. (Augusti's *Antiquities of the Christian Church*, Ward; Giesler's *Church History;* Neander.)

AGATHOTES CHIRAYTA. [CHIRAYTA.]

AGE. In legal acceptation, a person is said to be 'of age' when he has passed that period of life at which he is supposed to have acquired sufficient discretion to enable him to perform acts and enter into contracts, of which, before that period has arrived, he is presumed to be incapable, by reason of immaturity of understanding. The common law appoints certain specific times in the life of a man or woman before either is permitted to form contracts or incur obligations. Thus a male of the age of twelve years may take the oath of allegiance; and at fourteen, which for many purposes is considered the age of discretion, a person of either sex may choose a guardian, and be a witness, though children under twelve are frequently permitted to give evidence, after it has been ascertained by examination that they understand the nature of an oath. Formerly a female of twelve or a male of fourteen years, might validly bequeath personal estate; now by 1 Vict. c. 26, no will made by any person in England under the age of twenty-one years is valid. The law of Scotland in this respect resembles the former law of England. A person cannot act as executor till he is twenty-one.

A woman may consent to marriage at twelve, and a man at fourteen years of age; though parties under the age of twenty-one years cannot marry without the consent of their parents or guardians. [MARRIAGE.] The age of twenty-one years is, for most civil purposes in this country, the full age both of a man and woman, at which period they may enter into possession of their real and personal estates, may manage and dispose of them at their discretion, and make contracts and engagements. All persons under the age of twenty-one are legally called infants. A man cannot be ordained a priest till twenty-four, nor be a bishop till thirty years of age. A man cannot be a member of the House of Commons before the age of twenty-one. In the United States of America, a senator must not be under thirty, and to be eligible to a seat in the House of Representatives he must have attained the age of twenty-five. In France the age of twenty-five was formerly required in both electors and elected.

With respect to crimes, the law of England regards the age of fourteen years as the age at which a person is competent to distinguish between right and wrong. Under the age of seven years a child is not punishable for an offence; but above that age, and under the age of fourteen years, if it clearly appears that a child is conscious of the nature of the crime which he commits, he may be tried and punished for it. See Foster's 'Crown Cases,' p. 72, where a boy of nine was found guilty and executed for murder.

By 9 Geo. IV. c. 31, ss. 17, 18, and 4 & 5 Vict. c. 56, s. 3, carnal knowledge of a female under ten years of age is a felony punishable by transportation for life; the carnal knowledge of a female above ten and under twelve is a misdemeanor punishable by imprisonment and hard labour; as is also now an attempt to commit the offence, 14 & 15 Vict. c. 100, s. 9.

By 9 Geo. IV. c. 31, s. 20, the abduction of a girl under sixteen is punishable by fine or imprisonment; and by 12 & 13 Vict. c. 76, s. 1, procuring the defilement of a girl under the age of twenty-one, is a misdemeanor punishable by two years' imprisonment with hard labour. Apprentices and servants are protected against ill-usage from the master or mistress, by 14 Vict. c. 11, s. 1; and wives against the brutality of husbands, and children against that of parents, by 16 & 17 Vict. c. 30. (Blackstone's 'Comm.,' Mr. Kerr's ed., v. iv., pp. 61, 235, 241, 245.)

The Romans made three periods of age with reference to legal capacity: 1. Infantia, or the period from birth to the completion of the seventh year; 2. from the termination of infantia to the attainment of puberty, when persons were called Puberes; 3. from the attainment of puberty to the twenty-fifth year, during which time males were called Adolescentes, or Minores. From the attainment of the twenty-fifth year they were called Majores. An Infans could do no legal act. A person under the age of puberty could do the necessary legal acts in respect of his property with the sanction (*auctoritas*) of his tutor, who was the guardian of his property. It was somewhat unsettled what was the age at which a male attained puberty, but the best opinions fixed it at fourteen. A woman attained puberty at the age of twelve. Males who were puberes could manage their property, contract marriage, and make a will. Roman women of all ages were under some legal incapacities. Male persons between the age of puberty and twenty-five were protected to a certain extent in their dealings by a Lex Prætoria, and the rules of the Prætorian Edict, which were founded upon it. Under the Emperor Marcus Aurelius, all persons under twenty-five were required to have a curator, whose functions and powers were somewhat similar to those of the tutor up to the age of puberty.

(Savigny, *Von dem Schutz der Minderjährigen*, *Zeitschrift für die Geschichtliche Rechtswissenschaft*, vol. x., and *System des Heut. Röm. Rechts*, iii. 21, &c.)

AGENT (from the French *Agent*, and that from the Latin *Agens*). An agent is a person authorised by another to do acts for him or make engagements in his name; and the person who authorises him is called the *principal*.

An agent cannot be appointed to bind his principal by deed otherwise than by deed; nor can an agent be appointed by a corporation aggregate (unless for certain ordinary and inferior purposes) otherwise than by deed: and for certain purposes specified in the first, second, and third sections of the Statute of Frauds, the authority of the agent must be in writing. In all other cases no particular form is necessary: in commercial affairs agents are usually commissioned by a letter of orders, or by a retainer, but a verbal appointment is sufficient; and the mere fact of one person's being employed to do any business for another creates between the parties the relation of principal and agent.

An agent's authority (unless it is an authority joined with an interest, such as a power of attorney granted as a security for a debt) may, in general, be revoked by the principal at any time. It ceases upon the death or bankruptcy of the principal.

There are many kinds of agents, such as bailiffs, factors, brokers, &c. This article contains the general principles of law, which are applicable to all.

The general rule is that a man may make any contract by an agent which he can make himself, and do any act with respect to his own property by an agent which he may do himself. Any person may be an agent who would be competent to do the act for himself.

When an agent's authority is limited, he must adhere strictly to his instructions. If instructed to sell, he must not barter; nor if instructed to sell at a certain price, is he authorised to take less.

When the agent's authority is not precisely determined, his duty is to act in conformity with what may reasonably be presumed to be the intentions of the principal. In the absence of all other means of ascertaining what these intentions are, he must act for his principal like a prudent man in the management of his own business. If he is authorised to sell, and no price is limited by his instructions, he must endeavour to obtain the best price for the goods. If there have been other transactions of the same nature between the parties, it is presumed that the principal intends that the same mode of dealing should be pursued, which in former cases he had prescribed or approved.

In mercantile transactions, when the agent has no particular instructions, he should follow the common usage of the business in which he is employed; and he will be justified in doing so, even though, under the particular circumstances, he might have acted otherwise to the advantage of his principal.

The general authority to act as agent includes all necessary or usual means of executing it. An agent is therefore authorised to do all such subordinate acts as are either requisite by law, in order to the due performance of the principal object of the instructions, or are necessary to effect it in the best and most convenient manner, or are usually incidental to it in the ordinary course of business. Thus it the duty of an agent employed in the receipt or despatch of goods, to take care that the custom-house duties are satisfied, and the proper entries made; and he is authorised in making advances, as well for such incidental charges, as for any other expense necessarily incurred for the preservation of the property.

The next duty of an agent is to exercise a proper degree of diligence and skill. If he does an act which is not warranted by his authority, either express or implied, or if he does an act within his authority, but with such gross negligence or unskilfulness that no benefit can accrue from it, the principal may reject what he has done, if he rejects it as soon as he is informed, and gives notice to his agent within a reasonable time. If an agent puts out his employer's money at interest without his authority, or if a factor, employed to purchase, deviates from his instructions in price, quality, or kind, the principal may disavow the transaction.

If the principal does not either expressly or impliedly adopt the agent's act, the hazard of it lies with the agent, even though he did it in good faith, and for the interest of his employer. Any profit that may accrue from it he must account for to his principal; and if loss ensues, he is bound to make it good to him. An agent is likewise answerable to his principal for all damage occasioned by his negligence or unskilfulness. His responsibility extends to the whole amount of the damage suffered by the principal, either by damage done to his own property, or by his being obliged to make reparation to others.

It does not however extend to such losses by fire, robbery, or otherwise, as are purely accidental, and happen by no default of his own.

If an agent's negligence is so gross, or his deviation from his authority so great, as to amount to a breach of duty, that is, to a breach of the contract which the law, as we have seen, implies between them, the agent is liable to an action.

An agent must keep a regular account of his dealings on behalf of his principal, communicate the results from time to time, and account honestly when called upon.

An agent is not in general accountable for money until he has actually received it, unless he has by improper credit, or by other misconduct, occasioned a delay of payment. But an agent acting under a commission *Del credere*, that is, one who has undertaken to be surety to his principal for the solvency of the persons whom he deals with, is, in their default, accountable for the debt. If an agent has received money on behalf of his principal, he is bound to take care of it; and if any loss is occasioned by the fraud or failure of third persons, he will, unless his conduct be warranted by his instructions, or the usage of trade, be bound to make it good.

The agent must account for any interest which has been made upon the balance in his hands; and for all profit which he may have derived by dealing or speculating with the effects of his principal.

It is the duty of an agent to apprise his principal, with all convenient expedition, of all material acts done or contracts concluded by him.

The conduct of an agent, confidentially intrusted and relied on for counsel and direction—as an attorney, for instance—is liable to a stricter investigation, if he in any way acts improperly.

We now consider what are the duties of the principal to his agent; or what are the rights of an agent against his principal.

An agent is entitled to his commission; that is, a remuneration in return for his services. The amount of commission is usually determined by agreement; sometimes it is regulated by the usage of trade; and in some few cases it is limited by Act of Parliament, but the principle on which this legislation was founded has long been considered unsound.

An agent may forfeit his right to commission by misconduct: as, if he keeps no account; if he makes himself an adverse party to his principal; or if, in consequence of his negligence or unskilfulness, no benefit accrues to the principal from the services performed.

An agent is also entitled to be reimbursed all such advances made on behalf of his principal, as are justified by his authority, whether expressed or implied, or subsequently sanctioned by his principal. And cases may sometimes occur of urgent danger, when there are no means of referring for instructions, in which an agent is justified in making advances without particular directions. If, on account of the lateness of the season, or other good cause, he insures the cargo without orders, he is entitled to charge his principal with the premium, and in such case the assent of the principal would be inferred from very slight circumstances.

An agent has a lien upon the property of his principal; that is, a right to retain possession of it till his demand is satisfied. [LIEN.]

It remains to explain the consequences of the relation of principal and agent, as between the parties and third persons: and, first, as between the principal and third persons; and, secondly, as between the agents and third persons.

It is a general rule that the act of the agent is to be considered as the act of the principal. A bargain or agreement entered into by an agent therefore binds his principal, whether it tends to his benefit or his disadvantage: and, in order to have this effect, it is not necessary that it should be within the agent's real authority, either express or implied, provided it be within what may be called his *apparent authority*—that is, provided it is such as the person dealing with the agent might reasonably presume to be within his authority. An authority may be presumed from the principal's having previously authorised or sanctioned dealings of the same nature. Thus, if a person has been in the habit of employing another to do any act,—as, for instance, to draw or indorse bills,—he will be answerable for any subsequent acts of the same nature,—at least, until it is known, or may reasonably be presumed, that the authority which he had given has ceased. An authority may likewise be presumed from the conduct of the principal, with reference to the subject-matter of the transaction in question. For if a person authorises another to assume the apparent right of engaging in any transactions, the apparent authority must, as far as regards the rights of third persons, be considered as the real authority. Thus, a broker employed to purchase has no authority to sell; and if he does, his employer may (unless the sale was in open market) reclaim the goods so sold, into whatever hands they may have come. But if the principal has permitted the broker to assume the apparent right of selling the goods, he will be bound by a sale so apparently authorised.

Upon the same principle, when a *general* agent is employed,—that is, an agent authorised to transact all his employer's business of a particular kind, as to buy and sell certain wares, or to negociate certain contracts,—he must be presumed to have all the authority usually exercised by agents of the same kind in the ordinary course of their employment: and though the principal may have limited his real authority by express instructions, yet he will not thereby be discharged from obligations incurred in the ordinary course of trade towards persons who have dealt with the agent without any knowledge of such limitation. Thus where an agent purchases goods on credit, the seller may come on the principal for payment: and this right cannot be affected by any private agreement between the principal and agent, by which the agent may have stipulated to be liable to the seller.

Although the agent is, in all these cases, ultimately answerable to his employer for any damage that may follow from his having entered into an engagement not within his authority; yet the principal is, in the first instance, bound to keep an engagement so entered into by his agent upon a reasonable presumption of authority.

But in the case of a *special* agent (that is, of a person appointed merely to do certain particular acts), as no presumption of authority can arise from usage of trade, the principal will not be bound by any act not within the real authority of the agent; those who deal with the agent must ascertain what his authority actually is.

The agreement made by an agent, and all his dealings in connection with it, provided they are within his real or apparent authority, are binding on the principal. The representations made by an agent, at the time of entering into an agreement, (if they constitute a part of such agreement, or are in any way the foundation of or inducement to it), and, in many cases, even the admissions of an agent as to anything directly within the course of his employment, will have the same effect as if such representations or admissions had been made by the principal himself. If notice of any fact is given, or if goods are delivered to an agent, it will be considered as notice or delivery to the principal. And in general, payment to an agent has the same effect as if it had been made to the principal. But such payment must be warranted by the apparent authority of his agent. If money is due on a written security, as long as the security remains in the hands of an agent it is to be presumed that he is authorised to receive the money: but if he has not the security in his possession, the debtor will be liable, in case the agent should not account for it to his principal, to pay it over again.

If the principal gives notice to the buyer not to pay the money to the factor with whom he made the bargain, he will in general not be justified in doing so; but if the factor had a lien upon the goods for his general balance, he has a right to require the buyer to pay him instead of his principal; and such payment, notwithstanding any notice given by the principal, will be a discharge of the debt.

A principal is in general liable for all damage occasioned to third persons by the negligence or unskilfulness of his agent, when he acts within the scope of his employment; and for any misconduct or fraud committed by him, if it be either at his express command or within the limits of his implied authority. From this liability however persons are exempted who, though they appear in some degree in the character of principals, yet have no power in the appointment of those who act under them. Thus, the postmasters-general, and persons at the head of other public offices, have been held not to be liable for the conduct of their inferior officers. The owners and masters of vessels are also by statute released from liability to third persons from the negligence or unskilfulness of the pilots by whom the vsesels are navigated into port.

It remains to state what are the effects of the relation of principal and agent, as between the agent and third persons.

An agent is not in general personally responsible on any contract entered into by him on behalf of his principal; but there are several exceptions to this rule. For if an agent has so far exceeded his authority that his principal is not bound by his act, the agent is liable. And an agent is also liable when the contract was made with him not as agent. If in any contract made on behalf of his principal, the agent binds himself, or if the circumstances of the transaction are such that the credit was originally given to him, and not to the principal (whether such principal were known at the time or not), the agent will be liable, in the first instance, to the persons with whom he has dealt.

When an agent acts in his own name, and gives no notice of his being employed in behalf of another person, he is to be considered as the principal, and the persons who have dealt with him have the same rights against him as if he actually were so. In an action by the principal on demand arising from such transactions, they may set off a debt due from the agent himself; which they could not have done, if they had known that he acted only as an agent. And if he afterwards discloses his principal, he is not discharged from his liability; those with whom he has dealt may, at their option, either sue him on his personal contract, or the principal upon the contract of his agent.

An agent is responsible to third persons for any *wrongful* acts, whether done by the authority of his principal or not; and in most instances the person injured may seek compensation either from the principal or the agent, at his option.

An agent cannot delegate his authority to another, but he may employ other persons under him to perform his own engagements, and the original agent is responsible to his principal as well for the conduct of such sub-agents as for his own: but with respect to damage sustained by third persons from the wrongful acts of such sub-agents, the damages must be recovered either from the person who did the injury, or from the principal, for whom the act was done. The original agent is responsible to third persons only for his own acts, and such as are done by his command.

If an agent who is intrusted with money or valuable security, with written directions to apply the same in any particular manner, converts it to his own use; or if an agent who is intrusted with any chattel, valuable security, or power of attorney for the transfer of stock, either for safe custody or for any special purpose, without authority sells or pledges, or in any manner converts the same to his own use, he is guilty of a misdemeanor punishable with fourteen years' transportation, or to fine and imprisonment at the discretion of the court. But this does not prevent his disposing of so much of any securities or effects on which he has a lien or demand, as may be requisite for the satisfaction thereof. It is also a misdemeanor, punishable in the same manner, if a factor or agent employed to sell, and intrusted with the goods, or the documents relating to them, pledges either the one or the other, as a security for any money borrowed or intended to be borrowed, provided such sum of money is greater than the amount which was at the time due to the agent from the principal, together with any acceptances of the agent on behalf of his principal. (7 & 8 Geo. IV. c. 29, s. 49, &c.)

The 5 & 6 Vict. c. 39, entitled "An Act to amend the law relating to advances *bonâ fide* made to agents entrusted with goods," facilitates the practice of making advances on the security of goods or documents to persons who are known to have possession of them as agents. Any agent who is in the possession of goods, or of the documents of title to them, is to be held in law as the owner, to the effect of giving "validity to any contract or agreement by way of pledge, lien, or security *bonâ fide* made by any person with such agent." The agent may receive back goods or documents which have been pledged for an advance, and may replace them with others; but the lender's lien is not to extend beyond the value at the time of the original deposit. The documents which are held to authorise the agent in disposing of property represented by them, and the transference of which is a sufficient security to the lender, are—"any bill of lading, India-warrant, dock-warrant, warehouse-keeper's certificate, warrant or order for the delivery of goods, or any other document used in the ordinary course of business as proof of the possession or control of goods, or authorising or purporting to authorise, either by indorsement or delivery, the possessor of such document to transfer or receive goods thereby represented." Any agent who is in possession of such documents in the mode in which the act mentions, is considered to be in possession of the goods, and all pledges of such documents are pledges of the goods. An advance of money on the delivery of the goods or documents, pursuant to a written agreement to make such delivery, is valid, although the delivery of the goods or documents do not take place till after the advance. A contract by the agent's clerk, or any person acting for him, is binding. An agent who, contrary to his instructions and for his own benefit, grants a fraudulent security, is liable to a very severe punishment. There are provisions in the Act for enabling the owner to redeem his goods while they remain unsold, on satisfying the person who holds them as a security; and for protecting the principal in the case of the agent's bankruptcy.

AGES OF THE WORLD. In the mythology of the Greek and Roman poets, the history of the world was divided into four ages, the golden, the silver, the brazen, and the iron; as, for instance, Hesiod in his poem entitled 'Works and Days,' and by Ovid, in his 'Metamorphoses.' The golden age, when Saturn reigned, is represented as having been that of perfect innocence and happiness; from which the others have gradually degenerated more and more,—the iron age, or that which now subsists, being the most wicked and miserable of all. Sometimes these ages are spoken of as merely so many successive periods in the history of Italy. Saturn having been driven out of heaven by his son Jupiter, is supposed to have sought an asylum in that country, where, in return for the protection he received from King Janus, he taught him and his people agriculture, and the other arts of cultivated life. According to this latter mode of telling the story, it will be observed, the golden age is represented as consisting in the triumph of civilisation over previous barbarism; whereas the other version seems intended to indicate that the primæval state of man was that in which he enjoyed the greatest felicity and purity, and that he has been rather corrupted than improved by what is called civilisation. The two statements, therefore, may be taken as expressing two opposite theories or opinions which have divided speculators upon this subject down even to our own day. The disagreement among the fabulists, however, is only with regard to the original condition of man; it seems to have been admitted on both sides that a gradual declension both of the happiness and virtue of the world has been going on ever since the age of gold. The golden age is that of which the most complete pictures have been drawn; indeed it may be said to be the only one of the four of which the description is at all distinct. The age of iron was deemed to have commenced long before Hesiod's day, who lived probably at least 2600 years ago; it was, in fact, merely a general name for the existing order of things, as distinguished from some imaginary previous state. But neither that immediately preceding state, designated the age of brass, nor its forerunner, the age of silver, is to be found discriminated in the poetic painting by anything more than some slight varieties of shade. Of the golden age, when universal harmony prevailed throughout the living creation, and the bounteous earth yielded her increase untilled, we have various descriptions from the pens of modern as well as of ancient poets. The reader of Italian poetry will recollect in particular the celebrated chorus at the end of the first act of Tasso's 'Aminta,' and the imitation of it at the end of the fourth act of Guarini's 'Pastor Fido.'

AGIO, a term generally used to denote the per-centage difference existing between the values of the current and standard monies of any place. The metallic currency of wealthy states generally consists of its own coin exclusively, and it is in the power of the state to prevent the degradation of that coin below the standard, so that no calculations of agio, strictly so called, are rendered necessary. In smaller states, the currency seldom entirely consists of their own coin, but is made up of the clipt, worn, and diminished coins of the neighbouring countries with which the inhabitants have dealings. Under these circumstances banks were, at different times, established by the governments of Venice, Hamburg, Genoa, Amsterdam, &c., which, under the guarantee of the state, should be at all times bound to receive deposits, and to make payments, according to some standard value. The money or obligations of these banks being better than the fluctuating and deteriorated currency of the country, bears a premium equivalent to the deterioration, and this premium is called the agio of the bank.

To facilitate his money dealings, every merchant trading in a place where the deterioration of the currency is thus remedied, must have an account with the bank for the purpose of paying the drafts of his foreign correspondents, which drafts are always stipulated to be paid in bank or standard money. The practice being thus universal, the commercial money payments of the place are usually managed without the employment of coin, by a simple transfer in the books of the bank from the account of one merchant to that of another. The practical convenience which this plan of making their payments affords to merchants, who would otherwise be obliged, when discharging obligations incurred in standard money, to undergo troublesome and expensive examinations of the various coins in use, causes the money of the bank to bear a small premium above its intrinsic superiority over the money in circulation, so that the agio of the bank does not usually form an exact measure of that superiority.

The term *Agio* is also used to signify the rate of premium which is given when a person having a claim which he can legally demand in only one metal, elects to be paid in another. Thus in France silver is the only legal standard, and payments can be demanded only in silver coin, a circumstance which is found to be so practically inconvenient, that the receiver will frequently pay a small premium in order to obtain gold coin, which is more easily transportable; this premium is called the agio on gold.

AGLAIA. One of the group of small planets revolving between Mars and Jupiter. [ASTEROIDS.]

AGRARIAN LAW was the general title of any law among the Romans which related to the *ager publicus*, or public domain. As the subject of Agrarian laws constitutes perhaps the most important element in the history of the Roman republic, and as an utter misconception of their application has pervaded, till of late years, every work upon the subject, especially the popular writings of Hooke, Ferguson, &c., it seems desirable to place before the general reader a brief account of those more correct views which have been established by the researches of Heyne, Niebuhr, and Savigny.

Ever since the revival of letters it has been a universal error to look upon the agrarian laws, with which the names of the Gracchi and others were connected, as attempts to limit the amount of landed property that any individual might hold; and such an interference with private rights would indeed afford strong ground for condemning any statesman who could be the author of such a proposition, and any state where such a proposition could be favourably received. In the frenzy of the great French Revolution, there were indeed political fanatics, who, following the advice of Macchiavelli and Montesquieu, were willing to enact an agrarian law of this extravagant nature; and so much stress was laid upon the examples of Roman history that Heyne, in March 1793, availed himself of the opportunity offerred to him by the installation of a new pro-rector in the University of Göttingen, to address to that body a paper entitled 'Leges agrariæ pestiferæ et execrabiles' (see his 'Opuscula,' vol. iv. p. 351), in which he successfully contended that the laws so called among the Romans, instead of interfering with private property, solely applied to the lands of the public domain. Heeren and Hegewisch carried the inquiry further; but for the fullest and most satisfactory investigation of the whole subject we are indebted to Niebuhr and his friend Savigny.

As the victorious arms of the Romans extended their authority over one state of Italy after another, the right of conquest gave them a title to the lands of the conquered; but, except in cases of strong provocation, as in the defection of Capua in the second Punic war, it became the clemency of the conquerors to restore a part of the territory to the unfortunate owners. Yet a portion would perhaps always be reserved and added to the public domain. With regard to the disposition of the territory so acquired, we will not go back to an earlier date than the Servian constitution, which gave to the *plebes*, or commonalty, a share in the government, though an inferior one, with the patricians. The disposition of the conquered land was then, we may perhaps say, fourfold. Part was given in full property to religious uses, and part was sold by the quæstors for the supply of the treasury. The plebeians, who constituted the most important part of the army, received assignments of fixed and equal portions in full ownership, never perhaps exceeding seven jugers (that is, between four and five acres) to each individual. These lands were often given under the form of a colony, the parent state sending a body of the citizens to occupy some conquered town, or to found a new one. In all cases the boundaries of lands so assigned were marked out according to the strict principles of Roman limitation, and placed under the religious sanction of the augury. But a large portion of the territory which fell into the hands of the conquerors in the issue of a successful war must often have been in a state of utter desolation, for devastation by fire and sword was a constant and leading feature in ancient warfare; and in a country where the olive and the vine form an important branch of agriculture, such desolation was not easily repaired. Thus large districts were unfit for distribution among the plebeians, or for sale by the quæstors. Moreover, much of the mountain land, and even of the unhealthy plains in Italy, was, as it still is, adapted solely for pasturage, and therefore equally unfit for partition, though far superior in immediate value. The disposition of this unappropriated land, which constituted the permanent public domain, led to a singular mode of occupation. An edict was issued, giving authority, most probably to the patricians alone, to cultivate these lands, but with the full understanding that the state reserved to itself the ownership, and might at any time resume possession,—a right which was from time to time exercised. Yet, though the occupants had no title whatever as against the state, they appear to have been protected against individuals by the interdicts of the prætor, and a branch of law entitled *causæ possessionum*. Under this protection these lands often passed from father to son by a species of permitted inheritance, or as dowries to daughters, or were even transferred to other citizens by purchase; and in this way even plebeians, it would appear, might come into the occupation of them. But, no matter through how many hands the lands might pass, the tenure to the last occupier was as precarious as to the first; and, of course, this was always taken into account in estimating the value. On the other hand, the occupier was subject to certain restrictions and payments. He could not legally hold, at least after the Licinian law, more than 500 jugers (about 333 acres) of this public land; on the public pastures he was limited to 100 head of great, and 500 of small cattle; and he was bound to employ a fixed number of freemen. Some of these restrictions indeed did not always exist, but it seems highly improbable that some regulations of the kind should not have existed from the very beginning, if only to protect one patrician from another. But whatever doubt there may be on this subject, the state was always entitled to the payment of a tenth upon all grain, and a fifth on the olives and the wine, besides some charge, we know not how determined, for the use of the common pasture land. The technical terms used with regard to these possessions were as follows: the lands themselves were called *agri occupati, a. occupatorii, a. possessi, a. concessi, a. arcifinales*, or generally *possessiones*. The holder or *possessor* was said to have the *usus* of them; and the payment he made to the state was the *fructus* or *vectigal*. Instead of collecting this branch of the revenue directly, it was the practice to farm it out, which was expressed by selling or letting the *jus vectigalis* or *fructus*; and in the same sense they used the phrase *agrum fruendum locare*, or even more briefly, though somewhat ambiguously, *agrum locare*.

It must be confessed, indeed, that in this view of the first occupancy of the public domain, there is still something to be cleared up; for a mere edict, such as we have spoken of, without qualification or restriction, would have been little better than an invitation to a general scramble. But it is established incontrovertibly that the possession was simply permissive. If the original occupancy was founded in collusion, the case against the patricians will only be the stronger.

In the various usurpations of the patrician body the restrictions enumerated above were little attended to. The vectigal was rarely paid. While the plebeian was serving in the army abroad, the portion of the public domain possessed by him—and this could only be through purchase—was violently or fraudulently seized by a powerful neighbour. Large districts were monopolised by single holders. It was by them found more profitable to cultivate the land by slaves than by freemen, who were always liable and often called upon to perform military service. Those who held the chief power in the government conspired to deny the title of the state to resume their possessions; and even when new conquests added to the domain, the most desperate efforts were made to resist all further assignments of land to the plebeians, that is, to the very veterans who had effected the conquests. To redress these grievances, or rather to moderate them, agrarian laws were from time to time brought forward; but, we repeat, these laws never interfered with private property. The wealthy might hold land really their own to any amount. The sole object which the reformers had was to check usurpations of the public domain.

We cannot trace the subject historically through the whole existence of the republic, but a few remarks may still be useful. If we look at the birth, the station, the conduct, and the character of the distinguished men whose names are connected with the promulgation of agrarian laws, we shall find little reason for considering them as demagogues. Spurius Cassius indeed lived in a time when we can place little reliance upon the truth of Roman history; but he was himself a patrician, he had thrice been consul, and had thrice triumphed; and though he was eventually tried and executed for treason, the trial took place, not before a plebeian court, as is generally stated, but, as Niebuhr has established, in the 'Comitia Curiata,' where the patricians themselves, whose usurpations he had contended against, were at once his accusers and his judges. For understanding the true character of Licinius Stolo, and the wisdom and justice of his legislation, we will only refer to the first chapter of Niebuhr's third volume. In the time of the Gracchi, it may be thought by many that injustice and tyranny had obtained a title by prescription; but though there may be a question about the policy of the reforms they were endeavouring to introduce, no candid reader of Roman history can doubt the purity of their intentions, or the baseness of the majority among those who resisted them by revolution and assassination. Except the presumed guilt of supporting these agrarian laws, not even their enemies could find a blot in the characters of the two sons of the virtuous Cornelia. Velleius was no friend to democrats, but he says, speaking of the elder Gracchus, *Vir alioqui vita innocentissimus, ingenio florentissimus, proposito sanctissimus, tantis denique adornatus virtutibus, quantas perfecta et natura et industria mortalis conditio recipit.*—("A man in other respect (that is, except in his opposition to the usurpations of the patricians) as to his life most blameless, in ability most distinguished, in principle most upright, in fine adorned with every virtue in as high a degree as man can attain to, when the best gifts of nature are improved by discipline.")—At the same time his opponent Octavius, and his murderer the Pontifex Maximus, Scipio Nasica, were actually offenders under the very law which Tiberius was endeavouring to enforce. On the other hand, the consul Opimius, who headed his party in the premeditated massacre of the younger Gracchus and three thousand of his defenceless countrymen, and then erected a temple to Concord, was afterwards convicted of sacrificing the interests of his country for the gold of Jugurtha. For a full examination of the agrarian laws of Rome, see Niebuhr's 'History,' translation by Hare and Thirlwall, vol. ii. pp. 129—173; and among the ancient writers, Appian's 'Civil Wars,' book i. c. 7—27; Plutarch's 'Lives of the Gracchi;' Dionysius and Livy; Cicero's speech against Rullus, &c.

AGREEMENT, a mutual bargain, contract, or covenant. In its most extended sense, the word comprehends a large proportion of the transactions of civilised man in the mutual intercourse of society, and may even be said to form the basis of society itself. In a more limited and technical sense, an agreement gives rise to those obligations which it is the object of the law to enforce. In the latter sense, agreements are with more propriety termed contracts. All contracts are agreements, but all agreements are not contracts.

When the word agreement is used in its technical sense in the English law, it signifies a "mutual contract, on consideration, between two or more parties;" and the essentials of such an agreement are few and simple.

1. *Assent* is of the essence of an agreement. The parties to a contract must be in a situation to testify their free assent to it. Thus lunatics, infants, and married women are incapable of binding themselves except in some few transactions of necessity. In the purchase of those articles which conventional usage has rendered necessary (and which the law therefore terms "necessaries"), the contracts of the two former classes are obligatory on them; or, in the case of a married woman, on her husband. In the same way, fraud, intimidation, or undue advantage taken by a party to secure a benefit by an agreement, will discharge him who, from ignorance or the operation of external force, has apparently assented to it.

2. The *subject* of agreement must not be tainted with illegality. It would be repugnant to common sense that the law should enforce performance of any act which it had expressly forbidden, or which contravened its general policy.

3. An agreement, to secure the aid of the law in carrying it into effect, must have certain qualities mutually beneficial to the parties, or must be entered into with certain solemnities. Courts of justice cannot be called upon to give effect to every idle or inconsiderate promise. An agreement must either be contracted by a formal instrument in writing, sealed by the party who has bound himself by it, which is technically called a *deed*, and the contract is then a *specialty contract*; or if contracted in a less formal manner, by word or otherwise, it must appear that the parties derive from it reciprocal benefit. This is the meaning of lawyers when they affirm that a *parole* agreement (that is, an agreement not contained in a deed) cannot be legally enforced, unless there be a sufficient *consideration* to support it. Thus A cannot found legal proceedings against B, in respect of a promise made by B to A, unless by the original agreement A was either to confer some reciprocal advantage upon B, or was to put himself to some specific disadvantage at B's request. Upon this principle it is that, by law, a promise to make a voluntary gift can never be enforced. An agreement, thus defective for want of consideration, is called a '*nudum pactum*'—a phrase borrowed from the Roman law, from which also is derived the maxim '*ex nudo pacto non oritur actio*.' It must be added that the '*nudum pactum*' of the civil law differs materially from our simple contracts, which are so called when without consideration.

4. The *form* of agreements has in some cases been regulated by law. The most remarkable instance is that introduced by the Statute of Frauds, in the reign of Charles II., by which among other provisions, it is enacted that contracts in certain cases shall not be available, unless there be some memorandum or note of them in writing, duly signed by the parties to be charged, or their agents. [FRAUDS, STATUTE OF.]

The rules respecting the *construction* of agreements; the various modes by which parties may be released from the performance of them; and the circumstances under which they may excuse or justify non-performance, would form the subject of long legal disquisitions, and would here be obviously out of place.

There are two different remedies for breach of an agreement to which the injured party may resort, according to the nature of his case. He may either seek a pecuniary compensation in the shape of damages for the breach in a court of law; or, in cases where such compensation is inappropriate or insufficient, he may obtain from a court of equity a decree that the party offending shall perform his agreement specifically.

AGRICULTURAL CHEMISTRY. [CHEMISTRY, AS APPLIED TO AGRICULTURE.]

AGRICULTURAL INSTITUTIONS, AND SOCIETIES FOR THE PROMOTION OF AGRICULTURE. The effect of legislative enactments which have for their object the advantage of agriculture are treated of under AGRICULTURAL STATISTICS and elsewhere. The improvement of every branch of rural economy has been largely promoted by agricultural institutions; and those which have been, or are at present, most active in this way, may here be briefly noticed.

The Board of Agriculture, established chiefly through the exertions of Sir John Sinclair, and incorporated in 1793, was a private association of the promoters of agricultural improvement; but as it was assisted annually by a parliamentary grant, it was regarded by the country as in some sort a semi-official institution. One of its first proceedings was to commence a survey of all the English counties on a uniform plan, which brought out, for the information of the class most interested in adopting them, improved practices, originating in individual enterprise or intelligence, and which were confined to a particular district. The 'Surveys' are many of them imperfectly executed, but they were useful at the time, in developing more rapidly the agricultural resources of the country. During the years of scarcity at the end of the last and beginning of the present century, the Board of Agriculture took upon itself to suggest and, as far as possible, provide remedies for the dearth —by collecting information and making reports to the government on the state of the crops. The statistics which the Board collected were also at times made use of by the minister, or at least were believed to be so, in connection with his schemes of taxation. The Board encouraged experiments and improvements in agriculture by prizes; and the influence which it possessed over the provincial agricultural societies excited and combined the efforts of all in one direction. The Board of Agriculture was dissolved in 1816.

The Smithfield Cattle Club, which has been in existence above sixty years, and some of the provincial agricultural societies, especially the Bath and West of England Society, which commenced the publication of its 'Transactions' nearly seventy years ago, have been very useful auxiliaries, if not promoters of agricultural improvement. Until within the last few years, the exertions of Agricultural Societies have been too exclusively devoted to the improvement of stock.

With the establishment of the 'Royal Agricultural Society of England' a new æra commenced in the history of institutions for the improvement of English agriculture. This society, when it was established in May, 1838, consisted of 466 members. At the first anniversary, in May, 1839, the number of members had increased to 1104; and it continued to increase and to prosper.

On the 26th of March, 1840, the society received a charter of incorporation, on which it assumed the designation of the 'Royal Agricultural Society of England.' By the 22nd rule of the Society, "No question shall be discussed at any of its meetings of a political tendency, or which shall refer to any matter to be brought forward, or pending, in either of the Houses of Parliament;" and this rule is made permanent by the charter of incorporation. The objects of the society, as set forth in the charter of incorporation, are: 1. To embody such information contained in agricultural publications and in other scientific works as has been proved by practical experience to be useful to the cultivators of the soil. 2. To correspond with agricultural, horticultural, and other scientific societies, both at home and abroad, and to select from such correspondence all information which, according to the opinion of the society, may be likely to lead to practical benefit in the cultivation of the soil. 3. To pay to any occupier of land, or other person, who shall undertake, at the request of the society, to ascertain by any experiment how far such information leads to useful results in practice, a remuneration for any loss that he may incur by so doing. 4. To encourage men of science in their attention to the improvement of agricultural implements, the construction of farm-buildings and cottages, the application of chemistry to the general purposes of agriculture, the destruction of insects injurious to vegetable life, and the eradication of weeds. 5. To promote the discovery of new varieties of grain, and other vegetables, useful to man, or for the food of domestic animals. 6. To collect information with regard to the management of woods, plantations, and fences, and on every other subject connected with rural improvement. 7. To take measures for the improvement of the education of those who depend upon the cultivation of the soil for their support. 8. To take measures for improving the veterinary art, as applied to cattle, sheep, and pigs. 9. At the meetings of the society in the country, by the distribution of prizes, and by other means, to encourage the best mode of farm cultivation and the breed of live stock. 10. To promote the comfort and welfare of labourers, and to encourage the improved management of their cottages and gardens.

The society has already directed its attention to nearly all the objects above mentioned. The country meetings of the society, which take place annually in July, have perhaps been more serviceable in stimulating agricultural improvement than any other of the society's operations, by concentrating the attention of the society upon each part of the country in succession, and by exciting the attention of each district to the objects which the society is intended to promote. England and Wales are divided into nine great districts, and a place of meeting in each is fixed upon about a year beforehand. In 1839, the first meeting was held at Oxford, at which 23 agricultural implements were exhibited. Meetings have been held since at Cambridge, Liverpool, Bristol, Derby, Southampton, Shrewsbury, Newcastle, Northampton, York, Norwich, Exeter, Windsor, Lewes, Gloucester, Lincoln, Carlisle, Chelmsford, Salisbury, Chester, and with varying fluctuations. The number of implements exhibited had increased in 1858 to 3,438.

There can be no doubt that the mechanics of agriculture have made great progress since the establishment of the society. The opportunity of contrasting and estimating the utility of various implements used for similar purposes in different districts or in different soils, cannot fail to extend improvement from one district to another. One of the principal results effected by such institutions as the Royal Agricultural Society is to introduce the best practices of husbandry from the districts where agriculture is in its most improved state into those where it is most backward. Attached to the society's house there is a reading-room, and a library, to which has been added by purchase the books forming the library of the late Board of Agriculture. As a means of diffusing information on agricultural subjects, the publication of the 'Journal' of the society was commenced in April, 1839, and it has at present a circulation of nearly 10,000. The prize essays and all other communications intended for publication in the 'Journal,' are referred to the Journal Committee, who decide upon the arrangements of the work. The 'Journal' contains besides, very valuable contributions of a practical as well as scientific character.

The success of the Royal Agricultural Society has revived the spirit of existing associations, or led to the formation of new ones. Perhaps in no department of industry or science does there exist so general a spirit of improvement at the present time as in the kindred branches of agriculture and horticulture. Some of the provincial agricultural societies are on a scale which, a few years ago, could scarcely have been anticipated of a central and metropolitan society. The Yorkshire Agricultural Society holds its annual show in the different towns of that county in rotation, a plan which is very successful in rendering them attractive. The Bath and West of England Society in like manner meets annually in a fresh district of its province; and publishes a valuable annual volume of Transactions. In the United Kingdom there are now about 450 local agricultural societies; including farmers' clubs, which have also become numerous. They are eminently practical; but the local results which they collect and discuss may become applicable to other parts of the country placed under similar circumstances of aspect, soil, and situation. It would stimulate the exertions of these clubs, if a department of the 'Journal of the Royal Agricultural Society' were reserved for some of the best papers read at their meetings. The annual report of every farmers' club should be transmitted to the secretary of the Royal Agricultural Society; and the title at least of all papers read at the meetings during the year should be given in the 'Journal.'

The agriculture of Scotland has been largely indebted to the societies which have been established at different periods for its improvement. A "Society of Improvers in the Knowledge of Agriculture in Scotland" was established in 1723, and some of its Transactions were published. The society becoming extinct was succeeded by another in 1755; and the society which now stands in the same relation to Scotland as the Royal Agricultural Society to England was established in 1784. It is entitled the "Highland and Agricultural Society of Scotland." The constitution and proceedings of the society are as nearly as possible similar to the English society. The society publishes quarterly a very excellent Journal of its Transactions, which has at present a circulation of 2300. The Agricultural Museum at Edinburgh was assisted in 1844 by a parliamentary grant of 5000*l.*

In 1841 the 'Royal Agricultural Improvement Society of Ireland' was established on the plan of the Royal Agricultural Society of England; and in May, 1844, the number of subscribers was 581. Since its establishment great progress has been made in the formation of local societies in communication with the central society, which is the best means of ensuring the support and co-operation of the agricultural class in every part of the country. In 1841 there were only twenty-three of these bodies in existence; in 1858 there were sixty-nine. A very judicious arrangement has been made relative to the prizes distributed at the local meetings, which are now given for operations in husbandry only, the premiums for stock being furnished by the local association. The society has established an agricultural museum in Dublin for the reception of implements of husbandry, seeds, grasses, &c.; it circulates practical information connected with husbandry by means of cheap publications; and one of its objects is the organisation of an agricultural college. There is also the Royal Dublin Society for the Promotion of Husbandry, &c., which holds a cattle show and gives prizes annually for stock and agricultural improvements, and which possesses a good agricultural museum in the society's house in Kildare Street.

In England there are no institutions of a public nature which combine scientific with practical instruction in agriculture. The advantage of establishing such an institution was suggested by the poet Cowley; and in 1799 Marshall published 'Proposals for a Royal Institute or College of Agriculture and other branches of Rural Economy.' There is the Sibthorpian Professorship of Rural Economy in the university of Oxford; at the university of Edinburgh, a professorship of agriculture; and at the university of Aberdeen there are lectures on agriculture. The botanical, geological, and chemical professorships and lectures in the different universities are, to a certain extent, auxiliary to the science of agriculture. In the absence of such establishments as the one at Grignon, in France, young men are sent as pupils to farmers in the counties where the best system of agriculture is practised, especially Norfolk, Lincolnshire, Northumberland, and the Lothians; but although this may be a good plan for obtaining practical knowledge, it is imperfect as regards the knowledge gained of the scientific principles of agriculture. The Earl of Ducie established a model or example farm on his estate in Gloucestershire, where the scientific principles of agriculture were carried into operation; but this was very different from an institution which imparts a knowledge of these principles. In 1839 the late B. F. Duppa, Esq., published a short pamphlet entitled 'Agricultural Colleges, or Schools for the Sons of Farmers,' which contains many useful suggestions for the establishment of such institutions. He laboured indefatigably in the promotion of this object, and probably would have succeeded but for his premature death. Cirencester College, which was established in 1846, and originated in a paper on Agricultural Education, read by Mr. Robert J. Brown of that town before a local farmers' club, gives instruction in the higher branches of agricultural knowledge. Students are admitted either as boarders or out-students, the first class paying from 55 to 80 guineas per annum; the last, 40 guineas. The college is conducted by a principal, with professors of chemistry; of zoology, geology, and botany; of veterinary medicine, and surgery; of surveying, civil engineering, and mathematics; and of practical agriculture. The college has acquired a high reputation, is consequently well attended, and therefore prosperous.

Schools of industry, similar to the one established by the late Rev. W. L. Rham at Winkfield, and by the Earl of Lovelace at Ockley, may be made the medium of imparting an acquaintance with the principles of agriculture, which at present the labouring classes do not usually obtain. Other institutions of a like nature have been established in various places, and at the Reformatory School at Redhill, where a farm is cultivated by the boys, who are thoroughly instructed in practical agriculture.

In Ireland the government affords direct encouragement to agricultural education through the instrumentality of the Board of National Education. The persons who are trained for the office of teachers in the national schools are required to attend the lectures of a professor of agricultural chemistry; and during a portion of the time occupied in preparing for their future duties they are placed at the model farm at Glasnevin, where they are lodged, and where, during five mornings of the week, they attend lectures on the principles of agriculture; and an examination subsequently takes place. On the sixth morning they are taken over the farm, and the operations going forward are explained to them. The Board admits a certain number of in-door pupils for the term of at least two years, who pay 10*l.* a year for board, lodging and education. They work on the farm, attend the lectures, and receive such instruction as qualifies them to fill the office of bailiffs. There is likewise a class of schoolmasters trained to conduct agricultural schools. Thirty-seven model schools are established in different parts of the country. The Agricultural Seminary at Templemoyle, six miles from Londonderry, is one of the most successful experiments which has yet been made in the United Kingdom to establish an institution for agricultural education. It was founded by the North West of Ireland Society. The plan is in some degree taken from the institution established by M. Fellenberg, at Hofwyl, in Switzerland. An account of the institution and of the course of instruction will be found in the 'Minutes of the Committee of Council on Education,' p. 565, 8vo, ed. Power has also been given to Boards of Guardians to hold land for the purpose of instructing the workhouse boys in agricultural labour, and the plan has been adopted by many unions with considerable success.

Such societies as the Scottish Agricultural Chemistry Association, established at the close of 1843, were very well calculated to advance the progress of scientific agriculture; and they might be established in any district where a sufficient number of subscribers can be obtained to command the services of a competent chemist. Associations of this nature show how much can be done in this country without any assistance from the state. The object of the Scottish association was the diffusion of existing information, theoretical and practical, by means of occasional expositions, addresses, and correspondence; and secondly, the enlargement of the present store of knowledge by experimental investigations of practical agriculturists in the field and of the chemist in the laboratory. Landed proprietors who subscribed twenty shillings yearly, and tenants who subscribed ten shillings yearly, were entitled to have performed analyses of soils, manures, &c., according to a scale fixed upon; and if more than a certain number were required, a charge of one-half above the scale was made. Letters of advice, without an analysis being required, were charged 2*s* 6*d*.. Every agricultural society subscribing 5*l.* yearly to the funds of the Association was entitled to one lecture from the chemist; if 10*l.* to two lectures, &c. Counties which subscribed 20*l.* annually were entitled to appoint a member of the Committee of Management. The chemist of the association had his laboratory at Edinburgh, but he visited various parts of Scotland according to certain regulations. We give the details of this institution, though obliged now to speak of it in the past tense. It was well deserving of a longer life; and might be usefully revived upon a smaller scale in many limited localities. In Scotland most of its offices are now accomplished by the chemical officer of the Highland and Agricultural Society.

In France there are schools assisted by the state, where young persons can obtain instruction in agriculture, both practical and theoretical. The principal institution of this kind is that at Grignon, where one of the old royal palaces and the domain attached to it, consisting of 1185 acres of arable, pasture, wood, and marsh land, has been given up on certain conditions. The professors are paid by the government, and the pupils are of two grades, one paying 48*l.* a year, and the other 36*l.* For the purpose of imparting theoretical knowledge, courses of lectures are given on the following subjects: 1, The rational principles of husbandry, and on the management of a farm; 2, The principles of rural economy applied to the employment of the capital and stock of the farm; 3, the most approved methods of keeping farming accounts; 4, The construction of farm-buildings, roads, and implements used in husbandry; 5, Vegetable physiology and botany; 6, Horticulture; 7, Forest science; 8, The general principles of the veterinary art; 9, The laws relating to property; 10, Geometry applied to the measurement and surveying of land; 11, Geometrical drawing of farming implements; 12, Physics as applied to agriculture; 13, Chemistry, as applied to the analysis of soils, manures, &c; 14, Certain general notions of mineralogy and geology; 15, Domestic medicine, applied to the uses of husbandmen. The practical part of the education is conducted on the following system:—The pupils are instructed in succession in all the different labours of the farm. Some, for instance, under the direction of the professor of the veterinary art, perform the operations required by the casualties which are continually occurring in a numerous stock of cattle. Others are appointed to attend to the gardens, and to the following departments: woods and plantations; inspection of repairs taking place on the premises; making of starch, cheese, and other articles; the pharmaceutical department; book-keeping and the accounts. A daily register is kept of the amount of the manure obtained from the cattle of every kind. A pupil newly entered is appointed to act with one of two years' standing; and at the end of each week all are expected to make a report, in the presence of their comrades, of whatever has been done during the week in their respective departments. The professor, who presides over the practical part of their education, explains on the spot the proper manner of executing the various field operations; and he also gives his lectures on these different processes at the time when they are in actual progress. The professors in each department render their courses as practical as possible;—the professor of botany by herborisations; the professor of chemistry by geological excursions; the professor of mathematics, by executing, on the plan he has pointed out, the survey and measurement of certain portions of land. After two years' training in the theory and practice of rural economy, the pupils undergo an examination from the professors collectively, and, if satisfactory, a diploma is granted, which certifies to the capacity of the pupil for fulfilling the duties of what may be styled an 'Agricultural Engineer.'

Institutions designed for the improvement of agriculture, and supported by the state, have been established in most parts of Germany. In Prussia there is a public model farm and agricultural academy in nearly every province. The most important of these institutions is the one at Mögelin, in Brandenburg, about 40 miles from Berlin, which was founded by the late king. Von Thaer was at one period the director. The establishment consists of a college and a model farm of 1200 acres. When visited by Mr. Jacob, in 1820 ('Agriculture, &c., of Germany'), there were three professors, who resided upon the premises; one for mathematics, chemistry, and geology; one for the veterinary art; and the third for botany and the use of the various vegetable productions in the Materia Medica, as well as for entomology. Attached to the institution there was a botanic garden, arranged on the Linnæan system; an herbarium; a museum containing skeletons of domestic animals, models of agricultural implements, specimens of soils, &c. The various implements were made in workshops upon the farm, and the pupils were expected to acquire a general notion of the modes of constructing them. The sum paid by each pupil was very high, not less than 80*l.* a year.

At Hohenheim, in the kingdom of Würtemberg, two leagues from Stuttgard, an old palace has been appropriated as an agricultural college. The quantity of land attached to the institution is about 1000 acres. The pupils are of two grades, and those belonging to the superior class pay for their board 150 florins, and for their instruction 300 florins a year, or altogether 37*l.*, and extra expenses make the annual cost about 50*l.* Natives of Würtemberg are admitted at a lower rate than the subjects of other states. The higher class of students do not, as at Grignon, take part in the actual labours of husbandry; but the means of theoretical instruction are very complete. Lectures are delivered by twelve professors on the following subjects:—Mathematics and physics, chemistry and botany, technology, tillage and other departments of rural economy, forestry, and the veterinary art. The lectures are so arranged that they can be either attended in two half-years or three or four. In the former case much preliminary information must have been acquired. There is attached to the institution a small botanical garden; a museum of zoological, botanical, and mineralogical objects; skeletons of domestic animals; collections of seeds and woods; and a library of works on rural economy. The establishment also comprises a manufactory of beet-root sugar, a brewery, a distillery of potato-spirit, and there is an apartment devoted to the rearing of silkworms. A part of the farm is reserved for experiments. The second class of students do the manual labour, but they are nearly maintained at the expense of the institution, and, when they can be spared from field-labour, they have the opportunity of attending the lectures at the college.

In Bavaria the king has given up the domain attached to the royal palace of Schleissheim for the purposes of a model farm; but a great mistake has been made in selecting land much below the average standard of fertility, which, as well as land of extraordinary productiveness, should be avoided. It is on a much inferior scale to the establishment at Hohenheim. There are agricultural institutions supported by the state at Vienna, Prague, Pesth, and various other places in the south-east of Europe. We add to these remarks the following enumeration of European Agricultural Educational Institutions, extracted from a report by Dr. Hitchcock to the legislature of Massachusetts:—

	Superior Schools.	Inter-mediate.	Inferior.	Special.	Parts of Colleges.	Total.
England	1	..	4	..	..	5
Ireland	1	25	34	..	3	63
Scotland	..	..	..	..	2	2
France	5	..	70	..	..	75
Italy	..	..	1	..	1	2
Belgium	..	3	2	1	3	9
Prussia	3	2	12	13	2	32
Austria	4	..	3	25	1	33
Wurtemberg	1	2	1	3	..	7
Bavaria	1	1	32	1	..	35
Saxony	1	3	..	1	..	5
Brunswick	..	1	1	..	..	2
Meck. Schwerin	..	1	..	..	..	1
Schles. Holstein	..	2	2	..	..	4
Anhalt	1	1	..	..	..	2
Hesse (G. Duchy)	..	2	..	..	..	2
Weimar	..	..	..	..	1	1
Nassau	1	..	..	..	..	1
Hesse (Electorate)	1	..	..	..	..	1
Baden	..	1	..	..	..	1
Meiningen	..	..	1	..	..	1
Russia	2	10	51	1	1	65
Total	22	54	214	48	14	352

Although the column containing a reference to such agricultural institutions as form parts of colleges is blank opposite England, it should be mentioned that since the date of Dr. Hitchcock's report, the Trustees of the Queen's College at Birmingham have established an agricultural lectureship, and appointed Mr. Henry J. Tanner, of the Cirencester Agricultural College, their first Professor of Agriculture.

(*On public Institutions for the Advancement of Agricultural Science*, by Dr. Daubeny; *Journals of Royal Agric. Soc. of England*; Dr. Lindley's *Gardener's Chron. and Agric. Gazette*, &c. &c.; Thom's *Almanac and Official Directory* for Ireland).

AGRICULTURAL IMPLEMENTS. Few of the productive arts have made more signal progress within the last few years than those which relate to the cultivation of the soil. This progress is mainly due to four causes. First, the Repeal of the Corn Laws. The abandonment of protective duties on home produce has compelled the farmer to depend on his own resources. He is now placed in a position to feel the effects of any superiority or advantages possessed by foreign farmers; and he is urged by every motive of self-interest to maintain his ground. Those circumstances which depend upon political or fiscal regulations, and those which are due to climate or natural causes, he must bend to, if he cannot make them bend to him; but, in all the practical details of his art, he is more alive to what is going on around him than at any former period in the history of British farming. Second, the progress of agricultural chemistry. The chemical researches of Liebig and others have led to marked improvements, especially in the implements for distributing and otherwise treating manures. Third, the Royal Agricultural Society. The exertions of this admirable society—in conducting experimental researches, offering prizes for useful novelties, holding annual shows or exhibitions, drawing up reports on the agriculture of particular places at particular times, the popularisation of the results obtained by scientific men, and the publication of papers relating to all branches of agricultural art—have had a great effect in leading to improvements in the implements of farming. Fourth, the Great Exhibition of 1851. That wonderful assemblage, by comprising implements from foreign countries (many of which had not been seen here before), and by leading to the institution of many valuable series of experiments on groups of implements, gave a very notable impetus to the makers of agricultural implements, and, through them, to the farmers. The annual country exhibitions of the Royal Agricultural Society, as well as the metropolitan show of the Smithfield Cattle Club, have demonstrated how great has been the advance made in this art between the years 1851 and 1858. The Royal Agricultural Society's 'Trials' of implements have now assumed an important systematic arrangement. At the suggestion of the late Mr. Pusey, all agricultural implements have been placed in three groups, according as they relate to the preparation of the ground for sowing, the treatment of the crop from sowing to gathering, or the subsequent processes of the barn, &c. Trials of implements in the three classes take place in turn. At the Chelmsford meeting in 1856, for instance, the trial was of implements in the first class; at the Salisbury Meeting in 1857, it related to the second class; and at the Chester meeting in 1858 to the third. This plan has been since extended, and a quadrennial division is to be adopted for the future.

The present article is devoted to a general notice of the mechanical implements of agriculture, and of the kind of service which each is fitted to render—with cross-references to such special articles as may be found under other headings in the Cyclopædia. The details may be conveniently arranged under certain headings—Instruments of Tillage; Implements of Cultivation; Harvesting Implements; Preparations for Market; Implements for Stock-feeding; Land-draining; and the application of Steam Power to Agriculture. To some extent it will be necessary to describe processes and their objects; but for the most part the implements only will be treated of.

Instruments of Tillage.

Ploughs.—The better the soil, the less cultivation it requires to produce tolerable crops; hence, where the land is very rich, we find in general a slovenly culture; where the ground is less productive, more labour and skill are applied to compensate for the want of natural fertility. The simplest cultivation is that of the spade, the hoe, and the rake,—and on a small scale it is the best; but spade husbandry cannot be carried to a great extent without employing more hands than can be spared from other occupations. The plough, drawn by oxen or horses, is the chief instrument of tillage, and has been so in all ages and nations of which we have any records. A plough [Plough] should as much as possible imitate the work done with a spade. It should cut a slice from the land by its coulter vertically, and by the share horizontally lift it up, and turn it quite over by means of the mould-board; the art of the ploughman consists in doing this perfectly, and with such a depth and width as suit the soil and the intended purpose. In rich mellow soils a ploughed field should differ little from a garden dug with the spade. In tenacious soils, the slice will be continued without breaking, especially if bound by the fibres and roots of plants; the whole surface will be turned over, and the roots exposed to the air: it is of great consequence that all the slices be of the same width and thickness, and the sides perfectly straight and parallel. The plane of the coulter must be perfectly vertical, and that of the share horizontal, in order that the bottom of the furrow may be level, without hollows or *baulks*, which are irregularities produced by the rising or sinking of the plough, or inclining it to either side. The ancients were very particular in this respect, and recommended sounding the earth with a sharp stake, to ascertain whether the ploughman had done his duty. There are various modes of ploughing land, either quite flat, or in *lands* or stitches, as they are called in England, and, in Scotland, *riggs*, that is, in portions of greater or less width, with a double furrow between them—somewhat like beds in a garden. Sometimes two ridges are set up against each other, which is called ridging or *bouting*; the land then is entirely laid in high ridges and deep furrows, by which it is more exposed to the influence of the atmosphere and kept drier; this is generally done before winter, especially in stiff wet soils. Sometimes two or more ridges are made on each side, forming narrow stitches. When the ground is to be ploughed without being laid in lands or stitches, and all the ridges inclined one way, the mouldboard of the plough is shifted at each turn from one side to the other. The plough which admits of this is called a *turn wrest plough*, and is in general use in Kent, and in many parts of the continent, where the subsoil is dry and the land not too moist. In most other situations the ground is laid in *lands*, and the mould-board of the plough is fixed on the right side. When grass land or stubble is ploughed, care must be taken to bury the grass and weeds completely, and the slice cut off by the plough must be turned over entirely, which is best done by making the width of the furrow greater than the depth. When the grass and weeds are rotten, and the ground is ploughed to pulverise it, a narrow deep furrow is best; the earth ploughed up is laid against the side of the preceding ridge, which forms a small furrow between the tops of the ridges, well adapted for the seed to lodge in and to be readily covered with the harrows.

Nothing has more divided agriculturists than the question, whether the land should be ploughed deep or shallow; but a slight attention to the purposes for which land is ploughed, and to the nature of the soil, will readily reconcile these apparently contradictory opinions. A deep, rich, and stiff soil can never be moved too much nor too deep: deep ploughing brings up rich earth, admits the air and water readily, and gives room for the roots to shoot; while the rich compact soil affords moisture and nourishment. Wherever trees are to be planted, the ground should be stirred as deep as possible, even in a poor soil; for grass and corn, this is not, however, in ordinary practice found prudent; though their roots descend below the cultivated 'staple,' yet these crops are found in general to succeed best when the subsoil is left unloosened.

The great object in ploughing land is to divide it, expose every part of it to the influence of the elements, and destroy every plant or weed but those which are sown in it. To do this perfectly requires several ploughings, with certain intervals, and during that time no crop can be upon the land. This is the real use of fallows, and not, as was once supposed, to allow the land to rest; on the contrary, it ought then to have the least repose.

Harrows. Referring to the article PLOUGH for an account of the recent improvements in that important implement, we proceed to notice the other implements in connection with the processes of arable culture.

After the harvest, the plough is set to work, and the stubble ploughed in. The winter's frost and snow mellow it, while the stubble and weeds rot below. In spring, as soon as the weather permits, it is ploughed again, to complete the decomposition of the roots and weeds. The *harrow* is then, in most cases, employed, to stir the ground and tear up the remaining roots. The bush-harrow consists of a row of twigs or branches, fixed to a frame, and drawn over the surface of the ground. But this is intended rather for covering the seed with a light layer of earth, than to prepare the ground for sowing. The ordinary harrows have several rows of iron teeth or tines, which dig into the ground, and assist in comminuting the clods of earth. Until recently, the harrow was made with bars set square, and with teeth one behind another on each bar; to prevent the teeth, therefore, from dragging after each other in the channels, it was necessary to draw the harrow in an awkward way from the corner. In Williams's patent harrow the bars are set diagonally, at such an angle that every tooth, when the harrow is drawn square, may mark out a furrow for itself. In Howard's harrow, the diagonal arrangement is combined with a zig-zag framing, having a somewhat similar object in view. In Coleman's expanding harrow, the bars at every point of crossing are united by a loose pin instead of a screw; the effect of this is, that the width of the harrow can be increased or diminished, and the teeth can be brought nearer or farther apart, so as to suit the state of the land. This harrow has also very small wheels, which can be let down while it has to be conveyed from one field to another.

Scarifiers; Grubbers; Cultivators.—Various instruments have been invented to stir and mix the earth, without so often using the plough as was necessary in the old mode of farming, and also to loosen and separate roots and weeds. The scarifiers, grubbers, and cultivators now in use are all examples of this kind of implement. One of the earliest was Plenty's scarifier, which acted as if a large number of very small ploughs were working at once in one frame, each digging only to a small depth into the ground. The teeth, shares, or tines, were easily removable, so as to be replaced by others of different size or shape, according to the state of the soil; and when inserted they could be raised or lowered at pleasure, as a means of making a shallow or a deep incision. This implement divided the soil, but did not turn it over; it was well calculated to destroy roots and weeds, and to let in the air, but it was only adapted to tolerably loose and mellow soils, free from large stones. Finlayson's harrow or cultivator rakes the weeds out of the ground, and throws them on the surface without clogging the instrument. Farmers value the various kinds of cultivators and scarifiers chiefly on the following ground;—in a four-course system of husbandry, there are frequently seven ploughings in the four years; but by the use of these implements at certain seasons, working many tines or shares at once, but going only to a small depth, the regular ploughings may be reduced in number, and the total result produced by one-half the ordinary labour of man and horse. The implement-makers have vied with each other in ingenious modes of insuring these results. Coleman's scarifier, with six horses, is adapted for very hard ground. Biddel's, made by Messrs. Ransome, is suitable for deeper incisions into looser ground. Kilby and Bentall's paring-ploughs are midway in character between ordinary ploughs and scarifiers, and are useful for a very close surface of land. Cotgreave's plough is a cultivator, in which three processes are combined in rather a curious way; it first ploughs and turns a furrow five inches in depth; then it digs another five-inch furrow, inverts the soil, and deposits it on the top of the first; and lastly, a sub-pulveriser loosens the soil to a further depth of three or four inches. Beauclerk's patent plough and subsoiler may be likened to a common plough with an Archimedian screw attached, which revolves in the bottom of the furrow, thus ploughing and subsoiling at the same time. At the Smithfield Cattle Show in 1858, one of the implements exhibited was Romaine's cultivator or digger, which takes up and turns over larger masses of earth than is customary with other implements of the kind. A digging action is effected by Owen's potato-digging plough, exhibited on the same occasion; with this machine, two horses and one man can dig potatoes as rapidly as twenty persons can pick them up.

Rollers; Clod-crushers.—When the soil turned up by the plough is in large hard lumps, a roller, sometimes with spikes on its surface, is drawn over the land to break the clods, or mallets are used to break them by hand; but this is seldom necessary, except where very stiff soils have been ploughed when too wet, and the ridges have dried, and been ploughed again in dry weather. Deep wet clay soils require watching, to determine the proper time for ploughing; frost is the best pulveriser; and if they be kept from wet by careful draining in autumn, they will be loose and friable in spring. On light soils the plain roller is used with advantage to produce firmness, and to hinder a too rapid evaporation of moisture. Farm-rollers, like other agricultural implements, have undergone many improvements. "Not many years ago," said Mr. Philip Pusey, one of the most enlightened encouragers of scientific agriculture, "the landlord was often asked by his tenant for some old tree to convert into a roller; the tree-roller, when manufactured, had its framework loaded with rough materials to give it weight; but it soon wore and cracked, so as to become in a year a most ungainly implement." Iron rollers of excellent construction have since been introduced. For rendering the soil fine, however, the regular cylindrical form has one disadvantage, seeing that it passes so easily over small clods as to press without crushing them. Hence the invention of various kinds of *Clod-crushers.* M. Claes, of Belgium, has invented a roller intended for narrow round ridges, but also fitted to produce the crushing instead of the pressing action. It consists of four rings or partial rollers, so adjusted on one axis as to have independent and irregular movements. The best machine now in use in England for this purpose is Crosskill's clod-crusher. It is a roller of which the surface is jagged by iron teeth. Its principal use is in breaking down turnip land which has been fed off by sheep in wet weather, and afterwards baked by the heat of the sun; but it is also usefully employed as a presser for young wheat in March, when the soil has been swollen and the roots thrown out by alternating frosts and thaws. According to the competent testimony of Mr. Pusey, by using this implement on barley-land at the proper time, the necessity is avoided of sowing on cloddy ground, or of delaying the sowing for three weeks—in either case ensuring an additional quarter of barley per acre, and thus paying for the implement in the very first season. Another kind of clod-crusher, Gibson's, is adapted for a moist state of the soil; it is formed of two rows of very narrow wheels, alternating one with another. Patterson's self-cleaning clod-crusher contains a series of eccentrics upon an axle, which, in revolving, rub and clean each other. Crosskill's Norwegian harrow differs from his clod-crusher in having very long and fine teeth; it does not clog between the teeth, nor does it knead the soil. It is evident that each kind of clod-crusher is suitable for a particular state of the ground.

Many of the implements employed in the preparation of the ground for culture are now tested by dynamometers, or power-measurers, which show in what ratio the power employed is made to render useful service. At the Newton Abbot meeting of the Bath and West of England Agricultural Society, in 1857, several such instruments were submitted to trial. One showed the draught of ploughs and cultivators, from one to six-horse power; another ascertained the power consumed by horse-gear, independently of the machines to which it may be attached; while another tested the power of threshing and other rotary machines.

IMPLEMENTS OF CULTIVATION.

Sowing; the Dibble.—When the soil has been prepared by means of the implements above described, the processes of cultivation follow, including the sowing of the seed and the treatment of the growing crops. In arable land, the most common method is to sow the seed after the last ploughing, and draw the harrow over to cover it; the seed, if the land has been well ploughed, will mostly fall into the small furrows made by two adjoining ridges, and rise in regular rows. A more careful method, however, is that of *dibbling,* adopted in some of the eastern counties. The dibble is a rod about 30 inches long, having an oval ring for a handle at one end, and at the other a cone-shaped projection. With two of these dibbles, one in each hand, the sower makes small holes 4 or 5 inches apart, in rows 9 to 12 inches asunder; he pushes and turns the dibbles, to make clear holes, walking backwards along the furrows. Two or more children follow, and drop three or more grains in each hole; a bush-harrow is drawn over the ground, and fills the holes with loose earth. Great improvements have been made in the construction of hand dibbles, by which several holes are made and seed deposited in them by one operation. A dibble manufactured by Mr. Powell is one of the best of this class.

Drills.—Broad-cast and dibble sowing have, however, been almost abandoned in modern English farming. One half of the horse power formerly expended in harrowing is saved by the adoption of some of the modern drills or seed-sowing machines; a saving of seed is also effected; and there is also an avoidance of the necessity for that previous harrowing into ridges at a particular angle, which was formerly deemed necessary as a preliminary to hand-sowing. The drill is, in fact, the key to a whole system of husbandry; for, in addition to the advantages just enumerated, this machine is applicable to the use of many artificial manures, distributing them beneath the ground by means of special coulters, and covering them with earth, that their excessive strength may not injure the seed, which is deposited last of all. The use of the horse-hoe is almost wholly dependent on the previous use of the drill; indeed, the two bear to each other much the same relation as the hand-hoe and the dibble. For the construction and action of seed-drilling machines, see DRILL.

Top-dressers; Manure-distributors.—Wheat crops are usually provided with their requisite manure by farm-yard refuse or by sheep-folding. It usually, however, requires a top-dressing of manure during its growth. It was customary, a few years ago, to apply this by hand; but machines are now usually employed. These will distribute three or four bushels per acre of guano, rape-cake, superphosphate, nitrate of soda, or other fertilising agent. Holmes's top-dresser is a favourable example of this kind of implement. A more complicated machine is that by which manure is deposited either with the seed, or at least with an equal degree of regularity. Some among the many forms of drill are applicable to this purpose; and our implement makers now bestow great attention upon this department of their art. Thus, Reeves and Beaton's liquid-manure distributor consists of a series of buckets or troughs, attached to a metal chain or band; the chain works round two rollers as the vehicle progresses, the wheel giving the motive power to the rollers. Chandler's water-drill is an ingenious contrivance for depositing water as well as pulverised manure, at certain dry seasons. Some of Hornsby's drop-drills not only limit the seed and manure to particular lines, but to particular points in these lines, thereby increasing still more the economical action of drills. At the Salisbury meeting in 1857, Reeves's manure-distributor received much commendation: it comprises a box in which revolve a row of archimedean screws; these turn the dry powdered manure out at holes in the bottom of the box,—a slide, by diminishing or increasing the openings, regulating the quantity to be deposited.

Hoe; Horse-hoe.—Among the necessary implements for treating the young plants during their development is the hoe—worked by hand in the old-fashioned method, and by horse-power in the improved modern farming. [HOE; HORSE-HOEING.]

HARVESTING IMPLEMENTS.

Reaping Machines.—The operation of cutting the corn when it is ripe, is one of so important a character, that inventors have made many attempts, during the last century, to produce machines that shall effect this by horse-power instead of by the sickle or reaping-hook. The ingenious labours of M'Cormick, Hussey, Bell, Crosskill, and other machinists, in this department of their art, will be best noticed in connection with the process of reaping generally, under REAPING; REAPING MACHINES.

Horse-rakes.—Even the rakes which collect the scattered corn in a field are now to be numbered among horse-worked implements. The modern horse-rake used in many of our counties, is an implement about 8 feet wide, running on low wheels, and having about 30 prongs or teeth; it is drawn by one horse rapidly between the rows of cocked barley, &c., and is tipped up from time to time by a man who follows. One of these machines will do the work of about twelve women. At the Newton Abbot meeting in 1857, three or four "self-acting" horse-rakes were tried; but the automatic action was not in general satisfactory. At the Salisbury meeting the specimens were much more numerous, exhibiting many ingenious modes of overcoming difficulties.

Hay-making Machines.—The simple use of the fork to turn and toss the hay in the field, is now to some extent superseded by hay-making machines. Those which were first introduced, flung up the hay high in the air; but they are now so constructed as gently to stir it, without raising it to any great height. The hay-making machine is something like a paddle-wheel, with teeth or spikes in all the paddle-boards or floats. It is set in rotation by the wheels of the carriage to which it is attached. Its labour-saving effect is analogous to that of the horse-rake. Rowsell's hay-collector is a favourable example of this kind of implement. At the Salisbury meeting, the hay-making machines sent by Nicholson, Barrett and Exall, Smith and Ashby, Thompson, Nicholson, and other makers, worked so excellently as to show that this kind of process has been fairly brought within the range of machinery. Several instruments of minor character might be comprised under this particular section of our article: such as Allen's grass-mower, exhibited at the Smithfield Show in 1858; it will cut grass better and lower than the scythe, and at the rate of an acre per hour. Kinnaird's, Mazier's, Clayton's, and Catchome's, are all useful instruments for cutting clover or grass, each being suited for a particular kind of work.

PREPARATIONS FOR MARKET.

Carts and Waggons.—The conveyance of agricultural produce from the field to the barn, and from the barn to market, has not failed to enlist the attention of implement-makers. Many improvements in these vehicles have been recently introduced. The old-fashioned capacious tumbril for carting earth and dung, with broad wheels to prevent them sinking in soft ground, is too well known to need description. The best-constructed carts have iron axles, with the ends or arms turned smooth, and slightly conical. The light Scotch cart, drawn by one horse, is justly regarded as a useful vehicle for transporting earth or manure, especially in hilly countries. It is low and short, so that the horse draws very near the centre of gravity; and the load may be so adjusted as to bear more or less on the horse, according to the steepness of the road. The Scotch cart is made to carry hay and straw by means of a light frame, which is laid on it and projects over the body and wheels in every direction. To ease the weight resting on the back of the horse, carts have been invented with three wheels, the small additional wheel being made to turn in front; but they have disadvantages which counterbalance their advantages.

The Agricultural Jury Report on the Great Exhibition of 1851, announced a very marked improvement in recent years in the construction of agricultural carts and waggons, especially in the use of single-horse carts instead of pair-horse or three-horse waggons. "It is proved beyond question, that the Scotch and Northumbrian farmers, by using one-horse carts, save one-half of the horses which south-country farmers still string on to their three-horse waggons and dung-carts. The said three-horse waggons and dung-carts would also cost nearly three times as much original outlay." The implement-makers have shown that single-horse carts can be made suitable for any farming purpose. Mr. Busby's cart is one which has come largely into use. So much attention has recently been paid to this subject that, in a competitive trial at Grantham, five horses with five new carts were tried against ten horses with five old waggons, and clearly beat them in the amount of work performed. Some makers now attend most to the form of the harvest-cart, that the corn may be carried more steadily; some endeavour to make the cart low, for ease of loading and of draught; some try to give horizontality to the shafts; some make their wheels by machinery; while others strive for excellence in a 'cart-of-all-work,' which shall be adapted to as many kinds of farm-service as possible. At the Great Exhibitions in London and Paris (1851 and 1855), foreigners were much struck with the superior neatness and compactness of English farm-carts, over those made and used on the Continent. At the Salisbury meeting in 1857, a prize was offered for "the best one-horse cart, constructed with a view to lightness of draught and the ready loading and unloading of farm produce,—qualities which may be best attained by the judicious use of long shafts, high wheels, and cranked axles." This prize led to the production of a number of excellent carts for agricultural purposes.

Threshing Machines.—The important process of separating the corn from the husk used, in former days, to be effected by means of a flail beating against a threshing-floor; but farmers are now becoming more and more accustomed to employ the improved implement called the threshing-machine. For the simpler process, see BARN; and for the more complicated but more efficient, THRESHING; THRESHING MACHINE.

Winnowing and Dressing Machines.—These are so intimately allied with the machines last mentioned, in their purpose and action, that they may usefully be noticed together, under THRESHING; THRESHING MACHINES.

IMPLEMENTS FOR STOCK-FEEDING.

Turnip-Cutters.—The preparation of fodder for animals has become a department of farming in which many useful and ingenious implements are employed. It has been found that the labour of the jaws in masticating uncut food, tends to waste the muscle of the farm animals and retard their growth; it is therefore now a custom to cut or bruise most of the kinds of fodder for such animals. The *turnip-cutter* is one of the implements employed for this purpose. There is no doubt considerable advantage in the use of a turnip-cutter to the animals individually so fed, but the principal economy of the process arises from its saving much of the roots as food which is otherwise trodden down in the sheep-pen. Lambs fed with the aid of a turnip-cutter would be worth more at the end of a winter by 8*s.* a head than lambs fed on whole turnips, thus effecting a saving of about 70*s.* per acre on turnip crop. The turnip-cutters vary greatly in action, some cutting by a vertical, and others by a rotatory movement.

Chaff-Cutters.—Another implement of this class is the chaff-cutter. There not being enough natural chaff for the use of farm animals, artificial chaff is made by cutting straw into very small pieces. At first the straw was cut by a chopper, but cutting-machines were afterwards introduced; they usually consist either of a blade working vertically, or of one or more cutters ranged on a wheel; but in some large farms the cutters are worked by means of a strap connected with a fixed or moveable steam-engine. The process now costs only one-sixth or one-eighth of the charge formerly incurred. There was a trial of chaff-cutters during the Agricultural Meeting at Carlisle in 1855, in which one apparatus, made by Cornes, cut 1485 lbs. of chaff per hour by steam-power; those that worked by the muscular power of one man each cut quantities varying from 90 to 210 lbs. per hour. In Brown and May's screw-cam chaff-cutter, exhibited at the Smithfield Show in 1858, there are feed-rollers, which hold the hay or straw firmly while the knife is passing through, and these rollers move round to bring it forward in the space between the knives, ready for the next cut.

Crushers, Grinders, and Bruisers.—These machines, mostly of modern introduction, act by the crushing movement of rollers rather than the grinding movement of mills, and are intended to facilitate the comminution of substances for cattle-food. One is a linseed-crusher; another a corn-crusher; a third, an oil-cake bruiser; a fourth, a fine-meal mill; a fifth, a gorse-bruiser. It is evident, from a mere inspection of this list, that there is much scope for ingenuity in the arrangement of working parts for such machines. Some of the fine-meal mills, made principally to crush barley, beans, and oats, admit of adjustment that will "enable them to grind anything from linseed up to flint stones." Messrs. Hornsby, Garrett, Crosskill, and other manufacturers, now make steam-worked oil-cake breakers that will break 3000 lbs. of cake per hour for sheep, or 4000 lbs. for cattle.

Pulping Machines.—Farmers are not agreed concerning the amount of advantage derivable from the reduction of root-food to a softened state. In reference to potatoes, it has been found worth while to steam them for pig food; and even diseased potatoes, if not very far decayed, by being thus treated, may be rendered good victuals to be stored up for months. The pulping of turnips enables the root to be incorporated with other nutritious articles of food. Pulping and Steaming machines now occupy a place in all the exhibitions of Agricultural Implements.

Land Draining.

Drain-tile Machines.—In strictness, the preparation of ground for farming purposes ought to receive priority of notice, before the processes of agriculture. But in truth the two subjects are widely distinct. Draining is a part of the civil engineer's labours, requiring the application of numerous principles having little direct relation to vegetable culture. It is an answer to the problem—how to remove from land a too great abundance of moisture; in the same way that irrigation is the process of imparting to land an additional quantity of moisture.

Draining-ploughs.—Somewhat more closely connected with the farmer's operations, but nevertheless, requiring the aid of other persons, is the use of the very singular draining-plough; by which one machine not only digs a drain, but also places a layer of draining-pipes in it.

It will be convenient, therefore, to refer to Drain-pipes and Tiles, for an account of the ingenious machines by which clay is so fashioned as to be available for these purposes; to Draining, for a description of the modes of applying these pipes; and to Irrigation, for a notice of the modes of supplying water to the soil for the purposes of agriculture.

Application of Steam Power.

One of the most important questions now pressing on the attention of agriculturists is—to what extent may steam-power profitably supersede horse-power and manual labour? Steam-engines may be applied to work the machines of the barn and threshing-floor, such as threshing machines, winnowing and dressing machines, and the like; or they may be applied to the operations of the land, such as ploughing, harrowing, &c. All agree that these things can be done; but the problem waiting for solution is, whether they can be done profitably. Under the headings Drill, Plough, &c., will be found details relating to this matter; but it seems desirable to make a few general observations on the subject in this place.

All agricultural steam-engines must ultimately resolve themselves into one or other of five kinds—fixed engines, to work machines contiguous to them; locomotive engines, to work a fixed machine; fixed engines, working locomotive machines by means of a travelling strap or rope; locomotive engines, carrying their own railway with them over the surface of a field; and locomotive engines, travelling on lines of rail regularly laid down on the field.

With regard to the first of these kinds; it is evident that any mechanism which is made to rotate may have its rotation given by a steam-engine as well as by a horse moving in a circle, or by a man turning a handle or wielding a flail. We may, therefore, at once refer to the special articles for instances: simply stating, that steam power is becoming more and more largely employed every year in performing the operations of the barn and the mill. Fixed steam-engines have been in use many years in Northumberland and East Lothian for threshing and other barn operations.

The Royal Agricultural Society has been honourably distinguished by the zeal with which it has encouraged improvements in this direction. It propounded the question, whether moveable steam-engines would not be better than fixed engines for barn as well as field purposes. It assigned three reasons for answering this question in the affirmative. 1st. That if a farm be very large, it will be greater economy to wheel a locomotive steam-engine to different parts, than to employ horses and men in bringing all the corn in the straw to one point, and again carrying out the dung to a distance (perhaps) of two or three miles. 2nd. If a farm be of small or moderate size, it will not support the expense of a fixed steam-engine; whereas, a portable engine may be available for two or three farms, at a fair ratio of expense for each. 3rd. Although threshing can only be performed under cover in barns by fixed engines, it is perfectly feasible in the open air by a locomotive engine—a plan healthier and more expeditious for the labourers, and rendering practicable a diminution in the number of farm buildings requiring to be constructed by the landlord. The Great Exhibition of 1851 brought forward the skill of many makers, such as Hornsby, Tuxford, Clayton, Barrett, Hensman, Bullin, Roe, Ransome, and Garrett; but it also showed that the invention was still in its infancy, for the worst specimen consumed three times more coal than the best for the same amount of work. Of thirteen locomotive agricultural steam-engines put to trial, the nominal horse-power varied from 4 to 9; the time of getting up steam, 28 to 83 minutes; the coal used in getting up steam, 25 lbs. to 75 lbs.; the coal burned per horse-power per hour, 6·79 lbs. to 25·80 lbs. Mr. Locke, the eminent engineer, in reporting on these trials, said:—"If I might be permitted to suggest a little advice to the makers of these engines, I would beg of them to attend more to the proportions of the various working parts, and less to external ornament. There is a want of good proportions in several of the engines; and this to a mechanic or an economical farmer is of more importance than a profusion of brass." Taking the experience of 1851 as a basis, the engine-makers have every year endeavoured to introduce improvements. At the Carlisle meeting of the Agricultural Society, in 1855, a marked advance was observable in the locomotives for farm purposes. The maximum consumption of coal per horse-power per hour was 10 lbs., while the minimum was as low as 3·7 lbs. It was found, however, that some of the engines had been built expressly to win the Society's prizes and commendations, and that more attention was needed to the rough and every-day qualities required for practical farming. By the year 1857 it had become a practice not at all unusual to make one steam-engine, under the charge of an intelligent farm labourer, perform all the operations of setting in motion threshing and winnowing machines, cutting chaff or roots, crushing oats, grinding corn, pulping mangold-wurzel, splitting beans, sawing wood, pumping water, and applying steam for steaming potatoes or roots. At the Salisbury meeting in that year, it was announced that Messrs. Clayton and Shuttleworth were making and selling agricultural steam-engines at the rate of five hundred per annum; and by the close of 1858 they had made several thousands, mostly for export to foreign countries, where English agricultural machines are now eagerly sought for.

We have, lastly, to notice the most comprehensive system ever yet proposed, for applying steam-power to agriculture; a system only yet tried on a small scale, awaiting the time when it can be put to better tests. It is called the 'Guideway Steam Agriculture;' and it was fully described by its inventor, Mr. Halkett, at a meeting of the Society of Arts, on the 8th of December, 1858. The subject had been introduced to the society, and also to the Royal Agricultural Society, in 1857; but certain additions and improvements were made during 1858. The inventor regards his system as advantageous, not so much in the reduced cost of field operations, as in the increase of crops resulting therefrom. The principle consists in the laying down of permanent rails on the field, and the travelling of all the machines along those rails. The rails are laid in parallel lines on a very broad gauge. The ploughing, scarifying, sowing, hoeing, and reaping instruments are attached beneath a travelling carriage having locomotion given to it by steam power. The gauge has been tried at thirty feet; but the inventor sees no obstacle to the use of one as great as fifty feet. At right angles to the rails, along one side of the field, are other rails on a lower level, with very low carriages or trucks, the upper surface of which is on a level with the field rails; upon this truck the cultivating machinery moves, and is transferred sideways from one set of rails to another, or home to the steading. It is a sort of apparatus like that which is much in use on the Great Western Railway for transferring carriages from one pair of rails to another. This cross-railway Mr. Halkett calls the headland railway, on which the headland truck works. Three modes of laying down the rails are suggested. The first, for clay districts, consists in laying angularly-topped iron rails on a support of hard-baked bricks, which are themselves supported by a ballasting of burnt clay or concrete; this form requires that the tires of the wheels should have angular grooves to fit upon the rails. The second, for wood districts, is a cheap mode of laying down flat-surfaced creasoted wooden rails, on wood sleepers. The third, for market gardens and other high-rented land, consists in resting the rails on small posts or piles, in order to economise space. One reason for the great breadth of gauge is that as little land as possible may be occupied by the rails and their supports. As none of the machines could travel along the rails at a greater speed than two or three miles an hour, minute accuracy of gauge and of motion would not be so necessary as upon an ordinary railway.

Such being, in few words, the arrangement of the rails and carriages, the steam culture is as follows:—The steam cultivator, a system of ploughs, is driven by two locomotive engines, placed at the extreme ends or sides, which are geared together by intermediate shafts. The cultivator has two sets of ploughs, working in opposite directions, and each in use during one particular direction of movement only; the other set being meanwhile raised by racks and pinions. The inventor states that 25 acres can thus be ploughed in a day of twelve hours. The land having been ploughed up, a 'comminutor' takes the place of the 'cultivator,' being, like it, moved by locomotives; it is something like the Norwegian harrow, but revolves at a high velocity, and its tines or spikes break up the soil to a fine condition. The clod-crushing, the hoeing, the harrowing, the manure depositing, the water distributing, the reaping, and other field operations, are done by attaching the requisite machines or implements to the travelling carriage.

The advantages to be expected by the adoption of this system are insisted on by Mr. Halkett in a variety of ways. The great advances which have been made by Fowler, Boydell, and other implement-makers, in ploughing and breaking up land by steam, have schooled the mind to the possibility of the same power being eligible for use in the field, and have prepared agriculturists to expect a system that shall perform more than one operation. The system is applicable both to extensive holdings and to smaller farms, by modifying the amount of power to be applied. As to the space robbed from the field by the rails and ballasting, the inventor contends that, even if greater than it is, it would still be less than the open furrows between ridges; and also that no farm-roads would be wanted in the field, seeing that the guideway machines convey everything to and from the field. As the machines can be worked nearly as well in the dark as in the light, they might be made to do double duty in the twenty-four hours during seasons of exigency, by a relay of a few hands. When once the soil has been brought to a high condition, it may easily be kept so; for the whole weight of the machinery, engines, and implements rests upon the rails; nothing touches the soil except the implements in operation; no horses need stamp the ground with their iron-shod feet; and the footprints of the guide and the ploughman need never be seen pugging the clay, and treading into a solid clod that which has been reduced to the fineness of garden-mould. At present, the weeding, earthing-up, hoeing, and loosening of the earth among young crops are difficult to perform with the requisite care except by hand; but the guideway implements can be adjusted with great nicety, so as to travel at the requisite proximity to the rows at all times during the growth of the plant. Besides the machinery which carries the engines and implements, there are other guideway arrangements, equal in width from rail to rail, but smaller and lighter, for carrying water, manure, and the gathered crops; and the sprinkling of water and liquid manure can be effected nearly in the same way as by the water-drill. When manual labour is required for the purpose of weeding, transplanting, or any other light work, the labourers are conveyed to the spot by means of the trucks, upon which they sit or stand while the work is being performed, or while the crop is being transferred from the ground to the truck. The trucks for this purpose might be drawn by horse-power or by manual labour, if preferred. Where the side of a field is crooked, the crooked part may easily be fenced off and used for ordinary cultivation. Where roads or lanes intervene between different fields, a level crossing on moveable rails would enable machinery to pass from field to field. If a farm abuts on a railway, it may be made to communicate with it; by this means the produce may be sent to populous towns without once leaving the rails; manure may be brought from the towns to the fields at a very small expense; and marl, clay, or sand, may be brought cheaply from distant places. The smaller system of cultivation, for the light operations of a farm, or for the total cultivation of a market-garden, might be worked by one small steam locomotive instead of two. Mr. Halkett has sketched the appearance of his apparatus when provided with all the implements for drilling corn, drilling seeds between the rows of plants, hoeing, rolling, surface watering, watering in rows, underground watering between rows, carrying crops, carrying water, weeding, transplanting, dibbling, and cross-hoeing, for the light operations of a farm, or for market-gardens,—of course not all working at once, but showing the mode of arrangement for each. The inventor believes that the guideway system would be profitably employed in the West Indies, for ploughing, earthing the sugar crops, hoeing, carting the canes from the field, and other operations in which slave labour is now found to be really very costly.

In a discussion which followed the reading of Mr. Halkett's paper at the Society of Arts, very conflicting opinions were expressed concerning the advantages of his new guideway system of steam culture. It was contended by some of the members, that the machines would cost more than was stated; that the system was not well adapted for other than very large farms, with large rectangular fields; that the system would not be workable except under a custom of long leases of farms, which would induce the farmers to invest the requisite capital; that the curves, and twists, and corners of a field would always be a source of perplexity to the farmers under this system; that the profits could not be so large as had been stated; that, even if large, there must first be a very heavy expenditure of capital, from which most farmers would shrink; that fields would require a good deal of levelling to bring out all the excellences of the system; and that the rails *would spoil the fields for fox-hunting!* On the other hand, it was contended that Mr. Halkett's system contained the germ of that which may greatly advance the science and art of agriculture in a future day. The commercial difficulty in reference to the heaviness of the first cost was generally regarded as being more serious than any mechanical difficulties, which it was believed might easily be overcome. A further notice of various methods adapted to cultivate the land by steam will be found in the article ARABLE LAND.

Whatever may be the relative merits of different modes of applying steam-power to agricultural purposes, it is evident that this modern invention is, in conjunction with other improvements, working a great revolution in farming operations. Mr. Pusey, in reporting on this subject, as Chairman of the Exhibition Jury, in 1851, made the following estimate:—That by using lighter ploughs, cultivators that lessen the necessity for ploughing, drills that economise both seed and moving-power, horse-hoes instead of hand-hoes, varied manures instead of manures of a few kinds, reaping-machines instead of sickles, well-constructed carts instead of clumsy wagons, fixed and portable steam-engines, steam threshing- and winnowing-machines, turnip- and chaff-cutters, drain-tile machines, and draining-ploughs, *there had been effected in twelve years a saving of one-half the former outlay in cultivating a definite amount of crop.* It had been rendered further demonstrable that machinery had given comparative *certainty* to agriculture, by enabling many of the operations, in doubtful or unfavourable weather, to be done with quickness, which could hardly have been done at all by the hand method. Mr. Evelyn Denison (now, in 1859, Speaker of the House of Commons) prepared a Report on the Agricultural Implements displayed at the Paris Exposition de l'Industrie in 1855, in which he endeavoured to estimate the material saving accruing from the use of machinery in agriculture. Mr. Sidney, at the close of 1857, gave a few figures intended to bring down the estimate to that year. In this last-named estimate, it was supposed that within six years—that is, since Mr. Pusey prepared the Great Exhibition report—the landowners of the United Kingdom had expended ten millions sterling in draining two million acres of land, on principles and with tools not known until 1845. Then, besides all the saving on the items already enumerated, there is that precious, though not easily-calculated advantage resulting from the economy of *time*, by employing machinery at full force during short intervals of fine weather.

AGRICULTURAL STATISTICS can scarcely be said to exist as yet in England. Notwithstanding the acknowledged importance of exact information as to the amount of our agricultural production and consumption, especially to farmers, and the interest that is taken in the subject, as shown by the attention to the Mark Lane reports, which are little better than ingenious guesses, no steps have yet been taken to insure a correct estimate of the expected amount of the incoming crops, and the state of live stock. Such estimates as are made are derived from individual instances, than which nothing can be more fallacious. The great differences in cost, cultivation, and even of climate in England, make the application of the doctrine of *averages* almost more indispensable in agriculture than in any other trade. It is by the accumulation of individual parts that we arrive at something like a *law*. A law prevails in agriculture as in everything else, and the more any subject has the appearance of chance, the more necessary it is that the experiences should be registered, in order to arrive at the law expressed by an average. The inconvenience and loss occasioned by the absence of statistical returns has been often felt. After the harvest of 1846, the average price of corn for six weeks, from the middle of August to the end of September, was 48*s*. 2*d*., the lowest price being 45*s*. 1*d*. In October, the price improved; but in November it again fell to 50*s*. But as soon as the new year had begun, symptoms of scarcity manifested themselves, and the wheat of that same harvest, notwithstanding the importation of four millions and a half of quarters, reached the price of 102*s*. 5*d*. per quarter. In this case, a knowledge of the produce of the harvest would have saved the farmer from the sacrifice of his property at the beginning; it would have saved the country from a great loss in the price of the foreign corn imported, occasioned by a sudden rush into the market for large supplies; it would have probably saved considerable waste of food during the period when it was improperly cheap; it would have saved inconvenience to the foreigners in whose markets our purchases inevitably increased the price of wheat; and the gains of the merely speculating corn-dealers would have been saved to the community.

The desirableness of some knowledge on so important a subject has led many individuals to form, from the best available sources, general estimates, but the discrepancies show the unreliability of such estimates for any practical purpose. Some endeavoured to arrive at it by taking the acreage of the kingdom, the proportion supposed to be cultivated, and the probable amount of produce per acre. Gregory King, who wrote in 1685, was among the earliest. He estimated England and Wales to contain 39,000,000 acres, of which he supposed half to be uncultivated. Davenant, Grew, Templeman, Sir William Petty, Arthur Young, Dr. Beeke, Mr. M'Culloch, Mr. Porter, and others, formed estimates varying from 31,648,000 acres, to 46,916,000 acres, which was the estimate of Arthur Young, and was adopted by Mr. Pitt in his calculations for the probable amount of the Income Tax. In the census of 1851, the area is stated at 37,324,915 acres, which was very near the estimate of Dr. Beeke, who gave it as 38,498,572. Others, again, have endeavoured to ascertain the consumption by multiplying that of each individual by the number of the population, but here they differ materially, varying from 6 bushels to 8 bushels for each individual, an unsatisfactory difference of one third. We will now enumerate what measures have been taken in providing statistics by the government.

What are called the *corn averages*, are entries or tables originally intended to regulate the duty on corn; but if modified and improved, they might be made an auxiliary to agricultural statistics. For a century previous to the year 1851, such returns were collected from the principal seaports of twelve maritime counties—entirely in relation to the imposition of duty on foreign corn; the collector of the returns was appointed by the magistrates of the town or borough in which the return was made, but his salary was paid by the government. In 1821 a change was made. The averages were ordered to be collected from 120 large market-towns in England and Wales. Every corn-merchant, miller, baker, and maltster, was ordered to make weekly returns to the inspector. The inspector provided a place for the reception of these returns; he posted up in some convenient locality the gross weekly returns, with the average price of each description of grain sold in the preceding seven days. These averages were then forwarded to the Comptroller of Corn Returns, in London, who added up all the gross amounts from all the inspectors, and struck a six-weeks' average for the whole kingdom—which average regulated the duties on the admission of foreign corn for home consumption. When the 'sliding-scale' came into operation, there were several instances of the averages being tampered with, in London and some of the outports, by false returns; this was done by fraudulent persons, with a view of lowering the rates of duties by fictitious sales of large quantities of corn; thus swelling the quantity returned, raising the prices, and lowering the duty. In 1842 a motive of economy, whether wise or not, led to the appointment of excisemen, without any increase of salary, in place of inspectors, as the latter might die off, for taking the corn averages; and the returns are believed to have suffered in accuracy from this change. When the corn laws were repealed, further changes were made; the corn averages ceased to be as valuable as before in respect to fiscal regulations; but they remained important in connection with the commutation of tithes; and it is now considered that they might render useful aid to agricultural statists. The list of towns whence the returns are made has been largely increased; in all the towns thus added, excisemen have been appointed instead of inspectors.

These returns, it is evident, showed nothing beyond the average prices. In 1832 the attention of the government was directed to the attainment of more satisfactory results. In the previous year, a statistical inquiry had been made by a committee of the magistracy of Norfolk, respecting the acreage and crops of that county. The committee addressed circulars to 680 parishes; but 254 of these declined to answer the questions submitted to them, and the committee had no other resource than to infer from the 426 affirmative to the 254 negatives. Still, though imperfect, the result was useful as a beginning; and in 1832, when the Statistical Department of the Board of Trade was established, Lord Auckland saw the importance and necessity of obtaining correct agricultural statistics. Nothing was effected, however, until 1836, when the Board of Trade resolved to make a small experiment of its own. Circulars were sent to the clergymen of 126 parishes in Bedfordshire, enclosing schedules of the returns required, and asking for co-operation. This experiment was a most signal failure; for out of 126 parishes applied to, only 27 returned any answer. It was a time when the clergy and the high tory party distrusted the suspected radicalism of most new government projects, and it was on that account an unfortunate period in which to make the attempt. Eight years passed over; when, in 1844, Mr. Gladstone, at that time President of the Board of Trade, stated in the House of Commons that the subject was under his consideration. The Board of Trade, the Home Office, and the Poor Law Board, next had a long correspondence in reference to the question, whether the last named of these three might undertake the management of a system of national agricultural statistics; and it appears to have been decided that, as constituted at the time, the Poor Law Board could not adequately fulfil this duty. In 1845 the Board of Trade resolved to make another attempt, or rather three small attempts in the three kingdoms—North Hants in England, Mid-Lothian in Scotland, and Bailieborough Union in Ireland. The Irish inquiry was made by a private individual, and was satisfactory; the Scotch inquiry was managed by the schoolmasters of the respective parishes, and was equally successful; but the English inquiry was an utter and disheartening failure. The Board of Trade, in this last-mentioned case, addressed communications to the Board of Guardians of the different Unions; while the Poor Law Commissioners backed the application, by requesting the Board to employ their own paid officers to induce the occupiers of land to fill up the schedules that were sent to them. The result was almost *nil*; scarcely any returns were obtained; and a strong impression was left that nothing less than compulsory powers would be available for obtaining the desired statistics.

The next attempt was made in 1847, when Mr. Milner Gibson, Vice-President of the Board of Trade, brought into Parliament a 'Bill to make Provision for the Collection of Agricultural Statistics in England and Wales.' By the provisions of that Bill, the duty of obtaining the statistical information was to devolve upon the Registrar-General of Births, Deaths, and Marriages; the superintendent registrars throughout the kingdom were to be charged with the appointment of "agricultural enumerators" in their respective districts; the enumerators were to prepare lists of all the occupiers of land exceeding three acres, to send specified blank forms to those occupiers, and to collect those blank forms after an interval of fourteen days filled up with the several entries of particulars. This being done, the enumerators were to classify the returns, and construct general tables from them. These tables were to be transmitted to the superintendent registrars, by them to the Registrar-General, and by him to the Board of Trade. These returns and tables were to apply to the month of June in each year. The Bill was read a first time; but as the public had not yet learned to feel much interest in the subject, and as various party questions were then on the *tapis*, the Bill shared the fate of many others, and fell to the ground.

In 1854, an attempt was made to obtain complete statistical details through the machinery of the Poor Law Board. The selection was unfortunate, for the impression was instantly received that the returns would lead to additional assessment, and no explanation availed to remove that belief. In addition it was generally feared that such returns would be used against the farmers by their landlords in order to raise their rents, they, in very few cases, holding their farms upon lease. The West Riding of Yorkshire was the only division from which a complete return was procured. In all the other counties the returns were so incomplete as to be useless. Many Unions refused altogether, alleging that their officers had sufficient other duties to perform, and in some Unions up to a proportion of one half, where the guardians had consented, many parishes made no returns. In 1855, a Committee of the House of Lords was appointed on the subject, before which numerous witnesses were examined, and among them most of the Poor Law Inspectors. Notwithstanding their ill-success, and the many admissions they were compelled to make of the continued opposition that would be offered to the investigation of a farmer's affairs by Poor Law officials, the most of them represented that all that was required was a compulsory Act; and accordingly the Lords' Committee embodied a series of resolutions in their report, recommending the government to introduce a Bill into parliament for two returns a year, in July and November, to be carried out by the same machinery. The government however have not yet adopted the recommendation.

Under these disadvantages we will endeavour to give a few of such statistics relating to agriculture as rest upon sure bases. It is quite certain that a rapidly increasing population must have been fed, and that the means of feeding them can only arise from land not previously cultivated, from importation, or from improved cultivation. The following figures will give some notion of what has been effected in each division; unfortunately however, though the inclosures and population apply only to England and Wales, there is no separating the application of the imported wheat from that consumed in Scotland. The amount is no doubt very small, for wheaten bread was not generally used in that part of the kingdom in the early periods recorded; and from the vast improvement in cultivation during the latter portions of them, there is probably more than sufficient corn produced in Scotland to supply the population.

	Acres inclosed.	Qrs. imp.	Increase of Pop.
1800 to 1810	1,657,980	6,009,458	2,173,589
1810 to 1820	1,400,930	4,585,780	945,588
1820 to 1830	340,380	5,349,927	1,110,793
1830 to 1840	236,070	9,076,379	2,032,525
1840 to 1850	369,127	23,298,353	2,048,573

The increase of population is taken from between each of the decennial censuses commencing with 1801. The inclosures of course must necessarily decrease, and the best lands will have probably been among the earliest inclosed. Since 1846 the inclosures of commons have been conducted by commissioners, and are passed in Acts in groups, in which the acreage is only occasionally stated. The amount on the whole since 1850 does not average more than a few thousand annually, while the population has increased in about the same proportion as in the previous decennaries. The result is that somewhat above four million of acres have been acquired for the support of upwards of eight millions and a-half of additional mouths. In 1851 there were imported 3,833,636 qrs. of foreign wheat, and 5,363,478 cwt. of wheat flour; in 1852, 3,068,892 qrs. of wheat and 3,889,583 cwt. of flour; in 1853, 4,949,314 qrs. of wheat and 4,646,400 cwt. of flour; in 1854, 3,431,227 qrs. of wheat and 3,646,505 cwt. of flour; in 1855, 2,667,702 qrs. of wheat, and 1,904,224 cwt. of flour; and in 1856, 4,072,833 qrs. of wheat, and 3,970,100 cwt. of flour. During the whole of this period the price of wheat has on the whole decreased. During the long war with France, from 1800 to 1815 inclusive, the average price per quarter was 84*s.* 9*d.*; from 1816 to 1820, it was 78*s.* 4*d.*; from 1821 to 1830, it was 58*s.* 3*d.*; from 1831 to 1840, it was 57*s.*; from 1841 to 1850, it was 56*s.*; in 1851, it was 38*s.* 6*d.*; in 1852, 40*s.* 5*d.*; in 1853, 52*s.* 11*d.*; in 1854, 73*s.*; in 1855, 74*s.* 9*d.*; in 1856, 69*s.*; and in 1857, the highest point reached was 63*s.* in July, and the lowest in December 45*s.* 3*d.* In 1858, the price varied only between 49*s.* and 43*s.* during the year.

All the statistical returns obtained by government have a fiscal basis. The only real agricultural statistics we possess are those for hops, of which we know every cultivated acre and every pound of produce; and barley, of every bushel of as much as is made into malt. These we owe to the duty; but when, as in the case of live stock, the duty is discontinued, no account is taken by it even of importations, though the Board of Trade in their monthly returns give the number imported as obtained from other sources. The following is the return so given for the month ending November 30th, 1857, and for the whole of the year 1857.

		Month.	Year.
Oxen and bulls, and cows	number	9892	65,648
Calves	,,	2738	27,315
Sheep and lambs	,,	25,270	177,207
Swine and hogs	,,	1459	10,677
Bark	cwts.	28,686	381,243
Wheat	qrs.	456,804	3,437,957
Barley	,,	100,597	1,701,470
Oats	,,	197,296	1,710,299
Peas	,,	14,831	159,899
Beans	,,	36,368	305,775

		Month.	Year.
Indian corn or maize	qrs.	152,770	1,150,783
Wheatmeal or flour	cwts.	267,160	2,178,148
Indian corn meal	,,	58	1092
Hemp, jute, &c.	,,	108,779	1,439,622
Guano	tons	43,289	288,362
Oilseed cakes	,,	10,283	99.265
Potatoes	cwts.	215,386	955,057
Hops	,,	1857	18,712
Bacon and hams	,,	5331	366,934
Beef, salt	,,	5561	150,940
Pork, salt	,,	4433	88,732
Eggs	number	6,645,000	127,039,600
Butter	cwts.	31,189	442,837
Cheese	,,	33,882	394,749
Lard	,,	54	182,860
Clover seed	,,	8823	171,585
Flax seed and linseed	qrs.	164,734	1,051,113
Rape seed	,,	21,363	220,495
Timber of various sorts from British possessions and Foreign	loads	282,184	2,616,088
Wool, from British possessions and Foreign	lbs.	11,680,071	127,390,885

These returns apply however to the whole of the United Kingdom. The remainder of the estimates for England rest only upon probabilities. Thus, in the Journal of the Royal Society of Agriculture for 1856, the number of sheep in England and Wales is estimated at 27,000,000, worth upon an average 30*s.* per head. About 10,000,000 are annually slaughtered for food, producing 800,000,000 of lbs. of mutton, which, at 6*d.* per lb., amounts to 20,000,000*l.*; and calculating the weight of each fleece at 4½ lbs., 121,500,000 lbs. of wool is obtained, worth at 1*s.* 3*d.* per lb. nearly 8,000,000*l.* The number of cattle has been estimated at 5,620,000, and that of swine at about 5,000,000. The number of horses is given by Mr. M'Culloch in 1847, and they have probably not greatly increased since, as 1,500,000, the value of which he estimates at from 18,000,000*l.* to 22,500,000*l.* Such statements bear upon their faces evident marks of uncertainty, while the trouble any individual must have taken to procure materials even for a guess, shows the call there has been for this species of information.

In Scotland, where leases are, and have long been, almost universal, and where a less objectionable machinery was employed, statistical returns were much more easily obtained. Tenants there had indeed been long accustomed to the term, which some have asserted had no little influence in affrighting the farmers of England. In 1800, Sir John Sinclair had, with the assistance of the parochial ministers and others, produced a 'Statistical Account of Scotland,' giving in detail the state of every parish. This had been re-produced between 1834 and 1845, in so complete though bulky a form, and the agricultural improvements had been so great, as to justify the committee of ministers who had carried it through, in saying, "They now present not merely a new statistical account, but in a great measure the statistical account of a new country." In 1847 the members of the Highland and Agricultural Society of Scotland, by whom agricultural improvement has been greatly promoted, felt the need of statistics, and by means of their secretary, Mr. Maxwell Hall, set about obtaining them. They memorialised Sir George Grey on the subject, and were desired to communicate a scheme, which was done, but without result. In 1852 they again memorialised the Home Department, offering their assistance if any project were legalised, but again without anything being effected. In 1853 the government allowed the sum of 5000*l.* to make the experiment, and Mr. Maxwell Hall determined to endeavour to obtain the returns, though without any legal support. Complete returns were obtained for three counties, Haddington, Roxburgh, and Sutherland. In 1854 he travelled through a great part of Scotland requesting the assistance of farmers; he succeeded in removing their objections, and convincing them of the advantages; and by means of local branches of the parent institution succeeded in procuring complete returns for the kingdom. These have been continued annually up to 1857, since which, owing to an unfortunate misunderstanding, they have been discontinued. Though there have been a few omissions they are the most complete in their details of any yet known. Though the absence of similar returns of England deprives them of much of their value, they are still, conjoined with those of Ireland, of great importance. We give an abstract of the returns for 1856 and 1857. We may premise that the returns are from holders paying a yearly rent of 10*l.* and upwards (exclusive of tenants of woods, villas, feuars, householders and the like) in all the counties of Scotland except Argyle, Inverness, Ross and Cromarty, Sutherland, and that part of Bute which lies in Arran, in both years, and in Caithness, Sutherland, and Orkney, in 1856, where the returns are only from holders paying a rent of 20*l.* and upwards. Woods, sheep-walks, houses, roads, and waste, are omitted in the calculation.

In 1856 the number of occupants was 42,919; in 1857 there were 43,432. The number of acres under rotation of crop was 3,545,191 in 1856; of which, of wheat there were 263,328, of barley 165,738, of oats 918,644, of rye 4020, of bere 15,368, of beans 40,470, of peas 4817, of vetches 18,231, of turnips 460,131, of potatoes 149,351, of mangold 3531, of carrots 1532, of cabbages 1485, of rape 1407, of flax 2723, of turnip seed 1759, other crops 795, bare fallow 14,464, and grass and hay in rotation 1,475,775, which leaves 1602 of the stated total unaccounted for. The produce was 7,270,952 bushels of wheat, 5,581,970 of barley, 31,966,381 of oats, 6,540,267 tons of turnips, and 413,800 tons of potatoes. In 1857 the number of acres under crop was 3,556,572, of which there were of wheat 223,152, of barley 198,387, of oats 938,613, of rye 5989, of bere 21,607, of beans 39,186, of peas 3687, of vetches 18,418, of turnips 476,691, of potatoes 139,819, of mangold 2803, of carrots 1401, of cabbages 1704, of rape 2032, of flax 1534, of turnip seed 2576, of other crops 577, of bare fallow 18,582, and of grass and hay in rotation 1,459,805, an excess of 989 acres over the stated total. The produce was 6,154,986 bushels of wheat, 6,494,534 of barley, 32,750,763 of oats, 6,690,109 tons of turnips, and 430,468 tons of potatoes. In 1856 the total number of horses was 179,853, of milch cows 209,960, of other cattle 473,384, of calves 197,709, of sheep and lambs 5,816,560, of swine 128,924. In 1857 the numbers were, of horses 185,409, of milch cows 303,912, of calves 195,198, of sheep and lambs 5,683,168, and of swine 140,354. In this account the horses, cows, and swine kept in towns are not included; and it is estimated that above 300,000 head of stock, and upwards of 200,000 acres of tillage are held by occupants not in these returns. Fife and Haddington show the greatest proportional acreage in wheat and in white crops generally, and Aberdeen and Argyle the greatest in turnips; those counties also possessing the greatest number of live stock.

In Ireland, where the interest felt might have been supposed to be less, statistical returns have been obtained in an excellent form, and with no opposition. The task of gathering the returns was confided to the constabulary in 1852, and they have been continued annually since. We append the return of 1857:—In that year the returns show that there were 5,860,089 acres under crop, being an increase of 106,542 acres over the quantity in 1856. Of these 562,581 acres were in wheat, 1,978,878 in oats, 246,257 in barley, beans, peas, &c., showing a small increase of cereal crops generally, but a decrease on oats of 58,559 acres. On green crops there was a general increase of 45,637 acres, potatoes occupying 1,146,920 acres, an increase of 42,216 acres, and flax had decreased from 106,311 acres in 1856 to 98,074 acres in 1857; and turnips had decreased 4,487 acres. Meadow and clover had increased from 1,302,787 acres to 1,369,421 acres.

The produce of the 5,753,681 acres in cultivation in 1856 had been 2,738,163 barrels of wheat of 20 stone each; 14,778,045 barrels of oats of 14 stone each; 1,367,453 barrels of barley of 16 stone each; 50,709 barrels of bere of 16 stone; 72,165 barrels of rye of 20 stone; 431,561 bushels of beans and peas; 35,268,345 barrels of potatoes of 20 stone each; 4,581,172 tons of turnips; 287,838 tons of mangold wurzel; 332,650 tons of cabbages; 3,006,553 stones (of 14 lbs.) of flax; and 2,492,732 tons of hay. The total number of holders of land was 592,489; of whom 36,474 held not more than 1 acre; 82,035 not more than 5 acres; 179,931 not more than 15 acres; 138,424 not more than 30; 71,156 not more than 50; 53,279 not more than 100; 21,292 not more than 200; 8243 not more than 500; and only 1655 held upwards of 500 acres.

Live stock, except sheep, had increased remarkably. The number of horses was 600,693, an increase of 27,285; the number of cattle 3,618,544, an increase of 30,686; the number of sheep 3,448,676, a decrease of 245,618. Pigs numbered 1,252,152, an increase of 333,627.

Road contractors in Ulster are required to keep the roadsides and fences free from weeds, and surveyors in the other provinces are recommended to obtain authority from grand juries, &c., to enforce in them similar regulations.

Most foreign countries have found the necessity of having statistical returns of their agricultural produce. Austria, Prussia, France, Denmark, Hungary, Belgium, and the United States of America, have all such returns more or less perfect, among which those of Belgium take a high rank, and are nearly equal to those of Scotland. In France these duties devolve upon a department of the minister of commerce and agriculture. The management of the royal flocks, veterinary schools, and the royal studs; the distribution of premiums in agriculture; the organisation and presidency of the superior and special councils of agriculture, are comprised in the duties of this ministerial department. The councils-general of agriculture, &c. in each department of France collect the agricultural statistics from each commune; and the quantity of land sown with each description of grain, the produce, and the quantity of live stock for the whole of the kingdom, are accurately known and published by the minister of commerce and agriculture. In Belgium these facts are ascertained periodically, but not every year. In the United States of North America, at the decennial census, an attempt is made to ascertain the number of each description of live stock, including poultry; the produce of cereal grains, and of various crops; the quantity of dairy, orchard, and garden produce, &c., in each State. There are twenty-nine heads of this branch of inquiry. The only countries in Europe which do not possess statistical accounts of their agriculture founded on official documents are England and the Netherlands. On the same principle that a census of the population of a country is useful, it must be useful to have an account of its productive resources. The absence of official information is supplied by estimates of a conjectural character, founded at best only on local and partial observation. In France it was positively ascertained that the average produce of wheat for the whole kingdom is under

14 bushels per acre. In England it is known that a large crop of wheat is about 40 bushels per acre, and that a small one is about 20 bushels. The usual conjecture is, that the average produce of the kingdom in years of fair crops is about 28 bushels, but the total superficies sown with wheat or any other grain, and the total quantity of the produce, are matters simply of conjecture. Such statistics for the whole of a kingdom are highly valuable for the guidance of the inhabitants of that kingdom; but if we possessed them for the whole of the civilised world, what are called the chances of agriculture would probably be reduced to a certainty, and the price of food would remain with little or no variation. It may be added that the most trustworthy groundwork of conjecture on this subject is furnished by the Government inquiry in 1854, to which allusion has already been made; and which, though confined to eleven counties, namely, Hampshire, Wiltshire, Leicestershire, Norfolk, Suffolk, Berkshire, Worcestershire, Brecknock, Salop, Denbigh, and Yorkshire (East Riding), was yet sufficiently wide and sufficiently representative of the whole country to justify an estimate upon them of the total acreage of England and Wales. The following are the totals thus estimated. Total statute acres, 37,324,915, namely, wheat, 3,807,846; barley, 2,667,776; oats, 1,302,782; rye, 73,731; beans and peas, 698,188; vetches, 218,551; turnips, 2,267,200; mangold wurzel, 177,263; carrots, 12,638; potatoes, 192,287; flax, 10,156; hops, 18,976; osiers, 1,079; other crops, such as cabbages, &c., 97,334; barefallow, 895,969; clover, lucerne, &c., 2,820,066. The total under cultivation thus appears to be 15,261,842 acres. Under grass we have as follows,—permanent pastures, 8,874,946 acres; irrigated meadows, 1,292,329; sheepwalks and downs, 2,224,862; or in all, 12,392,137 acres. In addition to this there are 976,197 acres in gardens, roads, fences, houses, &c.; 786,658 acres in waste attached to farms; 1,697,362 acres in woods and plantations; 459,447 acres in commons belonging to parishes; 459,447 acres in holdings of less than 2 acres each; and 3,814,108 acres unaccounted for; making in all the beforesaid total of 37,324,915 acres.

Whenever the eleven counties are not in the aggregate truly representative, on the average, of the whole country, then it is plain that these figures must fail even of that imperfect accuracy which the partial returns for these eleven counties possess; and it is plain that in some of the particulars above specified no great confidence can be placed. The irrigated meadow land of England is, for instance, not nearly one-seventh or one-eighth of the ordinary permanent pasture as it is above represented to be.

The live stock of the country, estimated in the same way, is enumerated as follows:—horses, 1,050,931; colts, 258,079; milch cows, 1,376,703; calves, 707,192; other cattle, including working oxen, 1,339,270; rams, 244,106; ewes, 7,299,915; lambs, 6,987,982; other sheep, 4,159,085; swine, 2,363,724.

The total number of schedules issued in the eleven counties for the purpose of the inquiry was 118,287, and this represents the number of occupying tenant farmers in those counties. This number extended proportionately over the whole country would be 570,137.

These figures are given as the only approximation which we have to the agricultural statistics of England and Wales; though how far they must be from strict accuracy is sufficiently obvious. The inquiry in England did not extend, as it has done in Scotland and Ireland, to the produce of the country, but merely to the average of the crop, and the numbers of the live stock.

AGRICULTURE. Under various alphabetical heads will be found the theory and practice of husbandry. Any general observations are reserved for RURAL ECONOMY.

AGUE. Intermittent paludal fever is a disease belonging to the febrile group. Fevers are divided into three great classes. In the first the morbid phenomena that constitute the disease continue for a certain length of time; then they wholly disappear: after having been some time absent, they again recur, and this cessation and return of the phenomena alternate with one another for many times. The period that elapses between the cessation of the febrile phenomena and their recurrence, is called an intermission. Such fevers, then, as are attended with a cessation or intermission of the febrile symptoms for an observable space of time, are for this reason called *intermittent fevers* or *agues.* This is the first class. In the second class the febrile symptoms do not altogether disappear, but merely diminish in violence; they do not *intermit*, they only *remit;* for this reason this second class of fevers are called *remittent fevers.* In the third class, during the whole course of the disease, there is not only no retrocession of the symptoms, but no notable diminution of their violence. Such as the phenomena are when the fever is completely formed, such they continue to be with scarcely any variation until its close. For this reason this class of fevers is denominated *continued fevers.* [FEVER.]

The concourse and succession of phenomena which constitute a fever is called a paroxysm. An intermittent fever, or an ague, is therefore a fever consisting of a succession of paroxysms between each of which there is an intermission more or less complete.

The phenomena which constitute a paroxysm of fever are the following: The person is affected first with a loss of mental vigour, commonly indicated by inaptitude to attend to his usual avocations, or by dulness or confusion of mind. If not simultaneously with, very shortly after this mental debility there comes on a sense of physical weakness. The patient is languid, listless, disinclined to move, while every movement is performed with difficulty, and the effort to move is exhausting. The muscles or organs of motion are not merely weak—they are, at the same time, the seat of several uneasy sensations; the muscles of the extremities, and of the back especially, are affected with the sensation of soreness, as if they had been over-exercised, and this soon increases to decided pain, which is often very severe.

The next train of symptoms is ushered in by pallidness of the face and extremities: the features shrink; the bulk of the external parts is diminished; and the skin over the whole body is in a morbid state, as if drawn tight. Some degree of coldness is now felt, which at first is so slight as scarcely to be noticed, but at length the patient is fully conscious of a sensation of cold, which he commonly feels first in his back, but which thence extends over the whole body. This sensation of coldness increases until it becomes so severe as to produce a tremor in the limbs, amounting sometimes to trembling and shaking, and almost always producing distinct shivering.

From the first approach of the mental and physical languor, the pulse becomes weaker than in health. As the sense of cold comes on the weakness of the pulse is still greater, and it is at the same time always more frequent than natural; often irregular, and sometimes intermittent. The respiration also is shorter, feebler, and more frequent than in a state of health. The appetite fails; there is sometimes even an aversion to food; frequently the loss of appetite is succeeded by a sense of nausea and sickness, which occasionally increases to vomiting, and with the matter vomited there is, for the most part, a mixture of bile. From the commencement of the paroxysm there is generally some degree of thirst, which increases in urgency as the sensation of cold advances, being always proportioned to, and probably arising from, the dryness and clamminess of the mouth and fauces. Not the secretions of the mouth alone, but all the secretions of the system are diminished. The excretions also are lessened in quantity, and especially the urine, which is scanty and nearly colourless, and the alvine evacuations are usually altogether suppressed. Even in this stage, headache may come on, but it usually does *not* appear until the following.

The symptoms having continued for some time, at length disappear, and a remarkable change takes place in the character of those that succeed. The sensation of cold gives place to that of heat, and a temperature far greater than that of health prevails over the whole body. The face which had been pallid, now becomes flushed and red. The eyes which had been dull and heavy, are now more bright and glistening than natural. The features of the face and the other parts of the body recover their usual size, and become even more turgid. The pulse becomes more regular, strong, and full, the respiration fuller and more free, and the nausea and vomiting are less urgent: if before there were pain in the head, it now increases in severity; if there were none, it is now sure to come on, and while the sensibility is increased, the intellectual operations are more and more disordered.

By degrees these symptoms also pass away, and are succeeded by a different train. A moisture now breaks out first on the forehead, which by degrees extends over the whole body. As the perspiration flows, the heat abates; the pulse becomes slower and softer; the respiration more free; the nausea and vomiting cease; the thirst diminishes; the secretions and excretions are restored; most of the functions return to their ordinary state, and the patient is left comparatively free from disease, feeling only weak and exhausted.

Such are the phenomena that constitute a febrile paroxysm, and such is the order of their succession, and they obviously constitute three distinct states, or, as they are called, stages or fits; namely, the cold, the hot, and the sweating stage.

After one such paroxysm has remained for a certain length of time, it ceases; after it has ceased for a certain length of time, the same series of phenomena again arises, and observes the same course as before; and this alternation is repeated many times. It has been already stated that the length of time from the end of one paroxysm to the beginning of another is called an intermission, while the length of time from the beginning of one paroxysm to the beginning of the next is termed an interval.

Different names are given to the different varieties of this fever according to the length of the *interval.* If one paroxysm be succeeded by another within the space of twenty-four hours, the ague is termed a quotidian; if after forty-eight hours, a tertian; if after seventy-two hours, a quartan; if after ninety-six hours, a quintan. Those with longer intervals are usually termed erratic. The most common form in this country is a tertian; the next most common, a quartan; the next, a quotidian; the least frequent, a quintan. During the Peninsular war the quotidian was the prevailing type amongst our soldiers. M. Maillot also found that amongst the French troops in the North of Africa, the quotidian was the prevailing type.

Agues are divided into vernal and autumnal; the vernal beginning in February, and the autumnal in August. There is a great difference in their character. The vernal in general are milder and easily cured, while the autumnal are often severe and obstinate.

It sometimes happens that two intermittents attack the same person at the same time, and the ague is then said to be complicated. The most common complication is the case in which two tertians or two quartans attack simultaneously. What is called the double tertian, for example, consists of two tertians, each of which attacks at its regular time, and consequently the paroxysm occurs every day. This form of ague is distinguished from the quotidian, by comparing the paroxysms with each other. Though a paroxysm occur every day, yet if they be carefully observed it will be found that the alternate paroxysms only resemble each other, while if the paroxysm of a preceding day be compared with that of a succeeding day, some manifest difference will be observable. There may also be another form of the double tertian; namely, with two paroxysms on one day, and another on the following day; or there may be a triple tertian, with two paroxysms on each alternate day, and one only in the intervals. The double quartan also varies. It may occur with two paroxysms on the first day, none on the second or third, two again on the fourth day, or with a paroxysm on the first day, another on the second, but none on the third.

But whatever be the form of fever, the nature of it is essentially the same: yet the form is of some consequence, as denoting the severity and tendency of the disease; for a quartan is far more obstinate than a tertian, while a quotidian is apt to change into a continued fever. Quartans, for the most part, appear in autumn, while tertians are the most common in spring.

Whatever be the form of fever, the duration of the paroxysm is different in almost every different case. The longer the paroxysm, the shorter the intermission; the shorter the intermission, the longer the paroxysm. An extension of the period of the intermission, or a postponement of the period of attack, is in general a favourable event, denoting that the disease is declining; on the contrary, a prolongation of the paroxysm, or an anticipation of the period of attack, marks an increase in the severity of the disease, and is a sign that the intermittent is about to lapse into a remittent or into a continued fever.

From the preceding history of the disease it is clear, that the distinguishing character of intermittent fever is the regular return of the paroxysm at a fixed period, the entire cessation of it after a certain time, and the renewal of it after a specific interval, according to the species of the ague. Nevertheless, though these distinct intermissions and accessions are always apparent when the ague is regular, yet in the most severe and formidable cases it entirely loses its intermittent character and assumes a remittent, or even a continued form.

Cases which are frequently considered and treated as continued fevers, are often of the nature of intermittents. If a fever, truly of an intermittent nature, be of a bad kind, it often commences with the form of an alarming and dangerous continued fever; but as the disease declines and becomes milder, the intermission becomes apparent, and the true nature of the malady manifest; while, if an intermittent commences under its own form, but in its progress becomes severe, it often changes into a disease which cannot be distinguished from a continued fever.

There is nothing in the nature of disease more curious and inexplicable than this property of periodicity. During the intermission what becomes of the malady? Why after a specific interval does it uniformly recur? Physicians have endeavoured to refer this singular phenomenon, which, if it were not so clearly seen would not be credible, to the principle of habit; but this really affords no explanation, and in fact we have not advanced a single step towards the elucidation of these questions beyond the point at which Sydenham left them 200 years ago.

Exciting Cause of Ague.—That the effluvia which arise from stagnant water or marshy ground, are the immediate or the exciting cause of this disease, is now universally admitted. What the nature of these effluvia is, is not known. Neither their physical nor their chemical properties have been ascertained. Even their presence is known only by their effects on the human constitution. No other test of their existence has as yet been ascertained. The most distinguished chemists have applied all the resources of their art to the investigation of this subject, but hitherto with so little success, that all which they have ascertained is the mere fact, that in certain situations an aëriform substance is generated capable of producing intermittent, remittent, and continued fever, together with several other painful and dangerous diseases.

Though this poison be generated in the greatest abundance and intensity in marshy and swampy ground, yet without doubt it is also produced in situations which have none of the characters of a marsh. Wherever the ground is moist and contains decaying vegetable matter, this poison is capable of being generated. Woods afford it in almost as large a quantity as marshes, because in woods the ground remains a long time damp, and always abounds with decaying vegetable matter. Hence in all the densely wooded parts of England both intermittent and remittent fevers are rife. This is especially the case in the woody districts of Kent, Sussex, Hampshire, Wales, &c. The jungle of India consists of a low and dense brushwood, or a thicket of reeds and grass; and intense heat acting on the wet and decaying vegetation with which it abounds, the poison is here produced in the highest degree of concentration. Rice grounds, for the same reason, are notoriously productive of it. But it is curious that the clearing of woods sometimes increases the evil. Dr. Rush states that, in Pennsylvania, epidemics invariably follow the clearing and cultivation of forest lands, and that they do not disappear until after many years of continued cultivation. The same remark has been made in France; and the district of Bresse (Lyonnais), which was comparatively healthy when full of woods, has become nearly depopulated since they were cut down. The shade of the trees keeps the sun to a great extent from the wet ground; but the removal of the trees exposes the wet ground to the full action of the sun. Meadow land, imperfectly drained, contains in abundance the two conditions, moisture and decaying vegetable matter, and is in England a frequent and extended source of this poison. It is commonly considered that a large space of land in the condition of a marsh, a swamp, a thick and damp wood, or an undrained meadow, is necessary to the production of the poison; but while it is not easy to fix the minimum of the space that is requisite, it is quite certain that an exceedingly small space is sufficient. These facts show, in a striking manner, the danger and folly of creating artificial marshes as ornaments in parks and gardens.

Wherever generated, this poison, either mechanically mixed or chemically combined in the air, is capable of being conveyed in unimpaired power to a considerable distance by currents of wind. The influence of the Pontine marshes, situated at the distance of fourteen miles from Rome, is often felt in that city.

In warm climates where this poison is generated in the highest degree of intensity, it sometimes proves suddenly fatal to individuals of a ship's crew when the vessel is several miles from land. It is brought with the land-wind. It seems certain that the poison can be carried as far as the smell of the land is perceptible. A memorable instance of this occurred in a vessel that was five miles from shore. The wind suddenly shifted; the smell of land was perceptible; the nature of the neighbouring coast was known to the people on board, and the danger duly appreciated; every one that could do so hastened below to save himself from the noxious breeze. Some of the crew however were unavoidably employed on deck; the armourer of the ship was detained a few minutes in order to clear an obstruction in the chain cable, and was seized with fatal cholera in the very act in which he was engaged. Of the men that remained on deck, several died of the same disease in a few hours,—the attack having been simultaneous with the very first perception of the land smell; and in our country it is often conveyed by currents of wind to a distance of several miles. It frequently proceeds to the hills of Kent, for example, several miles distant from the marshes of Erith, Northfleet, or Gravesend. The watery vapour that is so apt to arise in situations most favourable to the generation of this poison, appears to be an exceedingly formidable conductor of it. Sir John Pringle, who had many opportunities of observing this fact in the campaigns in Flanders, about the middle of the last century, uniformly found that the number of men who were seized with sickness during the prevalence of a fog, far exceeded the number attacked when the weather was clear, though he did not attribute to the fog the production of the poison, but justly considered it as merely the conductor of it.

There are spots in which this poison is generated in such quantity and intensity, as to be capable of killing instantaneously whoever is exposed to it. Exposure to it in certain situations has proved fatal with a rapidity and certainty equalled only by a mortal dose of Prussic acid. Exposure to it in other situations produces what appears to be, and what is sometimes mistaken for, apoplexy—an affection of the brain, causing death more rapidly than almost any other disease to which the human body is subject. Exposure to it when less concentrated produces malignant fever of a continued form, destroying life in a few days or hours. Exposure to a still smaller concentration produces remittent, and to a yet smaller, the milder form of intermittent fever. And it may be so minute in quantity or so destitute of virulence in its own nature, as to be incapable of producing even intermittent fever, in its regular and well-marked form, and yet sufficiently potent to produce a long catalogue of grievous maladies. The secondary diseases which have this origin, and which have been much overlooked, consist for the most part of those painful affections of the nerves, which have been lately classed together under the general term of *neuralgia*. [NEURALGIA.] The exquisitely painful, and too often unmanageable diseases called tic douloureux, the disease called sciatica, the toothache, and more especially periodical headache, are oftentimes clearly traceable to this poison, and are as certainly produced by it as the most distinct and regular ague. Persons who live in situations where this poison is generated in abundance may never have ague, but at the same time they never enjoy a moment's health; while it is certain that long-continued exposure to it, though it may not produce any specific disease, included in the catalogue of the nosologist, fearfully abridges the term of life. Few persons in such situations attain the age of fifty. In some parts of America few of the inhabitants formerly lived beyond the age of forty; those who survived thus long had, at that early period, all the characters of extreme old age. Already, in those very situations, by the clearing, draining, and general cultivation of the land, the average term of life has been extended fifteen or even twenty years. There can be no question that the value of life which in modern times has increased so much in our own country, and which has improved in the rural districts in proportion to the better cultivation and the more complete draining of the land; and in the larger towns and cities to the better ventilation and the greater cleanliness for which they have been remarkable, has been mainly owing to these causes. So recently as the beginning of the present century, a celebrated physician, who had large experience of this matter, states, as a fact that came within his own observation and experience, that in small villages, in which the annual number of persons attacked with ague amounted to 200, not one case had occurred for several years.

Remote or predisposing Cause. The remote, or the predisposing cause of the disease is that which brings the system into a condition capable of being affected by the immediate or exciting cause. Whatever diminishes the vigorous action of the organs, impairs their functions and so weakens the general strength of the system, is capable of becoming a predisposing cause of fever; and every predisposing cause acts in one or other of these modes, and becomes a predisposing cause only and in proportion as it lessens the energy of the system, or disturbs the balance of its actions, which in fact is to render some portion of it weak. During a state of vigorous health the body is endowed with the power of resisting the influence of noxious agents, which in a less perfect state of health are capable of producing intense and fatal disease; and the action of all predisposing causes is to lessen this resisting power, or to weaken the energies of life.

Of all the predisposing causes of ague the most powerful is the continued presence, and the slow operation of the immediate or the exciting cause. The manner in which the immediate or the exciting cause of fever operates as a predisposing cause has been amply illustrated by Dr. Southwood Smith. "It is a matter of constant observation," says this author, "that the febrile poison may be present in sufficient intensity to affect the health, without being sufficiently potent to produce fever. In this case the energy of the action of the organs is diminished, their functions are languidly performed, the entire system is weakened, and this increases until at length the power of resistance is less than the power of the poison. Whenever this happens, fever is induced; not that the power of the poison may be at all increased, but the condition of the system is changed, in consequence of which it is capable of offering less resistance to the noxious agent that assails it."

Dr. Potter gives a remarkable example of this fact, with regard to the yellow fever, which fell under his own observation, and states other facts strikingly illustrative of the influence and operation of the predisposing causes. Strangers, from certain countries, he informs us, are insusceptible of yellow fever in America. In the most malignant and protracted epidemics which afflict that country, these strangers uniformly escape; emigrants from the West Indies, and other warm latitudes, for example, invariably resist the cause which produces these maladies in the native inhabitants. But the curious fact is, that such persons are unable permanently to resist the operation of the exciting cause; for, after a residence in America of some years, their constitution is so completely assimilated by the influence of the climate to that of the American, that they become equally sensible to its febrile miasma, and are as exquisitely impressed by them as the American citizens themselves. The illustration is equally striking and instructive if the position be reversed. The natives of northern climates are extremely susceptible to the influence of these miasma; that susceptibility is in exact proportion to the latitude of their country: those from the north of Europe scarcely ever escape an attack; the natives of Great Britain are nearly as susceptible to the influence of the poison, while persons even from the more northern countries of the United States are more liable to the disease than the citizens of the southern and middle States."

Among the other predisposing causes may be reckoned the period of life. All persons between the age of puberty and that of thirty-eight are peculiarly predisposed to this disease. After the disease has once existed, there remains in the constitution a remarkable susceptibility to its recurrence; and that from very slight causes, as from the prevalence of an easterly wind, or exposure to a very minute quantity of the poison that originally produced it, such as would not affect a person who had never been the subject of the disease. Hence, persons who have been once or twice, or oftener affected with ague, are most delicate tests of the presence of the exciting poison. Deficient and poor diet; intemperance; physical and mental fatigue; anxiety, cold, damp, debility, however induced—all these are extremely powerful predisposing causes. They enable a less dose of the poison to produce the fever, and they increase the intensity of it when established. They all act by weakening the resisting power inherent in the constitution, that is, by enfeebling the powers of life.

Treatment of Ague.—The first object in the treatment of a person affected with ague is to remove him from the influence of the poison by taking him out of an unhealthy, and placing him in a healthy situation. Unless this can be done, every remedy employed must act at a great disadvantage, and the power of the poison, or the debility of the patient, may be such as to render every effort to cure the disease unavailing without a change of residence. Often, however, circumstances will not admit of the removal of the patient. Whenever this is the case, the sick person must at least be put and kept in an apartment the most remote from the noxious spot, and it is a good and important general rule to place him in the highest part of the house. When this precaution is neglected, remedies constantly fail which readily and completely succeed when it is observed.

The treatment of ague includes the management during the paroxysm, the intermission, and the convalescence.

First, of the treatment during the paroxysm. The approach of the paroxysm should be carefully watched. The moment the first indication of its accession is apparent, an emetic, consisting of twenty grains of the powder of ipecacuanha with one grain of the tartar emetic, should be given, and as soon as the operation of the emetic is over, a draught should be taken, consisting of from twenty to forty drops of laudanum in an ounce and a half of camphor julep. This plan, in almost all cases, will completely stop the coming on of the cold fit; in a great number of cases it will also prevent altogether the accession of the hot fit, inducing at once the sweating stage, that is, the stage which constitutes the solution of the paroxysm. But if it should not actually stop the accession of the hot stage, it will assuredly diminish its violence and shorten its duration; and as soon as the hot stage is formed, the laudanum should be repeated in smaller doses, namely, in doses of from ten to twelve drops, repeated every hour, and continued until the sweating stage is completely established.

As soon as the cessation of the sweating stage terminates the paroxysm, and the latter is succeeded by the stage of intermission, cinchona bark should be freely taken. Of all the preparations of bark, the sulphate of quinine is incomparably the best. The dose is from two to four grains, and the most convenient mode of administering it is in the form of pill. During the whole period of the intermission, the dose of quinine should be repeated every hour, or every two hours, according to the urgency of the case. If the biliary secretion be unhealthy, which it almost always is, it will be useful to combine with every alternate dose of the quinine, from the sixth to the half of a grain of blue pill, together with two grains of the extract of gentian. If the bowels be constipated, the addition to each pill of from one to two grains of the extract of rhubarb will form an excellent aperient. Given in this mode, the extract of rhubarb moderately, but in general effectually, stimulates the alimentary canal, gently increasing its action, without producing purging. If, however, the bowels be constitutionally torpid, or be rendered so by the disease, a more active aperient must be substituted, and such will be found in the compound decoction of aloes, or the infusion of senna with camomile. The condition of the bowels must never be neglected, for a state of constipation will powerfully counteract every remedy.

This plan should be continued without intermission until the recurrence of the symptoms which denote a fresh accession of the paroxysm. Then the quinine, &c. should be suspended, and the emetic should be again repeated, which, as soon as its action has ceased, should be followed by the opiate, and this, on the solution of the paroxysm, by the bark, and so on in a constant series, until the paroxysm return no more. By this method of treatment the disease is usually cured after the third accession, consequently it is seldom necessary to repeat the emetic more than three times, and often twice and even once is sufficient.

Quinine, however powerful and effectual during the intermission, is commonly conceived to be useless and even pernicious during the paroxysm. But this is the period when opium is most effectual. It has even been given with success as the sole remedy. Dr. Trotter, who had an opportunity of observing its effects on a large scale in the Channel fleet, under Earl Howe, states, that whenever the sick felt the first approach of an attack, he prescribed from thirty to forty drops of laudanum; that if this dose did not bring on some warmth in the course of ten or fifteen minutes, he gave from twelve to fifteen drops more; that it was seldom necessary to increase the quantity beyond sixty drops in the space of an hour, decided relief being always afforded in that time; that in a few minutes from the exhibition of the opiate the spirits became exhilarated; the constriction on the skin was removed, and was followed by relaxation; the countenance looked more animated; a flush spread itself over the cheek; the pulse, from having been weak, quick, irregular, and sometimes intermittent, became less frequent, and more full and more equal; an agreeable warmth was diffused over the whole frame, and every unpleasant feeling vanished sometimes in a quarter of an hour. As soon as any symptoms indicated a return of the paroxysm, the laudanum was repeated in the same manner as at the accession of a former fit, and always with equal success, so that the patient seldom experienced much trembling and shaking; it was observed that the second paroxysm was commonly an hour or two later in the day than the preceding, and but few instances occurred of a return of the disease after the third paroxysm. The patients themselves were so satisfied of the efficacy of this remedy, that the moment they felt the first approach of an attack, they were sure to run to the cock-pit for relief. Dr. Lind, who also tried this remedy on a large scale, states that according to his experience, the good effects of opium are more uniform and powerful in intermittent fever than in any other disease, and that it affects the disease more rapidly than any other medicine; that if taken during the intermissions it has no effect either in preventing or mitigating the succeeding paroxysm; that when given in the cold fit, it occasionally removed it; but that when administered half an hour after the commencement of a hot fit, it almost always afforded immediate relief.

It is not sufficient that the recurrence of the paroxysm has been stopped once or twice by the use of the remedies prescribed. It should be borne in mind that there is in this disease a great tendency to relapse, and this tendency continues through the whole period of convalescence, and for some time after. The quinine should be continued in smaller doses for some weeks after the last paroxysm has supervened, especially if the weather be damp or easterly winds prevail.

If aperients are necessary, they should be warm and aromatic, and given during the intermission, so that their operation may be over before the accession of the paroxysm. Organic disease is occasionally produced by ague. The organs that are most liable to be diseased are the liver and the spleen; these become enlarged and hardened, scirrhous, as it is technically termed. The tumours occasionally press upon the great veins of the liver, and prevent the blood from passing freely from the abdominal viscera, and produce dropsy; they also press upon the ducts that carry the blood from the liver into the duodenum, or the small intestines which receive it; it may, therefore, be taken up by the absorbents and carried into the blood, diffused over the system, and so produce jaundice. In the same way diarrhœa may be produced.

Change of situation is a most powerful remedy; 1st, because it may remove the patient out of the sphere of the poison that produces the malady; 2ndly, because this is one of the diseases in which mere change of air is beneficial.

This disease is peculiarly apt to return. Relapse is brought on by very slight causes; a very small dose of the poison will renew it.

It is probable that errors in diet, or constipation will also do it. It is certain that cold, and that the east wind will do so; but it is probable that in the cold and moist air, and in the east wind, there is diffused some of the malaria. The patient should not go out in damp or cold weather, or during the east wind.

In protracted and obstinate cases which do not yield readily to quinine, arsenic is a very powerful remedy, and its efficiency is increased by its combination with opium or quinine. The proper dose of the arsenic is from two or three to ten drops of the liquor arsenicalis three times a day. This remedy should always be given soon after a meal; for if taken when the stomach is empty, it is apt to produce pain and vomiting. The operation of the remedy should also be carefully watched day by day; for, like other mineral poisons, it is apt to lie latent in the system for a considerable time, producing no apparent effect, and then suddenly to produce violent symptoms.

AIDE-DE-CAMP, a French term, denoting a military officer usually of the rank of captain, one or more of whom is attached to every general officer, and conveys all his orders to the different parts of his command. A field-marshal is entitled to four, a lieutenant-general to two, and a major-general to one. The monarch appoints as many aides-de-camp as he pleases, and this situation confers the rank of colonel. At the end of 1858, the number of aides-de-camp to the queen was thirty-five. There were also eleven naval aides-de-camp to the queen, one of whom, of the rank of admiral, is styled first and principal aide-de-camp, and has a salary of 365*l.* per annum; and ten others, of the rank of captain, have 182*l.* 11*s.* per annum. There are also two aides-de-camp appointed by the queen from the officers of the Royal Marines, whose salary is the same as that of the naval aides-de-camp.

AIDS (from the French *Aides*, which in the sense of a tax is used only in the plural number). Under the feudal system, aids were claims of the lord upon the vassal, not so directly connected with the tenure of land as reliefs, fines, and escheats. The nature of these claims is indicated by the term: they were rather extraordinary contributions than demands due according to the strict feudal system, though they were founded on the relation of lord and vassal. These aids varied according to local custom, and became in course of time oppressive exactions. The aids which are mentioned in the 'Grand Costumier' of Normandy for knighting the lord's eldest son, for marrying his eldest daughter, and for ransoming the lord from captivity, were in use in England, having been probably introduced by the Normans. But other aids were also established by usage or the exactions of the lords, for by Magna Charta, c. 12, it is provided that the king shall take no aids, except the three above mentioned, without the consent of Parliament, and that the inferior lords shall not take any other aids.

The amount of the two aids for knighting the lord's eldest son and marrying his eldest daughter was limited to a certain sum by the Statute of Westminster 1, 3 Ed. I. c. 36. The aid which was to ransom the lord when taken prisoner was of course uncertain in amount. Aids for knighting the lord's son and marrying the lord's daughter are abolished by the stat. 12 Car. II. c. 24. The aid for ransoming the lord is obsolete.

Aids is also a general name for the extraordinary grants which are made by the House of Commons to the crown for various purposes. In this sense, aids, subsidies, and the modern term supplies, are the same thing. The aids were in fact the origin of the modern system of taxation. (Blackst. 'Com.,' vol. i. p. 302; vol. ii. pp. 62, 85.)

Auxilia is the Latin word used by Bracton and other writers when they are speaking of the feudal aids above enumerated. The word *Aide* is derived from the Low Latin *Adiuda*. (Du Cange, 'Gloss. Med. et Infim. Latin.') The Spanish form *ayuda* ('assistance'), and the Italian *aiuto*, also clearly indicate the origin of the word 'aide,' which is from the participial form *adjuta* of the Latin verb *adjurare*.

AIR. This word is derived from the Greek ἀήρ and Latin *aer*. Though generally applied only to the material of the atmosphere, this term was, about the middle of the last century, extended to all the gases, as they were successively discovered, with a distinctive name for each. Though we confine ourselves here to the properties of atmospheric air only, we give the references to the modern names of the principal *airs*, as they were then called, which will be found mentioned in the chemical works of the last century.

Dephlogisticated Air, Empyreal Air, Vital Air,	see	Oxygen.
Phlogisticated Air	see	Nitrogen.
Nitrous Air,	see	Nitric Oxide, Deutoxide of Nitrogen.
Dephlogisticated Nitrous Air,	see	Nitrous Oxide. Protoxide of Nitrogen.
Inflammable Air,	see	Hydrogen.
Fixed Air,	see	Carbonic Acid.
Alkaline Air,	see	Ammonia.

The air which envelopes the globe is a *mechanical mixture* of two of those simple substances, to which chemists have given the name of *elementary;* viz., oxygen and nitrogen, with a very small proportion of carbonic acid, and water in the state of vapour. The two last are considered as accidental ingredients, and not constituent parts; as well on account of the smallness of their quantity, as because they occur in different proportions at different times. The atmosphere also contains a variable but minute trace of ammonia; traces of nitric acid, and of some compound of carbon and hydrogen, and often in towns sulphurous acid or sulphuretted hydrogen.

Referring only to the two principal ingredients, air consists on an average of 20·81 of oxygen by *measure*, and 71·19 of nitrogen in 100 parts; or, by *weight*, of 23·01 of oxygen and 76·99 of nitrogen. Whether the air be brought from an elevation of four miles above the surface of the earth, or collected on the summit of the Alps, or from crowded towns, or open plains, in various parts of the globe, it presents no sensible difference, with respect to its principal constituents, from the proportions above given. With respect to the weight of air, 100 cubic inches of dry air at mean temperature and pressure weigh rather more than 31 grains, the most accurate result being probably that of Biot and Arago, viz., 31·074 grains. Hence the weight of a given volume of air at 60° F. and 30 in. Bar. is only $\frac{1}{813}$th that of an equal bulk of water at the same temperature. Water dissolves about $\frac{1}{20}$th of its bulk of oxygen, and $\frac{1}{40}$th of nitrogen; hence rain water and melted snow contain in solution a larger proportion of oxygen than exists in the atmosphere, or about one part of oxygen to two of nitrogen, a circumstance of great importance to aquatic animals. The carbonic acid of the air is produced at the expense of its oxygen during the processes of respiration, combustion, fermentation, &c. Air that has been respired contains about 3½ per cent. of carbonic acid, although the proportion in the atmosphere does not exceed ·04 per cent. Certain mineral springs and the action of subterranean heat in volcanic districts upon limestone rocks beneath the surface, are also sources of carbonic acid to the air.

The average composition of the atmosphere in England, in 100 parts by volume, is as follows:

	Oxygen	20·61
	Nitrogen	77·95
	Carbonic Acid	·04
	Aqueous Vapour	1·40
	Nitric Acid, Ammonia, Carburetted Hydrogen	traces.
And in towns	Sulphuretted Hydrogen, Sulphurous Acid	traces.

Although the constituents of the atmosphere are of very different densities, yet, in consequence of the principle of DIFFUSION, they are uniformly mixed: one atom of oxygen is accompanied by four atoms of nitrogen, but yet so slightly held together, that the oxygen is readily separated from the nitrogen when required for the purposes of animal and vegetable life or combustion, and by the operation of the same principle, the heavy carbonic acid is distributed through the air, so that plants may easily absorb it, decompose it, retain the carbon as material for growth, and return the pure oxygen to the atmosphere. Some chemists, notwithstanding, have considered the air to be a chemical compound of 2 atoms of nitrogen to 1 of oxygen. An atomic compound of this proportion gives a ratio of 20 : 80 in volume, which is very nearly that given above, as deduced from experiment. M. Regnault, however ('Chimie,' i. 144), has shown that this view is hardly tenable, however remarkable the coincidence may be.

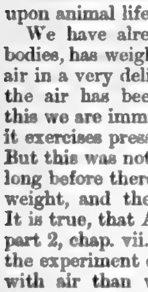
The air is a *mixture* of oxygen and nitrogen, and not a *chemical combination*. In what the difference consists, it is impossible at present to say; but the distinction may be illustrated by the following experiment, which we introduce the more readily, as we shall afterwards have occasion to refer to it. If eight grains of oxygen gas and one grain of hydrogen be confined in a glass tube from which the air has been previously excluded, they may be mixed in that state, and the *mixture* thus formed will not prevent either gas from separating from the other, and combining with any third body. That is, the oxygen, for example, will combine as readily with any substance which has a great affinity for it, as if the hydrogen were not present. But if an electric spark be passed through the tube, a new substance is formed out of the oxygen and hydrogen, by some species of mutual connexion very different from the former one, and which has the name of *chemical combination*. Nine grains of common water are formed from the eight of oxygen and one of hydrogen. The oxygen will not now easily be separated from the hydrogen by the application of a third substance, and there are few for which the oxygen has a greater *affinity* than for the hydrogen. The general characters which distinguish chemical combination from simple mixture, are, that in the former there is usually an alteration in the SPECIFIC GRAVITY, REFRACTIVE POWER, law of DILATATION from heat, &c.; while there is, generally, at the same time such a change of properties as no *à priori* reasoning could predict.

We have seen in the experiments already cited, that two elements which, when properly combined, produce a substance very different from either, may be placed in juxtaposition (such as is produced by mere mixture) without any such consequence following. If nitrogen and oxygen formed no other compound except atmospheric air, we might, perhaps, call the latter a chemical compound; but we should then be obliged to say, that the affinity of nitrogen for oxygen was singularly small. But the contrary of this is the fact. One equivalent of nitrogen may unite with one, two, three, four, or five equivalents of oxygen, forming the *nitrous* and *nitric oxides*, and the *nitrous*, *hyponitric*, and *nitric acids*; all of which have every character of chemical combinations.

The composition of air may be ascertained either *synthetically* or *analytically*. Synthetically, by mixing the proportions already noticed of oxygen and nitrogen; in which case it is found, that the mixture differs in no respect from common air: analytically, by an experiment similar to the one already cited; in which, however, it is presumed that we know the composition of water. If hydrogen be added to or mixed with a portion of common air, and an electric spark be passed through the mixture, it will be found that the hydrogen has combined with eight times its weight of oxygen (if there be so much), and has produced nine times its weight of water. In this way, by trial, the quantity of hydrogen may be found which will combine with all the oxygen in the mixture, and the remainder is then found to be simply nitrogen. A more accurate method, however, is to allow air to stream slowly over a weighed quantity of heated copper, whereby the oxygen is absorbed, and the nitrogen is received into an exhausted flask, weighed before the experiment was begun and after it was finished; the quantity of oxygen is found by the gain in weight experienced by the tube containing the copper.

Such are the principal chemical properties of air. For its effects upon animal life, see RESPIRATION.

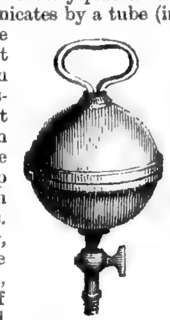
We have already observed that the air, in common with all other bodies, has weight. This is proved by weighing a bottle which contains air in a very delicate balance, and then by repeating the process after the air has been exhausted from the bottle by the air-pump. From this we are immediately led to conclude that, like all other heavy fluids, it exercises pressure upon all substances which are in contact with it. But this was not the order of discovery. The pressure was ascertained long before there was any other reason except analogy for inferring the weight, and the latter discovery was a consequence of the former. It is true, that Aristotle (Stanley's 'History of Philosophy, Aristotle,' part 2, chap. vii.) expressly mentions that air has weight, and even cites the experiment of a bladder, which he asserts weighs more when filled with air than when empty: but his followers of the middle ages entirely abandoned the doctrine. We shall speak more at length of the discovery, under the heads BAROMETER and ATMOSPHERE. It is here sufficient to observe, that the density of the air depends upon, and is a consequence of, the pressure of the superincumbent atmosphere. For the air is an elastic fluid, that is, its bulk increases, and its density diminishes, whenever the exterior pressure is wholly or partially removed. Let a loose bladder, tied at the mouth, and not so full of air as to be distended, be placed under the receiver of an air-pump, so that the air which presses the outside of the bladder can be exhausted. The interior air will expand so soon as the exhaustion begins, will presently distend the bladder to its fullest dimensions, and will even burst it. On the re-admission of the air into the space surrounding the bladder, the latter will gradually resume its former dimensions, and its withered or flaccid appearance.



As we ascend the atmosphere, the superincumbent column of air becomes of less weight, and the density becomes less; that is, a cubic foot at the height of 1000 feet above the ground is not so heavy, or does not contain so much air, as a cubic foot at the surface of the earth: which is thus explained. The air having in itself a force which tends to separate the particles from one another, or to expand the whole bulk, but which force grows less and less as the particles are more and more separated, that is, as the bulk increases, the state of rest will always be that in which the elastic force upon a square inch of the surface of air, arising from its own constitution, just balances the external pressure upon that square inch. To illustrate this, suppose a vertical tube, A B C D, open at both ends, *at first*, and filled with air, which communicates with the exterior atmosphere. Place a slight membrane, E F, across it, which can be moved up and down the tube, so that, except for friction, it would be displaced if the pressures of the air above and below it were in the least degree unequal. At present there are two equal and contrary pressures on the two sides of E F, arising from the weight of the column of air above E F. For if the pressure from underneath were less than that from above, E F would move downwards, and *vice versâ*. Now cover the end B D of the tube, so that the air in E F D B shall have no communication with the exterior air. The membrane E F still remains at rest; that is, the air E F D B, without being pressed by the exterior atmosphere through the section B D, exerts the same force upon E F from below as the exterior atmosphere does from above. This is what we mean by the *elastic force* of the atmosphere, as distinguished from the weight of the superincumbent column of air. The two being always equal, may easily be confounded; we only wish to impress upon the reader, that this repulsive force of the particles of air, of which we know nothing but its effects, is a counterbalancing force from within, so to speak, to the pressure from without, and is greater or less according to the less or greater nearness of the particles, as we shall proceed to exemplify.

To get a more distinct idea of the superincumbent pressure on E F, suppose the air to be entirely removed from above E F, so that the membrane must be held down in order to prevent the uncounterbalanced force beneath from driving it up, and exhibiting the phenomena of the air-gun. Let a liquid, mercury for example, be poured into the tube, until there is no longer any occasion to hold down E F, or until the weight of the mercury will just counterbalance the pressure of the air from below. In the average state of the atmosphere, this will require about 30 inches of the tube above E F to be filled with mercury. Now, let half the mercury be removed; that is, let it only stand 15 inches above E F. This is not sufficient to counterbalance the pressure from beneath, and the membrane will rise to twice its height above B D; that is, the air will now occupy twice the space which it did before. But this will not happen immediately, for it will settle at first at something less than the height we have mentioned, and attain that height by degrees. The reason would be manifest if a thermometer were placed in the space E F B D; for it would be found that the thermometer would *fall* when the expansion began, and would gradually regain its original height as the membrane acquired its full distance from B D. Similarly, if the quantity of mercury were doubled and made to stand at 60 inches above E F, the pressure on E F would be greater than that from beneath; the membrane would descend, the thermometer *rising* at the same time; and by the time the thermometer again indicated the same temperature as at first, the membrane E F would stand at half its original distance from B D. If any other quantities of mercury were added or taken away similar results would be found, so soon as the alteration of temperature was balanced by the surrounding atmosphere, which, in the first case, imparts heat to the apparatus, and, in the second, receives heat from it. Thus, if only one-third of the mercury were left, the air would overbalance it until it had expanded into three times its dimensions. If the mercury were increased five-fold, the air would never furnish a counterpoise until it was reduced to one-fifth of its former dimensions. This remarkable law, which holds for all gases as well as air, may be expressed as follows: *at the same temperature*, the elastic forces of two portions of air (or, which is the same thing, the weights of mercury they will balance) are in direct proportion to the densities, or in inverse proportion to the spaces occupied by these portions. In the apparatus above described, we do not pretend to show a good practical method of actually performing the experiment. For this purpose we must refer to AIR-PUMP.

The very great pressure of the atmosphere is illustrated by the following experiment. Two hollow hemispheres are loosely placed one upon the other as in the figure: the lower communicates by a tube (in which is a stop-cock, open for the present) with the exhausting apparatus of an air-pump. At present there is no impediment to lifting the upper from the lower hemisphere except its weight; the pressure of the air from within counterbalancing that from without. But if the air be withdrawn from the interior, and the stop-cock closed so that the apparatus can be unscrewed from the air-pump without allowing the air to enter, it will require an enormous force to separate the two hemispheres. Thus, if *all* the air be removed from the interior, there will be a pressure of 15 lbs. on each square inch of the section of the hemispheres; hence, supposing the diameter to be 4 inches, the area of the section will be about $12\frac{1}{2}$ square inches, and the force required to separate them will be $12\frac{1}{2} \times 15 = 187\frac{1}{2}$ lbs. This experiment was first performed by Otto Guericke, at Magdeburg, in 1654. Such being the external pressure, it may appear extraordinary that the human body is capable of supporting it without being crushed to atoms. The pressure on the body is computed at several tons. But the cause of wonder is purely imaginary. In the words of Dr. Robison "the human body is a bundle of solids, filled or mixed with fluids, and there are few or no parts of it which are empty. All communicate either by vessels or pores, and the whole surface is a *sieve*, through which the insensible perspiration is performed. The whole extended surface of the lungs is open to the pressure of the atmosphere; everything is therefore in equilibrio; and if free or speedy access be given to every part, the body will not be damaged by the pressure, however



great, any more than a wet sponge would be deranged by pressing it any depth in water." ('Mechanical Philosophy,' vol. iii. p. 541.)

The temperature of air, as already noticed, influences its elastic force. We have every reason to conclude, that the principal properties of this and all other gases are a consequence of the presence of heat, though we do not know what the latter is. It is probable that air would become first liquid, and then solid, if it could be made sufficiently cold. Like all other substances, air gives out heat when it is compressed, that is, raises the temperature of surrounding bodies, and *vice versâ*. This is strikingly illustrated by the fact that tinder can be set on fire when the air contained in a brass cylinder is suddenly and violently compressed by a piston.

From careful experiments it appears, that air and all other gases, as well as vapours, and also all mixtures of gases and vapours, obtain an increase of elastic force for every increase of temperature, and expand therefore, if expansion be possible, in the vessel which contains them. The quantity of this expansion, when the temperature passes from the freezing to the boiling point of water (that is, from 32° to 212° of Fahrenheit's, from 0° to 80° of Réaumur's, and from 0° to 100° of the Centigrade, thermometers), is 366 parts out of a thousand of the bulk which it had at the freezing point. That is, in the apparatus indicated in the preceding part of this article, form a graduated scale along B A, and suppose that B E contains a thousand parts, and that, the upper air being removed, as much mercury is poured in above E F as will cause the membrane E F to stand at E, when the temperature of the air is at the freezing point of water. Then, if the air be gradually heated from the freezing to the boiling point of water, either more mercury must be poured in, or the membrane with the superincumbent mercury will rise through 366 divisions more of the scale, and E will stand at 1366. And this dilatation is uniform: that is, whatever expansion arises from an increase of 12° of temperature, half as much arises from an increase of 6°, twice as much from one of 24°, and so on. This remarkable law, which holds, with perhaps a slight variation, at very high and very low temperatures, was discovered nearly at the same time by Dalton in England and Gay-Lussac in France. Now, in Fahrenheit's thermometer there are 212°—32°, or 180° between the boiling and freezing points of water; 80° in Réaumur's; and 100° in the Centigrade. Consequently, the whole increase of bulk, or $\frac{366}{1000}$, will give $\frac{366}{180000}$, $\frac{366}{80000}$, and $\frac{366}{100000}$, for the variations of bulk corresponding to a rise of one degree of temperature on each of the three thermometers; that is, about $\frac{1}{491}$, $\frac{1}{218}$, and $\frac{1}{273}$, respectively. But in applying these rules, it must be recollected that, in taking Fahrenheit's thermometer, for example, the expansion is $\frac{1}{491}$ of the *bulk which it had at the freezing point*. Suppose, for instance, we have a bulk of air which occupies 1000 cubic inches at the temperature of 62° Fahrenheit, and we wish to know how much it would occupy under the same pressure at 82° of the same. The first temperature is 30° above the freezing point. Now, suppose a certain volume of air to consist of 491 parts at the freezing point; then it is clear that, as air expands $\frac{1}{491}$ of its bulk for each degree, this volume at 62° will have become $491 + 30 = 521$ parts. Similarly, at 82° it will be $491 + 50 = 541$ parts. Hence, as 521 (the volume at 62°) : 1000 (also at 62°), so is 541 (the volume at 82°) : 1038⅜, which is the bulk required at 82°.

On the properties of air with regard to other bodies, we may notice that probably there is a slight adhesion of air to many, if not to all, surfaces. A small needle may be made to swim on water, and in this state the water evidently retires from around it, leaving it, as it were, suspended over a hollow in the fluid. This is attributed to the adhesion of a coat of air, which, with the iron, makes the whole specifically lighter than the water. Recent experiments on the pendulum, the most delicate of all philosophical instruments, have led some to suspect, that in addition to the resistance of the air, a slight coating of this substance travels with the pendulum, and thereby causes an irregular addition to its weight. [PENDULUM.]

The air is a permanent gas, incapable of being reduced to the liquid state by cold or pressure. It is also, like most gases, perfectly colourless, especially when we look through small quantities of it; although, if we notice the effect produced by large masses of it, we may consider it to be a coloured gas. Thus, the *blue* colour of the sky is probably merely the colour of the air seen through a length of about 45 miles. Hence, it has been observed by those who have ascended about 5 miles from the earth's surface, when they have left much more than half the atmosphere behind them, that the sky appears of a dark inky hue, owing to the very small reflection and dispersion of the light, while the blue colour no longer appears *above*, but *below* them. Similarly, the *blue* colour of distant hills is owing to the same cause.

In this article we have considered only the chemical and mechanical properties of air. The constitution of the whole mass will come under the article ATMOSPHERE. To complete the subject, refer to OXYGEN, RESPIRATION, COMBUSTION, VENTILATION, ACOUSTICS, AERODYNAMICS, and also to the 'Elements of Chemistry,' by Professor Miller, of King's College, London, and to the 'Cours de Chimie,' by Regnault.

AIR, in music, signifies 'Melody;' the terms are synonymous, it being understood that by both words is meant a succession of single sounds in measured time. The word Air was used in this sense nearly three centuries ago; but it is not now known why such an application of a familiar word was first adopted.

Rousseau says that the name of air is given to all melodies, to distinguish them from recitative. M. Suard, in the 'Encyclopédie Méthodique,' offers the following definition:—a piece of music, composed of a certain number of melodious phrases, united in a regular symmetrical form, and terminating in the key in which it began. Sulzer has followed M. Suard; so has Pietro Lichtenthal; but, without objecting to his definition, we consider the common and simple one the best,—namely, that succession of single sounds, regulated by the laws of musical rhythm, which constitutes what, in homely language, is called a tune. [RHYTHM.]

Air, or melody, is, allowedly, the most important of the constituents of music. A composition may be replete with learned and ingenious harmony, may abound in fugue, in imitation, and all the contrivances of science, but without good melody will never appeal to the heart, and seldom afford any gratification to the ear. Haydn carried this opinion so far as to say, "Let your air be good, and your composition, whatever it may be, will possess beauty, and must certainly please." Air is in music what design and outline are in the sister art of painting: harmony is the filling up, and the colouring.

The Greeks had many kinds of airs, which they called *nomes*, or songs; and we learn from the work of Philodemus on Music, recovered from the ruins of Herculaneum, that every trade and occupation had its Νομοι, or appropriate airs, which were played or sung to the workmen while they laboured.

The various kinds of airs, instrumental as well as vocal, will be found under their different heads. [ALLEMANDE; BARCAROLLE; &c.] In music composed for the theatre, and which is constantly introduced into the concert-room, are the following varieties of air, designated by Italian denominations, viz.—

The *Aria di Carattere* ('characteristic air'), which is distinguished by force and energy of expression, and by dramatic effect. The *Aria Parlante* ('speaking air'), which is rather declaimed than sung, and is best suited to the buffo or comic performer. The *Aria di Cantabile* ('singing air'), a tender, pathetic air, calling forth the expression and taste of the singer. The *Aria di Bravura* ('dashing air'), an air in which the performer displays his powers of execution, and seeks rather to astonish than please.

AIR-CUSHIONS. The mechanical application of common air, in respect of its pressure or elasticity, has been greatly extended within the last few years. Provided a mass of air can be confined within a given receptacle, and that receptacle be of an elastic or yielding character, the air assumes many of the qualities of a soft stuffing or padding, when its quantity is small compared with the size of its envelope; but when the quantity is as great as can be introduced without bursting the envelope, the air becomes nearly equivalent to a solid body. So long as the means were wanting for conveniently making air-tight cloth vessels, this principle was slenderly applied; but the use of caoutchouc or India-rubber, as a glutinous varnish, has developed many ingenious contrivances for this object. When a bag has been made of such material, rendered also air-tight by somewhat similar means at the seams, air may be passed into it as a substitute for more solid materials. In practice there are some very neat arrangements adopted in effecting this. Temporary air-seats or cushions are made by forming a bag of air-tight cloth, perfectly enclosed at every part except one corner, where is inserted a small tube and stop-cock, capable of effecting or preventing communication from the interior to the exterior. The cock being opened, and the tube applied to the mouth, air is blown into the cushion, until it expands to the desired degree of fulness; the cock is then closed, and the air remains imprisoned. When not in use, such a cushion can have the air expressed from it, and may then be folded up into a small space.

It is obvious that seats, cushions, pillows, and beds of various kinds, having a similar object in view in relation to softness, fulness, and elasticity, may be made by similar means. When the quantity of air included in an envelope is greatly increased, it may be made the means of producing actual pressure in a more equable way than by any solid bodies. Thus, an air-tight bandage was invented a few years ago, the object of which was to form a wrapper to a human limb under surgical treatment. There is a bandage with straps fitted for being tied round the limb; and when so tied, air is breathed into an air-tight envelope to the bandage, through a small tube provided with a pipe. By increasing or lessening the quantity of air impelled, the pressure of the bandage on the limb may be made so small as to be scarcely perceptible, or may on the other hand be made even painfully close; but in either case it will be equable in every part.

A patent has been obtained, by Mr. Walton, for certain modifications in the mode of preparing air-bags for beds and similar purposes. Hollow balls of India-rubber, filled with air, are enclosed within external coverings so as to form a sheet of balls; and many such sheets may be piled one on another to form a bed or mattrass of any required thickness. Such an arrangement would, however, be very complicated and expensive.

Further illustrations bearing on this subject will be met with under LIFE-BOAT and WATERPROOF COMPOSITIONS.

AIR ENGINES. Many attempts have been made to produce engines which should have the power of steam-engines without the use of steam. The compression or the rarefaction of air, brought about in some one of many different ways, is the agent relied upon for producing a moving force. In 1840 Mr. Stirling patented such a machine, and read a description of it before the Institute of Civil Engineers in 1846. In this engine two strong air-tight vessels are connected with the opposite ends of a cylinder, in which a piston works in the usual manner. About four-fifths of the interior space in these vessels is occupied by two similar air-vessels, or plungers, suspended to the opposite extremities of a beam, and capable of being alternately moved up and down to the extent of the remaining fifth. By the motion of these interior vessels the air to be operated upon is moved from one end of the exterior vessel to the other; and as one end is kept at a high temperature, and the other as cold as possible, when the air is brought to the hot end it becomes heated, and has its pressure increased, whereas its heat and pressure are diminished when it is forced to the cold end. Now, as the interior vessels necessarily move in opposite directions, it follows that the pressure of the enclosed air in the one vessel is increased, while that of the other is diminished; a difference of pressure is produced on opposite sides of the piston, which is made to move from one end of the cylinder to the other. The piston is connected with a fly-wheel, and motion communicated in the usual way. A large bakery has been established on this principle at New York, the machinery being worked by the ascensive force of a current of air heated by the baking ovens. At a certain height within a lofty vertical shaft is a horizontal wheel, with wings or vanes attached at an angle of 10°; the ascending air causes this wheel to revolve horizontally; drums are fixed on the spindle of the wheel, and straps or bands from these drums drive the machinery for grinding the flour and kneading the dough.

Baron Von Rathen made trial of an air-locomotive on a common road, in 1848. It travelled from Putney College (where it was constructed) to Wandsworth, at the rate of 10 or 12 miles an hour. The air-reservoir (substitute for a steam boiler) had a capacity of 75 cubic feet; it was capable of being charged with air to a pressure of fifty atmospheres, by a 6-horse power engine.

An air-engine of peculiar construction was employed in 1851, in the Govan Colliery, near Glasgow, invented by Mr. Randolph. There were circumstances connected with the shape and arrangement of the shafts of the mine which rendered the supply of steam difficult; whereupon Mr. Randolph, acting on a suggestion made by Mr. David Elder, contrived the air-engine. He makes use of compressed air, supplied by a compressing steam-engine at the surface, and conveyed down by a pipe to work an engine at the top of the second shaft, in the manner of a non-condensing steam-engine; the discharged air being thrown into the workings to aid in the ventilation of the mine. The air-engine, supplied by the compressing apparatus, is employed for working the winding and pumping apparatus of the second shaft. The compressed air is conveyed to it through a cast-iron shaft 10 inches in diameter, carried down the main shaft. At a meeting of the Institution of Mechanical Engineers, in 1857, it was stated that this machine had been working admirably for six years, and had illustrated many points connected with the useful employment of air-engines.

There are certain forms of air-engines, especially Ericsson's, which will be better noticed under Caloric Engine.

AIR-GUN. An instrument for projecting bullets, in which the moving power is the rush of condensed air allowed to escape, instead of the formation of gases arising from the ignition of gunpowder. The air-gun and the common gun are therefore the same in principle.

In the stock of the gun is a condensing syringe, the piston of which condenses air into a cavity, which has a valve opening inwards, just behind the bullet. The barrel is open, and the bullet (which should just fit it) is inserted in the usual way. The trigger opens the valve behind the bullet, and permits the rush of the condensed air, which propels the bullet. The moment the finger is withdrawn from the trigger, the air closes the valve, and remains, somewhat less condensed than before, for the next discharge.

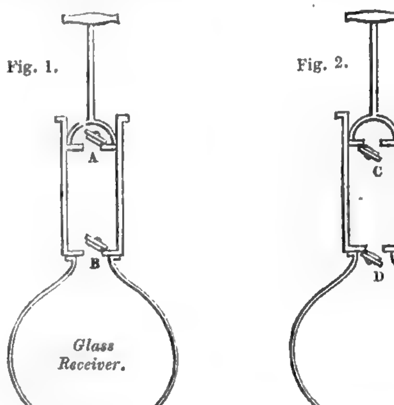
The same principle has been variously applied. In the *magazine air-gun*, there is a reservoir of bullets, in a channel under the barrel, one of which is turned in by a cylindrical cock pierced by a tube, which in one position is a continuation of the reservoir of bullets, and in another, of the barrel. Thus, by turning the gun upside down and turning the cock, a bullet falls into it from the reservoir, which, on re-turning the cock, is of course in the barrel. This is a very primitive application of the now famous principle of the Revolver, or revolving pistol. In some air-guns, the cavity containing the condensed air is a hollow copper ball, which can be screwed on to the gun after condensation. The *air-cane* is so called because it is usually in the form of a walking-stick. The handle contains the condensed air, and can be unscrewed and filled by a separate condensing syringe. There is some mention of an instrument similar in principle to the air-gun among the ancients; and it is said that Ctesibius, a celebrated mechanical philosopher, who lived, B. C. 120, at Alexandria, constructed an instrument, in which the air, by its elastic force, discharged an arrow from a tube. (Montucla, 'Histoire des Mathématiques,' vol. i. p. 267.) The invention, such as we have described it, is ascribed to Marin, a native of Lisieux, in France, who is said to have presented an air-gun to Henry IV.

Shaw's air-gun, patented in 1849, combines an endless band of vulcanised india-rubber with an air-exhausting apparatus. The elasticity is so applied as to compress the air by a single stroke of a syringe or air-pump, the moment before the discharge. The operation performed by the sportsman, to bring the apparatus into a charged condition, is very similar to that adopted in the use of the cross-bow.

Down to the present period, however, the air-gun, in all its forms, has been little other than a mere toy. No power, but only an adaptation of power, is gained by its use; for the condensation of the air itself requires force. The air-gun has never been used in war, on account of its expense, and the force which must be employed to condense the air. The *steam-gun*, exhibited in London a few years ago, exemplified a much more forcible agent than air for the propulsion of bullets; but nothing has hitherto been accomplished to render that mechanism practically available, although suggestions to that effect were made during the Russian war of 1854-5.

AIR-PUMP. A philosophical instrument for removing the air out of a vessel. We shall also include under this head the apparatus for forcing more air into a vessel, better known by the name of the *Condensing Syringe*, as the two differ very slightly in their main principle and simplest construction.

Fig. 1. Fig. 2.

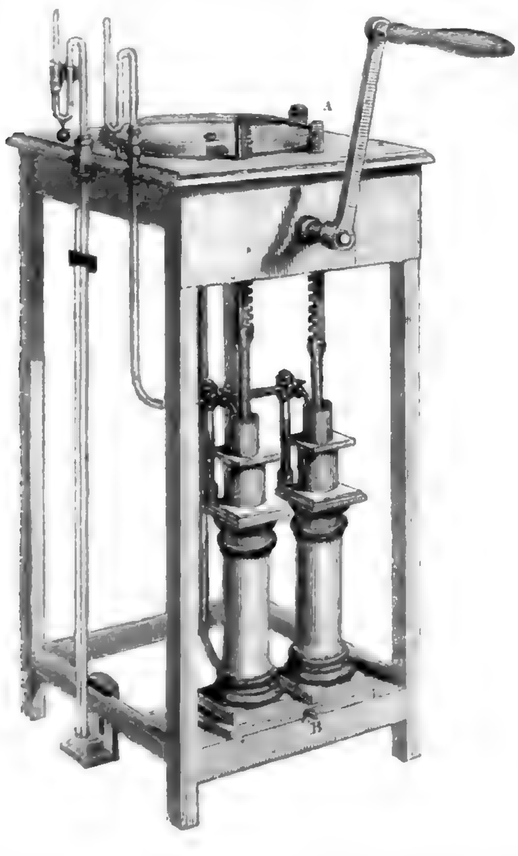


Above we have the sections of the simplest forms of an *exhausting* and of a *condensing* syringe. Both consist of a brass tube or cylinder, closed at one end, excepting an orifice to which a valve or lid is attached. A piston, with a rod and handle, enters at the other end, and can be moved up and down the tube. The piston is not entirely closed, but has a valve opening the same way as the other valve. Both are attached to vessels the air of which is to be rarefied or condensed. In fig. 1, or the exhausting syringe, both valves open upwards, or let air only *out* of the vessel and the piston: in fig. 2, or the condensing syringe, both open downwards, or let air only *into* the vessel and through the piston.

Let the whole contents of each vessel be, for example, six times that of the tube of the syringe, and let both pistons be pushed down. We first take the exhausting syringe. The instant the piston begins to rise, there is no air between A and B; the valve A is kept shut by the pressure of the exterior air, while the air in the vessel, pressing on B from underneath at the rate of about fifteen pounds to the square inch, raises it, and the air in the vessel is thus distributed between the vessel and the tube. If we call the tube one *measure*, the vessel is six *measures*; so that the air which occupied six measures now occupies seven, or is only six-sevenths of its former density. When the piston is returned again, the air in the tube is compressed, but cannot return into the vessel, because B does not open inwards. By the time the piston has returned through one-seventh of its descent, the equilibrium between the air in the tube and the external air will be re-established;

and by the time the piston has descended so much farther that the additional elastic force acquired from compression will suffice to lift the valve A, the latter will open, and the air will rush out. This continues until the piston has quite returned to B. That is to say, after every stroke of the piston, the air in the vessel has only six-sevenths of the density which it had before the stroke, since the air contained in six measures is expanded into seven by the rise of the piston. Therefore, at the end of the second stroke the density is $\frac{6}{7}$ of $\frac{6}{7}$, or $\frac{36}{49}$, that is, 36 measures of common air would weigh as much as 49 of the air we have now got inside the vessel. At the end of the third stroke the density is $\frac{6}{7}$ of $\frac{36}{49}$, or $\frac{216}{343}$. Without going farther, suffice it to say, that at the end of the twentieth stroke, the density of the rarefied air is about $\frac{1}{22}$; and at the end of 100 strokes, it would take about five million of measures of the rarefied air to weigh as much as one of common air. But long before this time a limit would be put to the exhaustion, in the present state of the apparatus. The air in the vessel cannot escape into the tube unless it has force sufficient to lift up the valve B; which after a certain number of strokes will not be the case, for the elastic force of the air diminishes in the same proportion as its density, being at first fifteen pounds to the square inch; so that by the time the density is reduced to $\frac{1}{480}$, the valve, if it present a surface of one square inch, will not rise, if it be so heavy as half an ounce. Let us, then, suppose B to be fastened to the piston by a loose string, so long that it becomes tightened just before the piston reaches its greatest height. The string will then open the valve, and the rarefaction will take place as usual.

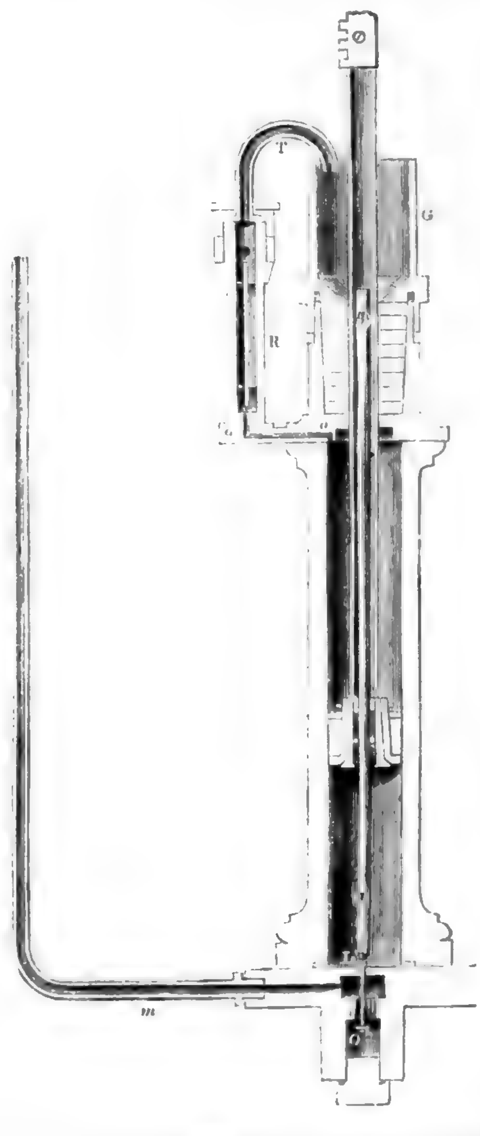
The condensing instrument will now be easily understood. Let the piston be raised, the valves will then be open; but the moment the piston begins to descend, the rush of air outwards will shut C, and the whole of the air in the tube will be forced into the vessel, which admits it, since D opens inwards. If this be done quickly, so that hardly any air escapes, seven measures of air, after the stroke, will occupy the space filled by six measures before it, so that the density of the air in the vessel will be $\frac{7}{6}$; or six measures of condensed air will weigh as much as seven of common air. When the piston returns, air rushes in through C, and presses the valve D, which nevertheless, unless made too heavy, does not open, because it is pressed with a greater force from within. In every succeeding stroke an additional measure of common air is added to the stock already contained in the vessel. At the end of the second stroke the density is $\frac{8}{6}$, at the end of the third $\frac{9}{6}$, and so on. Every succeeding stroke will be more difficult,



for the air contained between C and D in the descent of the piston, will not force D open until it is more compressed than the air within the vessel. Also the condensation increases only in arithmetical progression, while the corresponding rarefaction in the exhausting syringe takes place in geometrical progression. It would take 30,000,000 of strokes, all but one, to produce a condensation, the corresponding rarefaction to which is gained in a hundred. It is needless to say, that no materials that we could put together would bear such a pressure, and no force that we could exert would create it.

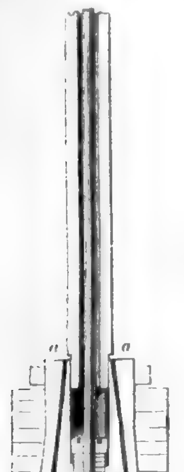
The exhausting syringe, as above described, is, in principle, the common air-pump. We shall now proceed to describe Cuthbertson's air-pump, containing the most recent material improvements.

The circular plate or *table* at the top is of metal or of glass ground to a perfect plane surface, on which is placed an inverted glass jar, from which the air is to be exhausted, called the *receiver*, the bottom of which is also carefully ground: so that if the plate be slightly smeared with grease and the receiver placed upon it, the junction of the two is air-tight. The hole in the middle of the plate is the end of a tube, which extends vertically downwards, until, curving at the bottom, it passes through the front beam below the barrels, with the interior of each of which it communicates. These barrels are exhausting syringes, the construction of which will presently be more particularly described: they are worked by rack-work, communicating with a cog-wheel and handles, space for the racks to play being cut in the upper wood-work of the apparatus. On the left are the gauges for ascertaining the degree of exhaustion obtained, and at A is a place for a PEAR-GAUGE. See also SYPHON-GAUGE, as we shall here only describe the most common, the *barometer-gauge*. The box attached to the under beam on the left contains mercury, out of which rises a tube and a graduated scale, as in the barometer. This tube passes through the higher wood-work, and also ends in the orifice which is in the middle of the plate, so that the communication being free, the air in the receiver, and that in the tube above the mercury, are in the same



state. Hence as the air is rarefied, the external air will force some mercury up the tube, and the height to which it has risen will show the degree of rarefaction. For example, suppose the common barometer to be 30 inches high, while the barometer-gauge of the air-pump stands at 20 inches. If the vacuum were complete, the barometer-gauge would be a common barometer, and would stand at 30 inches: but as it stands only at 20 inches, the pressure of the air in the receiver is equivalent to 10 inches of mercury, or one-third of that of the exterior air. Therefore the density of the air in the receiver is one-third of that of the exterior air, or two-thirds of the air have been removed.

The preceding cut shows a section of the piston rod, as well as of the barrel. The tube *m* comes from the receiver, and air can be admitted by it into the barrel, when the rod *gg* is raised. The rod *gg* passes into the piston-rod (which is hollow), and works stiffly in it, being however unconnected with it except by friction. This rod consists of two parts, above and below L, the latter of which is not thick enough to fill the orifice in which it plays. But when the piston descends, the conical juncture of the thicker and thinner parts is brought upon this orifice, and shuts it close. After this, and during the rest of the descent, the hollow piston-rod slides downwards upon the rod *gg*. As soon as the piston begins to ascend, the rod *gg* is raised with it, owing to the friction, so far as the nut O will let it rise, after which the piston-rod slides up *gg*. We have here the lower valve of the exhausting syringe, shut during the descent of the piston, open during the ascent, and not opened by the force of the air from underneath, so that the functions of the string which we supposed in our first exemplification are performed. A little higher up the barrel we find the piston, as better shown in the adjoining figure. The external part is a partial piston not connected with the piston-rod, but fitting closely to the barrel. The piston-rod, when rising, fits this exactly, renders it air-tight, and causes it also to rise. But when the piston-rod is descending, it will not cause the descent of the exterior, and, as we have called it, partial, piston, until the projecting shoulders *aa* (in the figure) come upon it; and, as these shoulders do not go all the way round, the piston in descending is not air-tight. This apparatus supplies the place of the upper valve, being air-tight in the ascent, but not so in the descent. Looking above the piston, we find that its rod works in metal shoulders, the interval between which is occupied by stiff leathers. The space above the leathers opposite to G is filled with oil, which is communicated slowly to the leathers, and also to the barrel beneath. From the latter, however, it is immediately expelled by the rise of the piston, which forces it, as well as the air in the barrel, through the channel *aa*. The oil and the air then force up the rod in the cavity B, which rod, working in collars, answers the purpose of a valve. The oil is there lodged, until it is collected in sufficient quantity to flow again into the reservoir at T. The air escapes into the exterior atmosphere.



Having shown that we have here an under valve shut during the descent, and open during the ascent, with an upper valve open during the descent and shut during the ascent, we need not repeat the manner in which the rarefaction is produced. We have only further to notice, that a branch from the main tube which enters the receiver is carried through the under wood-work in front, and emerges at B. It is here stopped by a screw; but when the operator desires to restore the air under the receiver, he opens this screw, upon which the communication between the exterior atmosphere and the receiver is restored, and the air rushes in. In the perspective figure, a cross bar, in which the upper parts of the barrels are inclosed to strengthen them in their position, is omitted for the sake of clearness.

We give in the following figure a representation of a more portable and less expensive species of air-pump, which, after what we have said, will need no description.

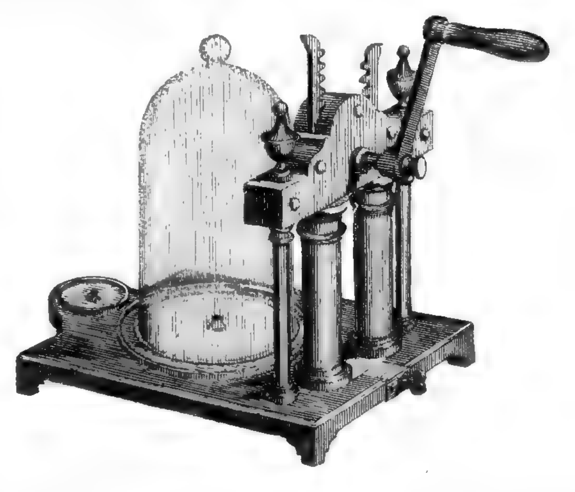
The small plate behind the receiver is for another small receiver, in which a gauge is placed. This guage is nothing more than a common barometer, which falls with the diminution of pressure from the air in the receiver, in the same way as the common barometer when the pressure of the exterior air is lessened by a change of weather.

The following experiments are among the most common of those shown with the air-pump:—

1. If the receiver be open at both ends, and the upper orifice be stopped by the hand,—on exhaustion the pressure of the exterior air will prevent the removal of the hand. If a piece of bladder be tied tightly over the orifice, as the exhaustion proceeds the bladder will be pressed inwards, and will finally burst with a loud report. The pressure of the air is also proved by the experiment of the hemispheres, described in the article AIR.

2. The weight of the air is proved by exhausting a copper ball furnished with a stop-cock, which is shut before the ball is removed from the air-pump. It will then be found to weigh less than before the exhaustion was made.

3. The presence of air in various substances may be detected. A glass of liquid placed under the receiver will give out bubbles of air as



soon as the exhaustion begins. A shrivelled apple will be restored to apparent freshness by the expansion of the air which it contains, but will resume its original appearance when the air is allowed to return.

4. The elasticity of air may be shown by placing a bladder under the receiver, not distended, and the mouth of which is tied up. On exhausting the receiver, the air contained in the bladder will expand it more and more, as more of the pressure from the exterior is removed; and the bladder will finally burst from the interior pressure. If a hole be made in the smaller end of an egg, and the egg be then placed in a wine-glass with this end down under the receiver, the small bubble of air which is always found in the larger end, will, by its expansion, force out the contents of the egg. On re-admitting the air, the contents of the egg will be forced back into the shell.

The first vacuum was made by Torricelli [TORRICELLI, in BIOG. DIV.; BAROMETER], but the first air-pump was constructed by Otto von Guericke, who exhibited it publicly at the Imperial Diet of Ratisbon in 1654. It was an exhausting syringe, attached underneath to a spherical glass receiver, and worked somewhat like a common pump. The syringe was entirely immersed in water to render it air-tight. Shortly afterwards, Boyle constructed an air-pump in which the syringe was so far improved that the water could be dispensed with. He also first applied rack-work to the syringe. The second syringe and the barometer-gauge were afterwards added by Hawksbee, and several minor improvements were made by Gravesande and Smeaton. All the alterations which have been made since the time of the invention, however important, relate to the mechanism only, and not to the principle on which the pump acts.

In the Great Exhibition of 1851, among the instruments exhibited in Class X., the best air-pump was by Mr. Newman. It has a ground-glass plate, and is furnished with two pumps with metal valves, on one of which are two barrels, open at the top. By this arrangement the receiver may be quickly exhausted to 0·4 inch or 0·5 inch. The other pump has a single barrel, with an oil-cistern at the upper part, and the air is lifted through a valve at the bottom of this cistern. "If anything re-enters the barrel it can only be oil, which is brought out with the air at the next up-stroke of the piston. The piston has a metal valve; but the opening of this valve is not necessary to the continuation of the exhaustion, as the piston at its lowest point passes below the aperture leading to the receiver. This construction of air-pump exhausts more thoroughly than any yet known." ('Jury Report.') In some experiments which were tried with this pump, the reading of the barometer at the time was 30·08 inches, while the gauge of the pump stood at 30·06 inches.

A pump exhibited by Messrs. Watkins and Hill, on a plan suggested by Mr. Grove, has oil-silk valves, and is so constructed as to leave the least possible residue of air in the valve after each stroke of the piston. "The piston is solid, without a valve, and the shape of its lower part is an obtuse cone. Part of this cone rises at the top of each stroke above the aperture leading to the receiver; and the air which has entered the barrel is, by the down-stroke, forced through a valve at the apex of the hollow cone terminating the lower end of the barrel, to which the lower end of the piston fits very accurately. The piston-rods pass through air-tight leather collars in the tops of the barrels. This pump exhausted the air till the elastic force was only 0·05 inch of mercury."

Mr. Siemen's air-pump was exhibited by Knight and Sons. "It consists of two cylinders of different diameters, the smaller one placed below the larger, and separated from it by a plate forming the bottom of the upper and the top of the lower cylinder. A piston-rod, common to both cylinders, passes through a stuffing-box in the plate, attached to which are two valved pistons, working in their respective cylinders. The advantage of this construction is, that the pressure of the external air on the oiled silk valve of the larger cylinder is taken off by the vacuum formed in the smaller one, and in consequence no greater resistance is offered by the valve than that arising from its adhesion and tension. The exhaustion of this pump is very rapid, and in the trial amounted to 0·24 inch of mercury." The motion of the pistons is effected by means of a short crank with a jointed connecting-rod, converting the circular motion given by the lever handle into a vertical one, which is maintained by means of a cross-head with rollers working between guides. This pump is more particularly described in Mr. Tomlinson's 'Rudimentary Treatise on Pneumatics.'

In the air-pump exhibited by Varley and Sons a new construction is adopted. "It is worked by a continuous rotatory motion of the handle, slide-valves being used to open and close the communication. On the piston arriving at one end to expel air from the barrel, it is followed by rarefied air from the receiver; the slide-valve closes upon the receiver and connects the two sides of the piston; the residual air expands into the larger space, becomes equally rarefied, and the subsequent motion of the valve separates these spaces, and connects the receiver with the closed end. The piston then returns to exhaust air into this end of the barrel and to expel it from the other, and thus continuous exhaustion is kept up; for, how rare soever the air becomes, it keeps flowing after the piston continually. The barrel is twice filled for every entire revolution of the handle. This pump has a single barrel with double action; it exhausts quickly, and the exhaustion was found to be 0·05 inch for a moment, but could not be maintained."

In the French department, the double-barrelled air-pump exhibited by M. Breton had, instead of valves, a glass plate sliding over apertures communicating with the receiver, and the pumps and the motion of this glass plate is produced by the mechanism which works the pump. "The approximate exhaustion is first made by the ordinary alternate action of the barrels. The system of communication is then changed by shifting round the glass plate, which serves as a valve during one-fourth of a revolution, when the rarefied air is condensed in one barrel and sucked into the other, whence it is ultimately ejected through a valve of oiled silk very close to the piston." In the air-pump exhibited by M. Deleuil, the barrels were of glass, and the valves, after M. Babinet's plan, were opened by means of wires passing through the pistons. The opening of the valves is thus rendered independent of the elastic force of the air left in the receiver, and the degree of exhaustion must depend on the air remaining after the action of the piston.

AISLE, or AILE (in Architecture), indirectly from the Latin word *ala*, a wing, through the French *aile*, which has the same signification. In French, this term is applied to the outlying and returning ends of a building, which we distinguish by its English equivalent, *wing;* such are the columned ends of the front of the British Museum. We apply the term aisle to the lateral divisions or passages of the interior of a church—those parts which lie between the flank walls and the piers, pillars, or columns, which flank the nave, or grand central division—when the structure is so arranged. Sometimes, but incorrectly, with reference to modern churches and chapels in this country, the mere passages or corridors which run between, and give access to the pews, are called aisles. Still more incorrectly, some writers, and even ecclesiastical writers, have called all the longitudinal divisions of the body of a church, aisles, thus including the nave under a designation which belongs only to its adjuncts and accessories.

The division of a church into what we term nave and aisles arose simply out of the difficulty which existed of spanning a great breadth with a roof without some intermediate support; and thus the greater Constantinian churches or basilicas of Rome were built with four rows of columns, forming five longitudinal divisions; that is, with two aisles on each side of the nave. This was imitated in subsequent structures, and the metropolitan churches of Milan and Paris were built in five divisions, or with four aisles, as they exist at the present time. That the custom of arranging the interiors of churches with aisles was continued in deference to ecclesiastical precedent, or at any rate long after the necessity for using the props which form them ceased architecturally, may be rendered clear by reference to the following fact. Most of our cathedrals and greater churches in this country are of later date than the roof of Westminster Hall, which, without intermediate support, spans a greater breadth than most of them can boast of; and yet they are, as a general rule, all divided into nave and aisles. In recent Gothic churches it is needless to add they are continued, even when, as in some of very small size, they are at once obstructive and costly.

In some English books, though perhaps in none of the present century, this term will be found written without the a—*isle*.

ALANINE ($C_6H_7NO_4$). When aldehyd-ammonia is acted on by hydrocyanic acid, and an excess of hydrochloric acid, a crystalline body, soluble in water, is formed, to which Strecker has given the name alanine. It crystallises in groups of prisms, which are insoluble in ether, nearly so in alcohol. Its solution has no effect upon test-papers. It sublimes at about 400°. It is homologous with *glycocoll* and *leucine*, and isomeric with *lactamide*, *urethane*, and *sarcosine*. When acted on by hyponitrous acid it is converted into lactic acid, as follows:—

$$2(\underbrace{C_6NH_7O_4}_{\text{Alanine.}})+2NO_3=2HO+4N+\underbrace{2HO,\ C_{12}H_{10}O_{10}}_{\text{Lactic Acid.}}.$$

ALARUM. It is curious to mark how much ingenuity has been displayed within the last few years in the invention of alarums, and how many patents have been taken out for the inventions. In most of these contrivances there is some little bit of mechanism which gives a shrill sound whenever attention is required to be directed to any subject with which the alarum is associated.

Without describing any of the older forms, we may glance at a few of the modern suggestions. The 'travellers' alarum' is a small brass box about 2½ inches in diameter by 1¼ thick. It has hands which may be set to any hour to awaken a sleeper. Mr. Allen, in 1844, registered an alarum intended to prevent injury to boilers from the water falling below its proper level; it consists of a float within the boiler, a steam-whistle on the exterior, and a tube of connection; when the water is at a proper height in the boiler, the float is buoyed up, and the whistle is silent; but when the water, and with it the float, descend too low, a little valve in the tube opens, and a current of steam from the boiler ascends to the whistle, which immediately gives forth a shrill sound, thereby indicating that the water has sunk too low in the boiler.

An alarum patented by Mr. Doull, is a 'railway whistle,' so constructed as to yield several notes, capable of being combined into a code of signals. A 'chemical alarum' by Mr. Mowbray consists of a copper cylinder, with a whistle at the top; a piece of carbonate of lime and a little muriatic acid are put into the cylinder, by which carbonic acid gas is speedily generated; and this is forced by some kind of mechanism into the whistle, whenever a sound is required to be produced. A contrivance by Mr. Hoare, described before the Society of Arts, consists of a chain of rods extending from end to end of a railway train, and moving freely on joints; at the end of the chain, in the guard's carriage, is a crank which, when the rods rotate on their axes, comes in contact with a hammer, and causes it to strike a bell; the driver, or the passengers in any carriage, can give a slight rotatory motion to the rods, and thus signals may be communicated. Up to the present time, however, all kinds of railway train signals have been sadly neglected. See further on this subject under RAILWAY.

But the busiest contriver of alarums, perhaps, is Mr. Rutter, who has called to his aid the marvels of electricity. In a patent for several such contrivances, taken out by him in 1847, one variety is the 'Fire Alarm', a complicated apparatus intended for use in large buildings. A galvanic battery is placed in one room, the alarum in another, thermometers in every room, and copper wires to connect all these pieces of apparatus. If the temperature of any room be greatly raised, as by accidental fire the rising mercury in the thermometer comes in contact with a metallic wire, which sets the galvanic battery in action, and this again works the alarum-bell in the same way as an electro-telegraphic clock, but with an adjustment intended to show in which room the rise of temperature has occurred. A second variety, the 'Trespass Alarum,' depends for its action on the placing, near every door and window, of a tube containing mercury, open at the top; the opening or closing of the door or window brings a small wire into contact with the surface of the mercury, and this completes a galvanic connection with a battery in another room: all the parts of the apparatus may be the same as those in the fire alarum, except by having open tubes of mercury near doors and windows, instead of thermometers in each room. A third variety, the 'Railway Alarum,' is intended to establish signals of communication between the guard and the engine-driver of a railway train. There is a copper wire carried through or upon or beneath each carriage, and connected with another in the adjoining carriage by a flexible metallic cord: the wire and cord being coated with gutta percha to secure isolation. There is thus a wire communication from end to end of the train. The guard has in his box or seat, a very small galvanic battery; and the engine-driver has a series of small studs connected with the rail on which his hand is usually resting. When the guard wishes to communicate with the engine-driver, he sends a slight galvanic shock through the wire to the spot on which the hand of the driver rests; and the duplication or variation of the shock may be made to indicate various signals.—It must be evident that great completeness and exactness would be necessary to render any of the above three kinds of alarum efficient for the purpose intended; and it may be added that, as yet, the contrivances have not come into actual use.

A floating alarum was suggested a few years ago by Mr Hobbs, of Bristol, to be moored to a sunken rock or other dangerous place at sea. The centre of the machine is an air-vessel or buoy. At each end is a box in which a whistle is fixed, whose mouth is protected from the water. As the water of the sea circulates in certain parts of the interior of the machine, it drives the air alternately from one end to the other, and impels it through the whistles; and the more violently the sea rocks the floating machine, the louder will the whistles give forth their sound. The proposal of the inventor is to make the buoy and whistles of such dimensions that the sound may be heard some miles distant. [BUOYS.]

ALBATA, is the name given to one of the numerous varieties of white metal, now so largely used in many branches of manufacture at Birmingham. Different mixtures or alloys will produce a white metal. For example, Mr. Parker obtained in 1844 a patent for five such compounds, all having the properties of whiteness and considerable malleability. One consists of zinc, tin, iron, and copper, in certain specified proportions; another of zinc, tin, and antimony; a third of zinc, nickel, iron, and copper; a fourth of copper, nickel, and silver; and a fifth of nickel, iron, and copper. It seems evident from the specification, that many different proportions of the ingredients may be adopted, in each of the above kinds. The mode of making white metal, of zinc 50, tin 48, iron 1, and copper 3, is thus described:—the iron and copper are first melted together in a crucible, and while in a fused state, the tin is added in such quantities at a time that the iron and copper shall not become solid; the zinc is then added, and the whole well combined by stirring. The flux is composed of one part of lime, one part of Cumberland ore, and three parts of sal-ammonia. The alloy thus produced may be cast in sand or ingots for rolling. The 'nickel-silver,' which has recently come largely into use, is a cheap substitute for silver, superior in many respects to albata, and having the metal nickel as one of its components.

See further in respect of these compound metals under ALLOY.

ALBIGENSES, a religious sect, which appeared in the South of France in the twelfth century, and was the object of long and cruel persecutions and wars. The denomination of Albigenses has been used by historians and other writers in two senses, and often indiscriminately. In its more restricted and appropriate sense, the Albigenses were a branch of the Paulicians from the East, who, being persecuted by the Greek emperors and clergy, took refuge during the eleventh century in Italy, from whence they spread into the South of France, Spain, and other countries. They were called in Italy, Cathari, or "pure;" also Paterini, from a place in Milan where they held their meetings; and Gazari, from Gazaria or Lesser Tartary, the country from which they came; they were called, in France, Bulgares, for a similar reason: and afterwards Albigenses, from Albiga, Albi, the town where their tenets were condemned by a council in 1176. But the Cathari were divided into two sects, one of which held the old Manichean doctrine of two eternal beings, one the God of Light, who was the Father of Jesus, and the other, the Principle of Darkness, who was the creator of the material world. This sect was also called Albanenses. The other division of the Cathari believed in one eternal principle, the Supreme God and Father of Christ, by whom the first matter was created; until the Evil Being, after his rebellion against God and his subsequent fall from heaven, arranged this original matter according to his own fancy, and gave it its present form and attributes. They believed that human bodies in particular were the production of the evil principle. The Albigenses belonged to this latter sect, which was also called Bajolenses or Bagnolenses. They had bishops, vicars, and deacons; they preached abstinence, mortification, and celibacy; their community, however, was divided into two classes, the Consolati, or "comforted," who lived in perpetual celibacy, abstained from meat and wine, and practised other austerities; and the Confederates, who, being unable to endure this mode of existence, lived apparently like the rest of the world, but bound themselves to enter before their death into the class of the "Comforted" by a ceremony of inauguration. But, in the more extended sense, the name of Albigenses was given in the twelfth and thirteenth centuries, not only to all the Cathari indiscriminately, but also to the other sects which existed in the South of France at the time, including the Waldenses, who were very distinct in their tenets from the others, and had no taint of Manicheism in them. They all agreed, however, in considering the authority assumed by the Popes in spiritual matters, as well as the discipline and ceremonies of the Roman Church, as unlawful and erroneous. Pope Innocent III. sent two legates, Peter of Castelnau, and one Rainier or Raoul, both Cistercian or Bernardine monks, as his legates to France, in order to extirpate all these heresies. Dominic, a Spaniard, and the founder of the order of Preachers, returning from Rome in 1206, fell in with the legates, and volunteered his services in the same cause. These champions, who, without asking for the advice or the concurrence of the local bishops, and upon the sole authority of the Pope, inflicted capital punishment on those heretics whom they could not convert by argument, were called, in common discourse, 'Inquisitors;' but the famous tribunal of that name was not established until 1233, by Gregory IX., who entrusted it to the Dominicans. In 1208, Castelnau, one of the legates, who had become odious by his severities, was murdered near Toulouse; and Innocent III. on this proclaimed a regular crusade against the Albigenses, and against Raymond VI., Count of Toulouse, who supported them. All the French barons were summoned to take the field; and Simon, Count of Montfort, was appointed chief of the expedition, under the direction, however, of Arnald, Abbot of the Cistercians, and the Pope's new legate. The war began in 1209, and lasted many years, attended by circumstances of the greatest ferocity. At the taking of Béziers a general massacre of the inhabitants began. The legate being asked by some of the military leaders how they were to distinguish the Albigenses from the orthodox Catholics, of whom there were many in the town,—"Kill them all," was the reply; "God will find out his own." Montfort lost his life at the siege of Toulouse, in 1218 and Raymond, his adversary, died in 1222. The war, however, was resumed by the sons of the two antagonists; until Pope Honorius III., alarmed at the successes of Raymond VII., induced Louis VIII., King of France, to take the field in person. At last the Count of Toulouse, pressed on all sides, made peace with the King in 1229. This was a mortal blow to the Albigenses. The Inquisition was now permanently established at Toulouse to try those heretics who had escaped the sword. Raymond himself died some years after; and in him the house of the Counts of Toulouse became extinct, and its territories reverted to the French crown. The extermination of the Albigenses in the South of France was complete; the country was devastated; and the language and poetry of the Troubadours became also extinct, the bards themselves being obliged by the terrors of the Inquisition to fly to other lands. Langlois, a Jesuit, has written a 'History of the Crusade against the Albigenses;' but a better account of them is found in the 'General History of Languedoc,' published at Paris in 1730.

AL BORAK, the name of an imaginary animal, on which, according to a Mohammedan tradition, considered as a dream by some, the Arabian prophet performed his journey from the temple at Jerusalem through the heavens. It is conceived by them to have been of a middle stature and size between that of a mule and of an ass, and to have received its name in allusion to the shining whiteness of its colour.

ALBUM, a Latin word, signifying any thing white. The prætor's album was probably a board, either having the surface or the letters white, on which the acts and edicts of that functionary were inscribed and publicly exhibited. The opinion of some writers, who have supposed that it was the room or place where such notices were hung up, is undoubtedly erroneous. Among the later Latin authors we read of the album of the judges, the album of the senators, and even the album of the citizens, which seem to have been books or registers in which the names of persons of those orders were enrolled. In the middle ages we find album, and albus, and albo (as an indeclinable noun), used for a register of saints, a muster-roll of soldiers, or, in general, any list or catalogue of names. Album also sometimes signifies a letter or epistle, in allusion to the white surface of the paper or parchment. (See the 'Glossaries' of Ducange and Carpentier.) An album, in modern times, is a book appropriated usually to receive the autographs or other manuscript contributions of authors, travellers, or any other person of whom it is thought worth while to collect such memorials; but sometimes, also, merely as a repository of drawings, prints, verses, and other miscellaneous fragments. On the Continent, the matriculation list and the black board at the universities have received this name; and the note-book of a tourist, in which he makes on the spot his memoranda of places and occurrences, is often called his album.

ALBUMEN. A member of the group of substances known as the *albuminoid* or *protein* group. There are *albumen*, represented by the white of egg and the serum of blood; *fibrin*—the muscular tissue of animals; *casein*—found in solution in milk, and forming the basis of cheese; and *legumin*, existing in the seeds of all leguminous plants. To these may be added *globulin* and *vitellin*.

The chemical composition of the varieties of the protein compounds is nearly identical, the ultimate analysis of albumen differing but slightly from that of the others. The following is by Mulder:—

Carbon	53·48
Hydrogen	7·02
Oxygen	22·00
Nitrogen	15·55
Phosphorus	1·55
Sulphur	0·40
	100·00

Casein contains no phosphorus.

Mulder considers that albumen, fibrin, and casein are compounds of a fundamental principle—*protein*—with different proportions of phosphorus and sulphur. This substance, however, to which the formula $C_{36}H_{27}N_4O_{12}$ has been assigned, has never been obtained free from sulphur.

As the animal body is composed to a large extent of muscular and fibrous tissues (fibrin), so it is impossible for an animal to exist on food that contains no protein principle; and Liebig considers that such azotized matter in the food is assimilated directly in the process of digestion by the animal, constituting muscle, nerves, &c. The proteic are sometimes termed the plastic elements of nutrition, in distinction from the respiratory elements.

Albumen forms a constituent both of the animal fluids and solids. Of the animal fluids, it forms an essential part of the serum of the blood; it abounds in the fluid that moistens the surface of the internal cavities of the body and of the organs they contain, and it exists in large quantity in the watery fluid poured out into those cavities in the disease termed dropsy. In some diseases it is met with in the urine. In the animal solids it forms the principal part of all membranes; of the skin, of fibrin, the basis of muscle or flesh, and of the organs called glands.

Albumen then exists in the animal body in two states, in the fluid and the solid form. The best example of fluid albumen is the white of egg. The white of egg consists entirely of albumen held in solution in water, and combined with a small quantity of saline matter. It is, therefore, nearly pure albumen. In this state it is a thick glairy fluid, denser than water, insipid, without odour, mixing readily with cold water, in a large quantity of which it is completely dissolved. Exposed in this fluid form to atmospheric air, it rapidly putrefies; but if a thin layer of it be exposed to a current of air, it dries and is converted into a solid, hard, and transparent substance resembling horn, and in this condition it may be preserved for any length of time without change.

The most remarkable character of albumen is the property it possesses of changing from a fluid to a solid state on the application of heat. This process is termed coagulation. If the white of an egg be exposed to a heat of about 134° of Fahrenheit, white fibres begin to appear in it; if the heat be raised to 160°, the fluid substance is converted into a solid mass; if the heat be still further increased to 212°, it dries, shrinks, and assumes the appearance of horn. In proportion as albumen is diluted with water, it requires a higher temperature to coagulate it; but if water hold in solution only the one-thousandth part of its weight of albumen, the water is rendered opaque by boiling. Before coagulation albumen is abundantly soluble in cold water, after coagulation it is no longer soluble in water.

But heat is by no means the only agent capable of coagulating albumen. Fluid albumen is changed into a solid by alcohol, and one of the readiest modes of obtaining solid albumen is to agitate white of egg with ten or twelve times its weight of alcohol. The alcohol unites with the water which held the albumen in solution, and the albumen is precipitated under the form of white filaments.

Albumen is also coagulated by all the stronger acids, the sulphuric, the hydrochloric, the metaphosphoric, and the nitric, but not by the acetic. It is also coagulated by the metallic salts, such as chloride of tin, subacetate of lead, chloride of gold, &c.; and so delicate a test of the presence of this substance is the chloride of mercury, or, as it is commonly called, corrosive sublimate, that if a single drop of a saturated solution of corrosive sublimate be let fall into water containing only the two-thousandth part of albumen, it will occasion a milkiness in the water, and produce a curdy precipitate. If a slight excess of the mercurial solution be added to the albuminous liquid and heat applied, the precipitate which falls on being dried is found to contain in every seven parts, five of albumen. But the most delicate test for albumen and other protein compounds is the acid liquor obtained by dissolving mercury in its own weight of nitric acid. It gives an intense red with aqueous solution of albumen, and can detect $\frac{1}{100000}$ of this substance. Soluble albumen rotates a ray of polarized light to the left. When pure it has a slightly acid reaction. Alkalies prevent its coagulation, and when coagulated dissolve it. It forms definite compounds with the alkalies—albuminates. The albuminate of potash contains according to Lieberkuhn 5·4 per cent of potash.

White of eggs and serum of blood always contain a small quantity of soda, and Gerhardt considers both substances to contain a definite quantity of bi-albuminate of soda, thus accounting for its soluble form.

That albumen contains a perceptible quantity of sulphur may be observed from the tarnishing of silver spoons that have been used for eating eggs; this being due to a small quantity of sulphide of silver formed on them.

Albumen, from its property of coagulating by heat, is of great use in the clarification of liquids. The albumen, as it is rendered solid by the application of heat, entangles all the substances not held in solution by the fluid, and carries them with it to the surface in the form of scum.

But the most interesting application of albumen is its employment as an antidote against one of the most deadly of the mineral poisons. Corrosive sublimate, or chloride of mercury, is scarcely second in the virulence and certainty of its poisonous properties to arsenious acid itself. For this poison, albumen (white of egg) is an effectual antidote, if administered before the poison is absorbed.

ALCAIDE, or ALCAYDE, a Spanish word derived from the Arabic *káyid*, from the verb *káda*, which means to *head*. The *alcaide* was formerly the governor of a fortress or a castle, and also the keeper of a jail. This name is frequently mistaken by foreigners for that of *alcalde*. The offices of these two functionaries however differ very widely, as the one is a military officer, and the other a civil magistrate. (Covarrubias, *Diccionario de la Academia*.)

ALCALDE, in Spain, is a judge appointed by the government or elected by the towns to administer justice within the district under his jurisdiction. The word is a corruption of the Arabic *El-Cadi*, which means judge or governor, or, according to Alcalá, from *Cahid*, which comes from the root *calede*, to preside. There are several denominations of *alcaldes*. The *Alcalde de Alzadas* is a judge appointed by the government, or the lord of the district, to whom the parties may appeal from the decision of the *Alcaldes Pedaneos*, or justices of the peace. The *Alcaldes de Casa y Corte* is a bench of judges, who singly or jointly try all criminals within the court and twenty miles from it, or sixty in cases of robbery. From the decisions of one of these alcaldes an appeal may be made to their tribunal. When the king travelled, one of these alcaldes was formerly obliged to assist the mayordomo in fixing the price of provisions on the road. In the chancillerias of Valladolid and Granada the criminal judges are called *Alcaldes de Crimen*, to distinguish them from the civil ones called *Oidores*. The limit of their respective jurisdiction is the Tagus,—that is, those of the Valladolid take cognisance of all criminal cases on their side of the Tagus, and those of Granada on the other.

The *Alcalde Mayor* is a judge appointed by the king or by the lord of the town to act as an assessor to the *Alcaldes* or *Corregidores*, who are not men of the law. The *Alcaldes Pedaneos* are elected by the people yearly; they preside at the common council, or Ayuntamiento, and act as magistrates. The parish officers are also called *Alcaldes*, and are distinguished by appellations expressing their office, such as *Alcaldes de Barrio*, or parish, *de Calle*, of the street, *de Noche*, of the night, because they patrol and watch during the night. As there is no jury in Spain, all the judges both give the verdict and pronounce the sentence. It is however worthy of observation, that in the *fuero* of Toledo, granted in 1083, it was ordered that all the cases should be tried by the book of the judges, in the presence of ten individuals of the most worthy and most wise of the city elected annually, who were always to sit at court with the judge. A sort of jury existed formerly in the Balearic Islands, but so beneficent an institution no longer remains in any part of the peninsula.

(*Diccionario de la Acad.*; Garibay; Covarrubias.)

ALCA'NTARA, THE KNIGHTS OF (*la Caballeria de Alcántara*), a military and religious order of Spain, so called from the town upon the Tagus. About the year 1156, Ferdinand II. received from his father the kingdom of Leon, with Galicia and Asturias. Of the first of these, a large portion was in possession of the Moors, especially the valley of the Coa, a river which, passing near Almeida, runs northward into the Douro. In this state of things, two brothers, with a body of knights from Salamanca, seized a hermitage in this valley called San Julian del Pereyro, which they converted into a fortress. Distinguished by their courage and success against the Moors, they were constituted by the Bishop of Salamanca a half religious, half military order of knights, under the rule of Saint Benedict; and the institution was confirmed by Pope Alexander III. in 1177. When Alcántara was recovered from the Moors in 1213 by Alonzo IX. of Leon, the defence of it was ultimately assigned to the knights of San Julian del Pereyro. This title was soon absorbed in that of Alcántara. Thirty-seven masters in succession commanded the noble order of Alcántara; and, like those of Calatrava and Santiago, they were at times almost too powerful for the monarchs of Spain. In 1494 or 1495, Ferdinand, the husband of Isabella, who had already assumed the command of the other two orders, prevailed upon Juan de Zuniga, son of the Duke of Arévalo, to resign the grand-mastership of Alcántara. From that time the dignity has remained in the crown of Spain. (A full account of the order has been given by Radez de Andrada in his *Chronicles of Alcántara*, and by Zapater in his *Cister Militante*.)

ALCARGIN, ALCARIN. } [CACODYL.]

ALCARRAZAS. This name is given to vessels made of coarse porous pottery, used in Spain for the purpose of cooling water. The cooling results from the copious evaporation of the small portion of water which soaks through the vessels to the outside; the heat necessary for bringing about this evaporation being drawn from the remaining water in the vessel.

A convenient substitute for the alcarrazas may be made in the following way:—Mix thoroughly, in the dry state, equal parts of siliceous sand and good clay; then bring it to a proper consistence with brine, adding afterwards a considerable quantity of common salt, which must be well incorporated with the clay by beating. Another method is to mix up the clay with twice its weight of charcoal in powder, and bake it until the charcoal is perfectly burnt out. The vessels to be used as coolers must not be fully baked.

For the modes of cooling the wort in making beer and wine, see BREWING; DISTILLING. See also, FREEZING; ICE HOUSES.

ALCHEMY, the pretended art of making gold and silver. The name appears to be derived from the Greek χημεία, chemistry, but the *al* prefixed to it denotes the probability of the Arabic origin of the imposture. Another and subsequent object of alchemy was the preparation of a universal medicine. Those alchemists who were supposed to be skilled in the art, were termed *adepts*, or *the adepts*.

In the opinion of the alchemists, all the metals are compounds, the baser of them containing the same constituents as gold, but mixed with various impurities, which being removed, the common metals were made to assume the properties of gold. The change was effected by what was termed *lapis philosophorum*, or the philosophers' stone, which is commonly mentioned as a red powder possessing a peculiar smell.

It is not quite certain either at what period or in what country alchemy arose; and different opinions on the subject are expressed by authors. Dr. Thomson ('History of Chemistry,' vol. i. p. 14) supposes that it originated among the Arabians when they began to turn their attention to medicine, after the establishment of the Caliphs; or that, if it had been previously cultivated by the Greeks, as there is some reason to suppose, it was taken up by the Arabians and reduced by them into regular form and order. This conclusion is rendered extremely probable, on account of the prefix of the Arabic article *al*.

Hermes Trismegistus is generally mentioned as one of the earliest alchemists; but the writings bearing his name are undoubtedly spurious. In 1692, Dr. Salmon, in his 'Clavis Alchymiæ,' published a translation of the 'Tractatus Aureus' attributed to Hermes, with the works of some other alchemists. The translation is accompanied with notes which rival the original in absurdity. The word *hermetic*, still in common use, is derived from Hermes. Geber, an Arabian physician who lived in the 7th century, is one of the earliest alchemists whose works are extant; but some doubt of their genuineness is entertained. Dr. Thomson ('History,' vol. i. p. 15) remarks, that though the principles which lie at the bottom of alchemy were implicitly adopted by him, he does not attempt to make gold artificially, nor admit the possibility of converting the baser metals into gold. In Dr. Salmon's work, however, the following passage occurs, translated from Geber's 'Alchemy of Sol': "Whatever metal is radically citrine, and brings to equality and cleanses, it makes gold of it; from whence we discern, that copper may be transmuted into gold by artifice," &c. &c.

Geber also treats of the *Medicine, Tincture, Elixir, or Stone of the Philosophers in general.* Dr. Johnson supposes that the word *gibberish*, anciently written *geberish*, was originally applied to the language of Geber and his tribe; many of the quotations given by Salmon would certainly justify the etymology. Although it is also apparent that Geber was an alchemist in the most comprehensive sense of the word, and although his works abound with the most absurd and mystical phrases, yet his chemical labours were directed to the improvement of medicine. He has also described and depicted various furnaces, crucibles, alembics, aludels, and other useful chemical apparatus, of which he was probably the inventor; and he treats of distillation, sublimation, calcination, and various other chemical operations.

Omitting any mention of less celebrated alchemists, we proceed to notice Albert Groot, usually called Albertus Magnus, a German, who was born at Bollstaedt in 1282. He was acquainted with all the sciences usually taught in that age, and his works were published at Leyden in 1651, in twenty-one folio volumes, among which are seven tracts on alchemy. According to Dr. Thomson, Albertus, in his treatise 'De Alchemia,' gives an account of all chemical substances known in his time; was well acquainted with chemical apparatus, and with the methods of purifying the precious metals. He imagined that the metals were composed of mercury and sulphur, and accounts for the diversity of them, by the difference in the proportion of their constituents and their purity. His writings are in general plain and intelligible. Thomas Aquinas is asserted to have been the pupil of Albert; he wrote three works on alchemy which are said to be always obscure, and often unintelligible; the word *amalgam*, signifying a compound of mercury and another metal, occurs, and probably for the first time, in his writings; which contain also some other terms still used in chemistry.

The alchemist next to be mentioned is Raymond Lully, who was born at Majorca in 1235. He was a very singular person; he travelled to various kingdoms to preach Christianity, and died in 1315, on his passage from Africa, where he had been on this service.

Lully is stated to have been the scholar and the friend of Roger Bacon; his reputation as an alchemist was very high, and his works, which are generally obscure, amount to nineteen. He obtained nitric acid by distilling a mixture of nitre and sulphate of iron, observed its power of acting upon metals generally, and of dissolving gold when mixed with sal-ammoniac. He appears also to have known various other chemical compounds, and their action upon each other.

Roger Bacon, frequently called Friar Bacon, a Franciscan monk, was born at Ilchester, in Somersetshire, in 1214. Notwithstanding the great learning and scientific acquirements of Bacon, he was deeply imbued with the mystery of alchemy: this is the more remarkable, because he exposes the absurdity of believing in magic, necromancy, or charms. His chemical and alchemical writings amount to eighteen, a list of which may be seen in Dr. Thomson's 'History of Chemistry,' vol. i. p. 35. Bacon appears to have been acquainted with the composition of gunpowder, and by some he is thought to be the inventor of it. It was, however, probably introduced into Spain by the Moors; and Bacon, from his acquaintance with Arabic, might have acquired information of its composition from some writing in that language. Bacon has hinted at his knowledge of the ingredients of gunpowder, in his 'Epistola de Secretis Operibus Artis et Naturæ et de Nullitate Magiæ,' in the following enigmatical sentence: "Sed tamen salis petræ Luru. Vopo. Vir Can Vtriet sulphuris; et sic facias tonitrum et coruscationem, si scias artificium.' Saltpetre and sulphur being distinctly named, we have only to suppose charcoal to be concealed under the enigmatical terms quoted, and then all the substances contained in gunpowder are mentioned as capable of producing thunder and lightning when properly used.

It is not to be wondered at, in a barbarous age, that one who was skilled in so many sciences should be accused of witchcraft; we accordingly find, that Bacon was imprisoned on this charge, and narrowly escaped starvation, or being burnt as a magician. The real ground of his offence appears to have been his exposure of the immorality of the priesthood. He died either in 1284 or 1285; his 'Opus Majus,' edited by Dr. Jebb in 1733, and the 'Epistola,' already quoted, are the works of this author most worthy of perusal. In the list of Bacon's works already referred to, there are several professedly on alchemy. Dr. Salmon has translated one which is not among them, called 'Radix Mundi;' another work on alchemy, called 'Speculum Alchemiæ,' mentioned in the list above referred to, is also translated by Dr. Salmon.

Arnoldus de Villa Nova was not only an alchemist, but an astrologer and magician. He is said to have been born, in 1240, at Villeneuve, a village of Provence: he was educated at Barcelona, which place he was obliged to leave, in consequence of foretelling the death of Peter of Aragon. When he left Barcelona, he went to Paris, and travelled through Italy; and afterwards taught in the university of Montpelier. He acquired high reputation as a physician; and was well skilled in several languages and in the sciences of his time.

He wrote about twenty different works, some of which are professedly on alchemy: the book entitled 'Rosarium' is probably the most curious, it being intended as a compendium of the alchemy of the day. The second part of this work, which professes to treat of the art of making the philosophers' stone, is stated to be quite unintelligible. Like his predecessors, he considered mercury as a constituent of metals; and professed that he could increase the philosphers' stone at pleasure. He died in the year 1313, on his way to visit Pope Clement V., who lay sick at Avignon.

Raymond Lully and Arnoldus de Villa Nova are stated to have inspired men of all ranks with a taste for alchemy. Pope John XXII. was one of them; he professed and described the art of transmuting metals; and boasts, in the beginning of his book, that he had made 200 ingots of gold, each weighing a hundred pounds.

The 14th century produced a considerable number of alchemists,—as Nicolas Flammel, Pierre le Bon of Lombardy, the monk Ferrari in Italy, Cremer, abbot of Westminster, the disciple and friend of Lully, John Daustein and Richard, in England, practised and wrote upon hermetic philosophy. The work attributed to Flammel is generally reckoned spurious. The 15th century was more productive in adepts, even than the preceding. About 1408 flourished John Isaac Hollandus, and his countryman of the same name, who were either brothers or a father and son. They were born in the village of Stolk, in Holland. Few circumstances are known respecting them. They wrote several treatises on chemistry, which are remarkable for clearness and precision, considering the time at which they appeared. In the opinion of Boerhaave, they were very distinguished chemists. Paracelsus and, subsequently, Boyle repeated many of the experiments contained in their works; they related, however, principally to the transmutation of metals. In this century was born George Ripley, who was canon of Bridlington, in Yorkshire: he published a work, called 'Medulla Alchymiæ,' which is translated by Dr. Salmon, in his 'Clavis.' This work is replete with the same sort of unintelligible jargon which usually abounds in such productions. He wrote another work, in rugged rhyme, called the 'Compound of Alchemie,' which was dedicated to Edward the Fourth.

Basil Valentine, a Benedictine monk, of Erfurt, in Germany, was born at the latter end of the 14th century; and, with the exception of Paracelsus, he was, perhaps, the most famous professor of the hermetic philosophy: but he possessed, at the same time, very considerable merit as a chemical experimenter, and was much occupied in the preparation of chemical medicines. He first introduced antimony into medicine: his work on this subject is entitled 'Triumphwagen Antimonii,' which was translated from the German into Latin, under the title of 'Currus Triumphalis Antimonii,' by Kerkringius, in 1671. In this book he strongly advocates the chemical sect; and treats the practice and theories of his opponents with great severity, because they are unable to prepare their own medicines: "They know not whether they be hot or dry, black or white; they only know them as written in their books, and seek after nothing but money. Labour is tedious to them, and they commit all to chance; they have no consciences, and coals are outlandish wares with them; they write long scrolls of prescriptions, and the apothecary thumps their medicine in his mortar, and health out of the patient."

Basil Valentine was of opinion that the metals are compounds of salt, sulphur, and mercury, and that the philosophers' stone was composed of the same ingredients. He was acquainted with many of the properties of several metals, and with the effects they were capable of producing by their chemical agency. He was, however, more particularly informed with respect to antimony, and knew most of the preparations of it which at present exist in the pharmacopœias of Europe. Twenty-three different publications have been ascribed to Basil Valentine, but it is uncertain how many of them were written by him. His works contain the first accurate mention of the nitric, hydrochloric, and sulphuric acids, with intelligible directions for preparing them; and he was acquainted with a very considerable number of metallic salts and compounds.

We have now mentioned the principal writers on alchemy. There arose, however, from time to time, various authors, who appear to have been rather believers in the possibility of the transmutation of metals than pretenders to have accomplished it. A list of alchemists, from Hermes, who is represented as having flourished nearly 2000 years before the Christian era, down to Mathieu Dammy, in 1739, may be seen in the 'Encyclopédie Méthodique:' it is copied from Dufrenoy's 'Histoire de la Philosophie Hermétique.' This list contains names which are more familiar as chemists than as adepts; such, for example, as Paracelsus (who applied the philosophers' stone, not to the making of gold, but to the preparing of medicines), Libavius, Van Helmont, Glauber, and Kunckel.

To these believers in the art may be added Bergmann, a celebrated chemist of very late date, who, after summing up the evidence for and against the possibility and probability of transmutation, observes, respecting the numerous relations that have been given by writers of apparent veracity, that, "although most of them are deceptive, and many uncertain, some bear such character and testimony, that, unless we reject all historical evidence, we must allow them entitled to confidence."

The later Peter Woulfe, who was a Fellow of the Royal Society, and died in 1805, is reported to have been a believer in alchemy. His name is associated with chemical operations on account of the apparatus which bears his name, but which had been previously described by Glauber.

The last person, at least in this country, who professed to convert mercury into silver and gold, was Dr. Price of Guildford: he is said to have convinced some persons of the possibility of the transmutation; his experiments were to have been repeated before competent judges, but he prevented detection and exposure by destroying himself with laurel water. This happened in 1782.

For an account of that mysterious substance, the philosophers' stone, by which the wonders of transmutation were worked, and a detail of the process for preparing it, given in the words of an adept, we refer the reader to Dr. Thomson's 'History of Alchemy,' p. 23.

Dr. Thomson states, that the philosophers' stone, prepared by the elaborate process above referred to, could hardly have been anything else than an *amalgam of gold;* and "there is no doubt," he adds, "that amalgam of gold, if projected into melted lead or tin, and afterwards cupellated, would leave a portion of gold; all the gold, of course, that existed previously in the amalgam. It might, therefore, have been employed by impostors to persuade the ignorant that it was really the philosophers' stone; but the alchemists who prepared the amalgam, could not be ignorant that it contained gold."

In the 'Memoirs of the Academy of Sciences' for 1772, M. Geoffroy published an account of the various modes in which the frauds of the adepts were carried on; some of these we shall mention. He observes that, instead of the mineral substances which they pretended to transmute, they put oxide (*chaux*) of gold or silver at the bottom of the crucible, the mixture being covered with some powdered crucible and gum-water, or wax, so that it might look like the bottom of the crucible. On other occasions, they made a hole in a piece of charcoal, filled it with powdered gold or silver, and closed the hole with wax; or they soaked charcoal in a solution of these metals, and threw the charcoal, when powdered, upon the material to be transmuted. They used also small pieces of wood, hollowed at the end, put filings of gold or silver into the cavity, and stopped it with fine sawdust of the same wood, which on burning left the metal in the crucible. Sometimes they whitened gold with mercury, and made it pass for silver or tin; and the gold, when melted, was exhibited as gold obtained by transmutation. They had a solution of nitrate of silver, or of chloride of gold, or an amalgam of gold or silver, which, being adroitly introduced into the crucible, furnished the necessary quantity of metal. A common exhibition was, to dip nails into a liquid, and to take them out apparently half converted into gold: these nails consisted of one-half iron, neatly soldered to the other half, which was gold, and covered with something to conceal the colour, which the liquor removed. Sometimes they had metals made of gold and silver soldered together; the gold side was whitened with mercury, dipped into some transmuting liquid, and then heated; the mercury being dissipated, the gold portion of the metal appeared.

Bergmann, in his 'Essays,' vol. iii. p. 93 ('History of Chemistry during the Middle Ages'), has given a number of cases in which gold had been supposed to be formed by the use of the philosophers' stone. They were unquestionably the results of some of the above-mentioned tricks; but Bergmann states it as his opinion, that some accounts of transmutation are "entitled to a greater degree of credit" than others. "For doubtless," he adds, "if a person, who has no faith in the changes of alchemistry, should obtain by chance a small piece of the philosophers' stone, and, on making the experiment alone in his closet, procure a quantity of gold heavier than the stone, will it not be difficult to explain in what manner he was liable to be deceived?" Before the difficulty is required to be explained, the fact must be placed on incontestable evidence.

The question has sometimes been asked, whether the labours of the adepts have been favourable or otherwise to the progress of chemical science? This question we should be inclined to answer in the negative, on account of the disrepute into which the jargon of their writings and the frauds of their experiments must have brought, not only their authors, but the science which they abused. On this subject Dr. Thomson however remarks ('History,' p. 30), "As the alchymists were assiduous workmen, as they mixed all the metals, salts, &c., with which they were acquainted, in various ways with each other, and subjected such mixtures to the action of heat in close vessels, their labours were occasionally repaid by the discovery of new substances, possessed of much greater activity than any with which they were previously acquainted. In this way they were led to the discovery of sulphuric, nitric, and hydrochloric acids. These, when known, were made to act upon the metals; solutions of the metals were obtained, and this gradually led to the knowledge of various metalline salts and preparations, which were introduced with considerable advantage into medicine. Thus the alchemists, by their absurd pursuits, gradually formed a collection of facts, which led ultimately to the establishment of scientific chemistry." It may be also stated in favour of the alchemists, that phosphorus was discovered by an adept of the name of Brandt, at Hamburg, in 1677: this he procured from urine, while searching for some substance capable of transmuting silver into gold.

Gibbon, 'Decline and Fall,' vol. ii. p. 137, speaking of alchemy, says, that, "congenial to the avarice of the human heart, it was studied in China as in Europe, with equal eagerness, and with equal success. The darkness of the middle ages insured a favourable reception to every tale of wonder; and the revival of learning gave new vigour to hope, and suggested more specious arts of deception. Philosophy, with the aid of experience, has at length banished the study of alchemy; and the present age, however desirous of riches, is content to seek them by the humbler means of commerce and industry."

A not very successful attempt has lately been made to show that the alchemists were in reality moral philosophers, who clothed their thoughts in metaphorical language, and that the transformations they describe refer to mental and not to chemical processes.

ALCOHOL. ($C_4H_6O_2$)—*Spirit of Wine; Hydrate of Ethyl; Vinic Alcohol.* Alcohol was first discovered as a distinct compound by a physician of Montpelier about 1300, but its true composition was first made known by De Sassure. Alcohol is derived, 1st, from the fermentation of saccharine matters, and, 2nd, from the products of the destructive distillation of coal and other organic substances. It may also be made artificially from its elements. Practically it is always obtained from the first source. By contact with yeast, grape sugar is transformed into alcohol and carbonic acid.

$$\underbrace{C_{12}H_{12}O_{12}}_{\text{Grape Sugar.}} = \underbrace{2C_4H_6O_2}_{\text{Alcohol.}} + \underbrace{4CO_2.}_{\text{Carbonic Acid.}}$$

The alcohol thus produced is contained in the various fermented liquors, such as beer, wine, wash, &c., greatly diluted with water and mixed also with several other substances. From the latter it is freed by repeated distillation, by which much of the water is also got rid of; but on account of the chemical affinity existing between alcohol and water, it is not possible to obtain the former free from the latter by simple distillation, though frequently repeated; the specific gravity of the product is never less than 0·825, and the rectified spirit of wine of commerce and of the 'London Pharmacopœia' has a specific gravity of 0·835.

In order to obtain pure or absolute alcohol, other methods must be resorted to. According to M. Sœmmering, the water may be entirely separated from alcohol by the following process: Put the spirit into an ox's bladder coated with isinglass, and expose it to a temperature of 105° to 120°; the interior of the bladder is moistened by the water of the spirit, and whilst the exterior coat dries, fresh portions of water continue to penetrate the bladder, and to evaporate from its surface, while but little of the alcohol escapes with it. Spirit put into a wide-mouthed bottle and tied over with bladder, suffers a similar evaporation of the water and concentration of the alcohol. Geiger and Planiava assert, however, that the remaining alcohol still retains three per cent. of water. Pajot Descharmes proposed to place spirit in a flat vessel beside fragments of chloride of calcium under a closed receiver; the air contained in this soon becomes loaded with the vapour rising from the spirituous liquor, the salt combines with the aqueous portion of it, and the alcohol is gradually concentrated; some, however, is lost, being vaporised and condensed with the water. Berzelius, 'Traité de Chimie,' t. vi. 448.

Graham proposes a process upon a similar principle, namely, that of placing a shallow vessel of spirit over another containing coarsely powdered lime, under a bell-glass, upon the plate of an air-pump; the air is exhausted till the alcohol begins to boil, and the lime absorbs the water only of the vapour which rises. If sulphuric acid be substituted for lime, then both the water and spirit evaporate and are totally absorbed. 'Edinb. Phil. Trans.' 1828.

Although these are interesting processes, yet they are scarcely applicable on an extensive scale. The best methods depend upon adding to the spirit some substance which has affinity for the water, and none or but little for the alcohol; thus carbonate of potash is a deliquescent salt, and has consequently a great affinity for water, but unlike most salts of this description, it has no affinity for alcohol, and is totally insoluble in it. When, then, dry carbonate of potash in powder is put into rectified spirit of wine of specific gravity 0·835, the water which it contains dissolves the alkaline salt, and forms a dense solution, on which the alcohol floats, not, however, quite free from water, for when separated and distilled, its specific gravity is reduced only to 0·815, and therefore it still continues to retain about 5 per cent. of water.

A convenient material for obtaining alcohol, nearly if not quite free from water, is sulphate of copper, strongly dried so as to expel its water of crystallisation. If strong spirit of wine be digested for three or four days with an equal weight of the dried sulphate, and the mixture be distilled from a water bath, alcohol, absolute or nearly so, will pass into the receiver. By repeated rectifications from large quantities of quick lime, alcohol may be obtained perfectly absolute. Chloride of calcium which has been fused so as to render it free from water, is an extremely deliquescent salt, and is more powerful than most substances in separating water from alcohol. Mix equal weights of spirit and pieces of the fused chloride in a stopped bottle; when the salt is dissolved, pour off the clear solution into a distilling apparatus, and continue the operation until the product is equal to half the bulk of the spirit employed. If the distillation be properly conducted, the alcohol obtained is perfectly free from water.

In performing any of these processes, however, it must be borne in mind, that absolute alcohol absorbs water with great avidity, and consequently it can neither be obtained nor preserved absolute, unless it be carefully protected from the air so as to prevent its absorbing atmospheric moisture.

Pure alcohol possesses the following properties: It is a limpid colourless liquid, of an agreeable smell and a hot pungent taste. Its specific gravity is 0·791 at 68°, or 0·7947 at 59°. It has never been frozen, although exposed to a cold of —220°. It is extremely volatile, producing considerable cold during evaporation. Heat expands alcohol in a greater degree than it does water; for 100,000 volumes become 104,168 by being heated from 32° to 100°; whereas an equal bulk of water heated to the same degree, is increased only to 100,908. Under the average atmospheric pressure alcohol boils at about 173°, but in the vacuum of the air-pump, ebullition occurs at 60°, and even below it. In becoming vapour, alcohol absorbs only 0·436 of the heat required to evaporate an equal weight of water; and, according to Gay-Lussac, ('Ann. de Chim. et de Phys.' xv.) the density of the vapour of anhydrous (waterless) alcohol compared with that of atmospheric air, is as 1·613 to 1·000. When the vapour of alcohol is strongly heated, as by being passed through a red hot porcelain tube, it is decomposed, and there are obtained, gaseous hydrocarbons, aldehyde, naphthaline, benzole, phenylic alcohol, and several other substances, together with a small amount of carbon. Alcohol, and the vapour arising from it, are extremely inflammable; it burns with a lambent flame. Although the flame of alcohol yields but little light, its heat is intense; it burns without any smoke, and the only products of the combustion, under common circumstances, are water and carbonic acid. When, however, alcohol is burned in the lamp without flame, in the wick of which a platinum wire is kept ignited, then acetic acid and other products are also formed. There are several substances which communicate colour to the flame of alcohol: boracic acid and cupreous salts impart green; barytic salts, yellow; and the salts of strontia, an intense and beautiful crimson colour.

Alcohol may be fired by the electric spark, which when passed through a mixture of the vapour of alcohol and oxygen gas, causes it to take fire and explode violently. The vapour of alcohol requires three times its volume of oxygen gas to be perfectly burned, and it then yields water and twice its volume of carbonic acid gas. At low temperatures, alcohol suffers but little change by exposure to the air; the portion which does not evaporate is rendered weaker by attracting water, and it absorbs at the same time some air.

Alcohol has great affinity for, and readily mixes with water in all proportions, and during their combination heat is evolved; if, for example, equal measures of water and of alcohol of specific gravity 0·825, both at 50°, be suddenly mixed, the temperature is raised to 70°, and the specific gravity of the mixture, when cooled, exceeds its calculated density; if, however, the alcohol be weak, then the mean density is diminished.

For the density of various mixtures of alcohol and water, see ALCOHOLOMETRY.

In contact with acids, alcohol forms a vast number of ethereal salts, several of which are remarkable for possessing the fragrant odour of various fruits. With concentrated sulphuric acid it yields sulphovinic acid, which, on being heated, produces ether. [ETHER.] Oxidising agents convert it into aldehyde and acetic acid. Chromic acid acts upon it so violently as to cause inflammation when strong alcohol is dropped upon the acid. Pure alcohol does not oxidise when exposed to the air, but when mixed with fermentisable matters it gradually absorbs oxygen, and is converted into acetic acid. Chlorine acts readily upon alcohol, forming a series of chlorinated products, and finally chloral.

The solvent power of alcohol is great; and it has been long known and extensively applied. Graham ('Trans. Royal Soc. Edin.') has shown that, like water, it combines with bodies in definite proportions; these compounds he terms *alcoates*; not many of them have been formed, and they were obtained simply by dissolving the salts constituting their base, and previously rendered anhydrous, in absolute alcohol, with the assistance of heat. On cooling, the alcoates were deposited in the solid state; the crystallisation was generally confused, but in some cases regular forms appeared. The crystals are transparent, soft, and easily fusible by heat in their alcohol of crystallisation; their formation is prevented by the presence of a small quantity of water. Chloride of calcium forms an alcoate consisting of 2 atoms of alcohol and 1 of the salt; nitrate of magnesia, 1 atom salt + 3 atoms alcohol; alcoate of nitrate of lime consists of 2 atoms salt and 5 atoms alcohol. Several metallic salts were also converted into alcoates, and analysed by Graham; the alcohol of some alcoates is retained with so great force of affinity as not to be expelled at a temperature of 400° to 500°.

Alcohol is capable of dissolving the resins, and many similar bodies upon which water has no action; hence its use in varnish-making. With the fixed oils, except castor oil, it does not readily unite; but it dissolves the essential oils and camphor with great facility, and hence its use in pharmacy and perfumery. Some substances which are soluble in water are precipitated from it by alcohol—gum, for example; while, on the other hand, water precipitates resinous bodies from solution in alcohol. Alcohol dissolves sulphur and phosphorus, but not the earths or their carbonates: it also dissolves sugar, soap, the oxalic, tartaric, gallic, benzoic, and some other acids. Alcohol is largely used in the preparation of various kinds of ether. The results of its action with sulphuric acid are very different according to circumstances: thus, by varying the proportions, we may procure sulphovinic acid, ether, oil of wine, or olefiant gas. As it remains fluid at the lowest temperatures, it is advantageously employed in filling thermometer tubes, for experiments on artificial cold; its antiseptic properties are great, and hence its use in preserving anatomical preparations; on account of its ready inflammability, the purity and the intense heat of its flame, it is conveniently, but not economically, employed in chemical lamps, usually termed *spirit lamps*.

It readily dissolves ammoniacal gas; and as the caustic alkalies, potash and soda, are taken up in large quantity by alcohol, and as it does not dissolve their usual impurities, the solution, by dilution with water and subsequent distillation, yields these alkalies in a state of great purity. In analytical operations it is sometimes employed to separate two salts, both of which are soluble in water, but only one in alcohol. It is also largely employed in proximate organic analysis, and in the preparation of the various ethyl compounds used in chemical investigations.

For most of these purposes pure alcohol may be replaced by the *methylated spirit* now allowed by the Excise under certain restrictions to be sold free of duty.

Alcohol, Medical properties of. These are of a twofold kind; first, those in which it is employed on account of its solvent powers, it being, next to water, the most extensively employed solvent, to obtain, preserve, or facilitate the administration of a variety of active principles, vegetable, mineral, or animal; and secondly, those in which its own powers over the human frame lead to its use as a therapeutic agent. The former will be treated of under TINCTURES; and it is only necessary to observe here, that, besides for these, it is employed in many pharmaceutical processes in which it does not ultimately appear, either for its solvent or precipitating properties, such as in the preparation of many of the alkaloids, namely, aconitina, strychnia, &c., which, though the most potent medicinal agents we possess, are greatly restricted in their application by the high price charged for them. This arises partly from the minute quantity in which they exist in their original sources, the plants which produce them; but far more from the high duty on alcohol, which places our practical chemists at a great disadvantage compared with those of France and Germany. Methylated spirit is now allowed to be used, which is a great boon.

The therapeutic properties of alcohol are therefore the only properties to be noticed here; and it is by no means intended to discuss points which have excited keen controversies in reference to the employment of alcoholic stimulants as ordinary beverages, but simply that employment of them which is conceded to be allowable by all parties—their use as medicinal agents. Besides, as many who do not require them are, in accordance with the usages of society, in the habit of taking them, it is proper to indicate which are the least hurtful. The excessive use of ardent spirits is deservedly reprobated, and every reasoning person will gladly lend his aid to root out this almost national vice; the evil effects of which are not limited to the individual, as the physical ailments engendered by habitual drinking have a great tendency to become hereditary. The mental powers of the offspring are also greatly influenced by the habits of the parent; and diseases of the brain, with derangement of the intellectual faculties, are the consequence. The extension of education and the better tone of feeling in the higher classes have done something to banish inebriety from the upper circles of society; and a more correct understanding of what is for their true interests has abated it among the labouring classes. Furnishing the operatives with the means of rational and healthful recreation, both mental and bodily, after the hours of toil, will aid this fortunate revolution. The refreshment of a bath will be found greater, more lasting, and more economical for the workman, than any artificial stimulant, and has been advocated by themselves.

It is proper however that the mode of action of alcohol should be understood, to determine when it should be used. A single moderate dose, suitable for the individual, produces effects which are entirely limited to the viscera of the abdomen. They extend themselves from the solar plexus of nerves to the organs upon which the splanchnic nerve is distributed, and excite in these a livelier action. A feeling of comfort in the abdomen, quicker and more powerful digestion, stronger peristaltic motions, increased desire for meat and drink, more abundant secretion, especially augmented secretion from the kidneys, are the common phenomena which result from the lowest degree of its action. A larger quantity, or several small doses repeated at short intervals, extend the action beyond the sphere of the splanchnic nerve, even to the spinal chord, the brain, and entire nervous system. The feeling of comfort and warmth experienced in the præcordial region is diffused over the whole frame. The pulse is raised, becomes more powerful and quicker, all muscular actions take place with more ease, strength, and capacity of endurance, the tone of the nervous system is raised, the influence of the nervous energy upon the other organs is quicker and more powerful; but, above all, that part of the nervous system whose functions are executed by the brain is most perceptibly increased, as is seen in the greater cheerfulness, humour, and courage, as well as the more active and acute power of thinking. During this degree of action the sensibility to external impressions is unimpaired, or even in many instances augmented, as is manifested by a more eager participation in the incidents occurring or sentiments expressed, and in the expansion of the affections or passions.

Contemporaneously with these, all the functions of organic life are carried on more actively; of which we have proof in the increased secretions, especially of the cutaneous transpiration and secretion of urine.

From this view, it is obvious that alcohol is an agent which, within certain limits, may be most beneficially employed when some portion of the system, particularly the stomach, brain, or kidneys, requires assistance. Hence, under the influence of many sedative poisons, alcohol furnishes the readiest and most potent means of counteracting their effects, the prolonged action of which would prove fatal. Some poisons however, particularly those of ranunculaceous plants, such as monkshood, probably from their active principle being dissolved by the spirit, have their deleterious influence increased by alcohol. In the sinking stage of fevers, and many analogous states, alcohol furnishes the only means of warding off death. In malarious districts and in very humid regions, a moderate use of alcoholic drinks protects the frame against injurious impressions. Hence, in Holland, and even in fenny districts of our own country, alcohol is useful. When cold is conjoined to humidity, it is still more serviceable. The Swiss peasant at great elevations on the Alps, and the shepherd in the Highlands, set the mists of their mountains at defiance; the former by his 'enziangeist,' or 'bitter-snaps,' the latter with whiskey. Such persons are rarely intoxicated. Many persons with feeble and slow digestion have the process expedited by a small portion of alcohol taken after their meals. Those also who suffer much from acidity in the stomach, or who are prone to calculous disorders, find great benefit from pure alcohol, in preference to either malt liquors or wines. (Prout, 'On Diseases of the Stomach,' 3rd ed. p. 9.) For the difference between pure alcohol and alcohol combined with other principles in wines, see WINES. With persons very prone to acidity, pure alcohol agrees better than any wines, especially than the sweet wines; and those disposed to the lithic acid diathesis find alcohol preferable to all wines except those of the Rhine, the employment of which however must be habitual, not occasional. Immense benefits would be conferred on the community in this country, if those light wines could be introduced at a moderate price, as the quantity of alcohol in them is very small compared with other wines.

A reference to the chemical composition of alcohol will show that it is a highly carbonised compound. When taken to excess it produces exhaustion of the nervous power and an oppression of the circulation, almost apoplectic. Emetics or the stomach-pump, vegetable acids given freely, occasionally dashing cold water on the face or head, artificial respiration, and very cautious venesection, in some instances restore the sufferer. Liebig says alcohol has not been detected in the urine. When the quantity taken is not excessive, and can be all exhaled by the lungs, this may be true; but the presence of alcohol in the brain, blood, and urine has been proved by Dr. Percy.

(Dr. Golding Bird, in *Medical Gazette*, vol. xxxiv. p. 690.)

ALCOHOLIC DRINKS. The number of alcoholic drinks is surprisingly large and varied. The following are the principal:—*Agua Ardiente*, made in Mexico, from the fermented juice of the Agave; *Arack* or *Arrack*, made in India from the juice of the palm and from rice; *Araka*, made in Tartary, from fermented mare's milk; *Araki*, made in Egypt from dates; *Arika*, made in Tartary and in Iceland, from fermented cow's milk; *Brandy*, made in nearly all wine countries from wine and from fruits; *Branntwein*, the coarsest sort of spirit used in Germany, is manufactured principally from potatoes, but occasionally rye is used; *Geneva* or *Hollands*, made in Holland from malted barley or rye, rectified on juniper berries; *Gin*, made in England from malted barley, rye, or potatoes, and rectified with turpentine; *Goldwasser*, made at Dantzic from various kinds of corn, and rectified with spices; *Kirschwasser*, made in Switzerland and Germany from the Machaleb cherry; *Lau*, made at Siam from rice; *Maraschino*, made in Dalmatia from the Macarska cherry; *Mahwah Arrack*, made in India from the flowers of the Madhuca tree; *Rum*, made in the West Indies and South America from cane sugar, and molasses; *Rakia*, made in Dalmatia from the husks of grapes, mixed with aromatics; *Rossolio*, made at Dantzic from a compound of brandy with certain plants; *Sekis-Kayarodka*, made at Scio from fruit and lees of wine; *Slatkaia-trava*, made at Kamschatka from a sweet grass; *Show-choo*, made in China from the lees of rice wine; *Trosta*, made in the Rhenish provinces from the husks of grapes fermented with barley and rye; *Tuba*, made in the Philippine Islands from palm-wine; *Vino Mercel*, made in Mexico by distilling the fermented juice of the Agave; *Whiskey*, made in Scotland and Ireland from raw and malted grain, and in the south of France from sloes.

However different the above alcoholic beverages may be, they all have a common resemblance in these particulars:—they all consist chiefly of spirit or alcohol diluted in very various proportions; they all contain portions of essential oils, or colouring matter, or extractive matter; they all derive their distinctive character from the nature of these added substances; and they may all be made to yield pure alcohol by re-distillation and rectification. [BRANDY; DISTILLATION; GIN; &c.]

Numerous as they are, these drinks are wholly distinct from the various rich and luscious CORDIALS and LIQUEURS. The Americans display remarkable ingenuity in the preparation of such drinks, and no less in the invention of extraordinary names for them.

ALCOHOLOMETRY. The process of estimating the percentage amount of absolute alcohol in any sample of spirits, which is usually effected by the determination of the specific gravity of the sample. As a preliminary to this estimation, it is necessary that the alcohol should be freed as far as possible from every foreign ingredient except water. This is easily effected, in the case of wines and fermented liquors, by submitting them to distillation until the whole of the alcohol has passed over. The temperature of the distillate being then brought to 60°, it is ready for the determination of the specific gravity, which is performed by a delicate hydrometer. [HYDROMETER.] Vast numbers of experiments have been made by various observers on the densities of mixtures of alcohol and water, and the results of these experiments form the groundwork of the different tables exhibiting the percentage of alcohol in spirits of various specific gravities. The following table by Drinkwater is one frequently used in alcoholometry:—

Specific gravity at 60° F.	Percentage by weight of alcohol.	Specific gravity at 60° F.	Percentage by weight of alcohol.	Specific gravity at 60° F.	Percentage by weight of alcohol.
1·0000	0·00	·9945	3·02	·9891	6·35
·9999	0·05	·9944	3·08	·9890	6·42
·9998	0·11	·9943	3·14	·9889	6·49
·9997	0·16	·9942	3·20	·9888	6·55
·9996	0·21	·9941	3·26	·9887	6·62
·9995	0·26	·9940	3·32	·9886	6·69
·9994	0·32	·9939	3·37	·9885	6·75
·9993	0·37	·9938	3·43	·9884	6·82
·9992	0·42	·9937	3·49	·9883	6·89
·9991	0·47	·9936	3·55	·9882	6·95
·9990	0·53	·9935	3·61	·9881	7·02
·9989	0·58	·9934	3·67	·9880	7·09
·9988	0·64	·9933	3·73	·9879	7·16
·9987	0·69	·9932	3·78	·9878	7·23
·9986	0·74	·9931	3·84	·9877	7·30
·9985	0·80	·9930	3·90	·9876	7·37
·9984	0·85	·9929	3·96	·9875	7·43
·9983	0·91	·9928	4·02	·9874	7·50
·9982	0 96	·9927	4·08	·9873	7·57
·9981	1·02	·9926	4·14	·9872	7·64
·9980	1·07	·9925	4·20	·9871	7·71
·9979	1·12	·9924	4·27	·9870	7·78
·9978	1·18	·9923	4·33	·9869	7·85
·9977	1·23	·9922	4·39	·9868	7·92
·9976	1·29	·9921	4·45	·9867	7·99
·9975	1·34	·9920	4·51	·9866	8·06
·9974	1·40	·9919	4·57	·9865	8·13
·9973	1·45	·9918	4·64	·9864	8·20
·9972	1·51	·9917	4·70	·9863	8·27
·9971	1·56	·9916	4·76	·9862	8·34
·9970	1·61	·9915	4·82	·9861	8·41
·9969	1·67	·9914	4·88	·9860	8·48
·9968	1·73	·9913	4·94	·9859	8·55
·9967	1·78	·9912	5·01	·9858	8·62
·9966	1·83	·9911	5·07	·9857	8·70
·9965	1·89	·9910	5·13	·9856	8·77
·9964	1·94	·9909	5·20	·9855	8·84
·9963	1·99	·9908	5·26	·9854	8·91
·9962	2·05	·9907	5·32	·9853	8·98
·9961	2·11	·9906	5·39	·9852	9·05
·9960	2·17	·9905	5·45	·9851	9·12
·9959	2·22	·9904	5·51	·9850	9·20
·9958	2·28	·9903	5·58	·9849	9·27
·9957	2·34	·9902	5·64	·9848	9·34
·9956	2·39	·9901	5·70	·9847	9·41
·9955	2·45	·9900	5·77	·9846	9·49
·9954	2·51	·9899	5·83	·9845	9·56
·9953	2·57	·9898	5·89	·9844	9·63
·9952	2·62	·9897	5·96	·9843	9·70
·9951	2·68	·9896	6·02	·9842	9·78
·9950	2·74	·9895	6·09	·9841	9·85
·9949	2·79	·9894	6·15	·9840	9·92
·9948	2·85	·9893	6·22	·9839	9·99
·9947	2·91	·9892	6·29	·9838	10·07
·9946	2·97				

Another table, by Fownes, is less minute, but takes a wider range. Every alternate number in this table is the result of a direct and careful experiment.

Percentage by weight of Alcohol.	Specific Gravity at 60° F.	Percentage by weight of Alcohol.	Specific Gravity at 60° F.	Percentage by weight of Alcohol.	Specific Gravity at 60° F.
0	1·0000	33	1·9528	67	1·8793
0·5	·9991	34	·9511	68	·8769
1	·9981	35	·9490	69	·8745
2	·9965	36	·9470	70	·8721
3	·9947	37	·9452	71	·8696
4	·9930	38	·9434	72	·8672
5	·9914	39	·9416	73	·8649
6	·9898	40	·9396	74	·8625
7	·9884	41	·9376	75	·8603
8	·9869	42	·9356	76	·8581
9	·9855	43	·9335	77	·8557
10	·9841	44	·9314	78	·8533
11	·9828	45	·9292	79	·8508
12	·9815	46	·9270	80	·8483
13	·9802	47	·9249	81	·8459
14	·9789	48	·9228	82	·8434
15	·9778	49	·9206	83	·8408
16	·9766	50	·9184	84	·8382
17	·9753	51	·9160	85	·8357
18	·9741	52	·9135	86	·8331
19	·9728	53	·9113	87	·8305
20	·9716	54	·9090	88	·8279
21	·9704	55	·9069	89	·8254
22	·9691	56	·9047	90	·8228
23	·9678	57	·9025	91	·8199
24	·9665	58	·9001	92	·8172
25	·9652	59	·8979	93	·8145
26	·9638	60	·8956	94	·8118
27	·9623	61	·8932	95	·8089
28	·9609	62	·8908	96	·8061
29	·9593	63	·8886	97	·8031
30	·9578	64	·8863	98	·8001
31	·9560	65	·8840	99	·7969
32	·9544	66	·8816	100	·7938

In order to avoid the trouble of reducing the temperature of the sample of spirits to 60°, tables of a more elaborate nature have been constructed, showing the percentage of alcohol from the density taken at any temperature within the ordinary range of our climate; but these tables are too voluminous for insertion here.

In this country it is usual to express the strength of spirits in degrees *under* or *over proof*; the strength of proof spirit being fixed by Act of Parliament at such a specific gravity that at 51° F. thirteen volumes are equal in weight to twelve volumes of water. Proof spirit has therefore, according to this standard, a density of ·9186 at 60°, and contains very nearly half its weight of absolute alcohol (49·5 per cent.). Sykes' hydrometer is the instrument in general use by the Excise for estimating the strength of spirits according to this standard, and its scale is so arranged as to show the volume of water which must be added to or abstracted from 100 volumes of the spirit in order to bring it to the *proof* standard. Thus if the hydrometer indicates 18 over proof, it shows that 18 volumes of water must be added to 100 volumes of the spirit to reduce it to proof strength; whilst 24 under proof signifies that 24 volumes of water must be abstracted from 100 volumes of spirit to render it proof; or in levying the duty upon such spirit, 100 gallons must be reckoned only as 76 gallons, the duty being assessed upon the proof gallon.

An ingenious method of estimating the alcohol in fermented liquors, without the trouble of previous distillation, has been devised by M. Tabarié ('Ann. de Chim. et de Phys.' xlv. 222). It consists in boiling a known volume of the liquor, the density of which has been estimated, until the whole of the alcohol has been expelled; then replacing the liquid evaporated by an equal volume of distilled water, and again taking the specific gravity, which will now be found to be higher. A table prepared for the purpose shows the percentage of alcohol from this difference in density. Another and more accurate method of effecting the same object consists in ascertaining the boiling point of the liquor. Water boils at 212° and alcohol at 173°, when the barometer stands at 30 inches; consequently a mixture of the two will boil at some temperature between these points, dependent upon the relative quantities of alcohol and water present. Tables of the boiling points of spirits of different but known strengths having been constructed, a reference to these shows at a glance the percentage of alcohol in any sample the boiling point of which has been ascertained. It is found that this method yields results sufficiently accurate with most of the fermented liquors and sweetened spirits in ordinary use, as the sugar and salts present affect the boiling point to a scarcely sensible degree.

The following table embodies the results of alcoholometrical experiments by Brande, Christison, and others, on the percentage of alcohol in the chief descriptions of wine, beer, and spirits:—

		Percentage of absolute alcohol.
Strong Port		17·10
Strong Port, mean of seven samples		16·20
White Port		14·97
Dry Lisbon		16·14
Madeira	from	14·09 to 16·90
Sherry	from	13·98 to 16·17
Teneriffe		13·64
Shiraz		12·95
Malmsey		12·86
Amontillado		12·63
Claret	from	7·72 to 8·99
Rivesaltes		9·31
Hambacher		7·35
Rudesheimer	from	6·90 to 8·40
Tokay		9·09
Champagne		11·60
Cognac		53·39
Rum		53·68
Geneva		51·60
Whiskey		54·32
Edinburgh Ale	from	5·70 to 6·06
Burton Ale		8·88
Stout		6·80
Best London Porter		5·36
Bavarian Beer	from	3·60 to 4·20

ALCOHOLS. Under this term chemists now understand a series of bodies which may be represented as water in which one-half of the hydrogen is replaced by a positive organic radical, thus:—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}O_2. \qquad \left.\begin{matrix}CnH(n+1)\\H\end{matrix}\right\}O_2.$$

Water. Alcohol.

CnH (n+1) being the general formula of a series of uniatomic positive radicals, *n* here representing an even number of atoms, as 2, 4, 6, &c. [CHEMICAL FORMULA]. The above is the general formula of the most important and best-investigated series of alcohols, of which the common or vinic alcohol $\left(\left.\begin{matrix}C_4H_5\\H\end{matrix}\right\}O_2\right)$ is a member. The following are the chief alcohols belonging to this series:—

ALCOHOLS.

Methylic.	Butylic.	Cetylic.
Ethylic, or Vinic.	Amylic.	Cerylic.
Propylic.	Caproylic.	Melissic.
	Caprylic.	

The two first have been long known; the others have been discovered by the more recent researches of Cahours, Brodie, Balard, Bouis, Wurtz, and Chancel.

Most of the alcohols are liquid; but the three last in the list are solid, at the ordinary temperature. All, except the higher terms of the series, are capable of being distilled without decomposition. By oxidising agencies they pass first into aldehydes, and finally into acids

$$\underset{\text{Alcohol.}}{\left.\begin{matrix}CnH(n+1)\\H\end{matrix}\right\}O_2} + O_2 = \underset{\text{Aldehyde.}}{\left.\begin{matrix}CnH(n-1)O_2\\H\end{matrix}\right\}} + \left.\begin{matrix}H\\H\end{matrix}\right\}O_2.$$

and

$$\underset{\text{Aldehyde.}}{\left.\begin{matrix}CnH(n-1)O_2\\H\end{matrix}\right\}} + O_2 = \underset{\text{Acid.}}{\left.\begin{matrix}CnH(n-1)O_2\\H\end{matrix}\right\}O_2}.$$

In contact with acids under favourable circumstances they yield a series of bodies possessing generally a fragrant odour, and termed *ethers* or *ethereal salts*. [ETHEREAL SALTS.] Heated with the sulphuric or phosphoric acid several of the alcohols lose water and are converted into ethers. The alcohols are produced by various chemical processes; thus, the methylic, ethylic, and propylic alcohols are derived from the destructive distillation of wood, and of coal; several, as the ethylic, propylic, butylic, amylic, and caproylic are obtained by the fermentation of saccharine liquids; the ethylic and propylic may also be produced by acting with water upon a solution of their olifenes (C_4H_4 and C_6H_6) in concentrated sulphuric acid, whilst the cetylic, cerylic, and melissic are derived from animal secretions.

Another series of alcohols have the general formula $\left.\begin{matrix}CnH(n-1)\\H\end{matrix}\right\}O_2$; it is represented by the allylic alcohol recently discovered by Hofmann and Cahours, which contains the radical allyl (C_6H_5), and has the formula $\left.\begin{matrix}C_6H_5\\H\end{matrix}\right\}O_2$. Allylic alcohol is obtained by treating the oxalate of allyl with ammonia; oxamide is at the same time produced, according to the following reaction:—

$$\underbrace{C_4O_6,\ (C_6H_5O)_2}_{\text{Oxalate of Allyl.}} + 2NH_3 = 2\underbrace{(C_6H_5O,\ HO)}_{\text{Allylic Alcohol.}} + \underbrace{N_2H_4C_4O_4}_{\text{Oxamide.}}$$

Allylic alcohol is a very mobile liquid, insoluble with water in all proportions, and possessing a pungent odour irritating the eyes and lungs. It boils at 217°, and when ignited burns with a luminous flame. By oxidising agents it is converted into acroleine and acrylic acid, to which bodies it stands in the same relation as vinic alcohol to acetic aldehyde and acetic acid. Allylic alcohol yields an ether the oxide of allyl $\left(\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}O_2$, and a series of ethereal compounds; in fact, in its chemical relations, it bears the closest analogy to vinic alcohol.

A third series of alcohols containing the radicals of the formula (Cn H(n — 7)), is represented by phenylic alcohol, or carbolic acid as it is frequently termed, which has the formula $\left.\begin{matrix}C_{12}H_5\\H\end{matrix}\right\}O_2$. [PHENYL SERIES.]

A fourth series, discovered by M. Canizzaro, have the same general formula as the last, but are only isomeric, and not identical or homologous with the third series. The only alcohols at present known belonging to this series are the following:—

Benzoic alcohol $\left.\begin{matrix}C_{14}H_7\\H\end{matrix}\right\}O_2$. Cuminic alcohol $\left.\begin{matrix}C_{14}H_7\\H\end{matrix}\right\}O_2$.

All the alcohols belonging to the four series above described contain *uniatomic* radicals, that is, radicals representing or replacing one atom of hydrogen in a double atom of water; recent researches however have demonstrated the existence of other classes of alcohols, containing *biatomic* and *teratomic* radicals, replacing respectively two and three atoms of hydrogen in as many double atoms of water. Glycol ($C_4H_6O_4$) is an example of a biatomic, and glycerin ($C_6H_8O_6$) one of a teratomic alcohol. The following formulæ exhibit the relations of these three families of alcohols to each other and to water:—

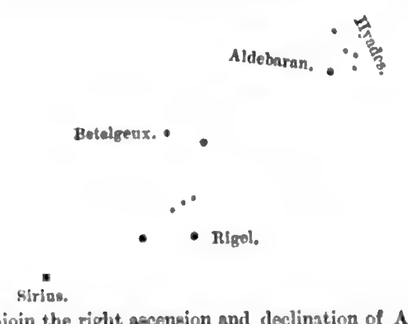
		Water Types.
Vinic alcohol	$\left.\begin{matrix}(C_4H_5)\\H\end{matrix}\right\}O_2$	$\left.\begin{matrix}H\\H\end{matrix}\right\}O_2$.
Glycol . . .	$\left.\begin{matrix}(C_4H_4)''\\H_2\end{matrix}\right\}O_4$	$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_4$.
Glycerin . .	$\left.\begin{matrix}(C_6H_5)'''\\H_3\end{matrix}\right\}O_6$	$\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_6$.

ALCORAN, or ALKORAN. [KORAN.]

ALCOVE. This term is found in most of the modern European languages, and is similarly applied throughout to a recess in a room intended for a bed, or in which a bed may be placed. It is not however necessarily restricted to this meaning; and in England, where such recesses are not so common in bed-chambers as they are in some other countries, and particularly in Spain and France, alcove is applied to a similar recess in a room of any kind, and yet more commonly to an ornamental covered garden-seat.

The term is originally from the Arabic language, in which it means, simply, the cave or recess; and it passed into the other European languages through the Spanish, which acquired it during the occupation of a part of Spain by the Arabs.

ALDE'BARAN, the Arabic name of a large and bright star of the first magnitude, called in modern catalogues *α Tauri*, situated in the eye of the constellation Taurus, whence it is called also by the Arabs *Ain al Thaur*, the bull's-eye. It is the bright star in the group of five, known by the name of the HYADES, on which account it is called by Ptolemy, ὁ λαμπρὸς τῶν Ὑάδων. Its light is rather reddish, and of late years it has become remarkable as having been frequently occulted by the moon, and having exhibited the curious phenomenon of projection on the moon's disc. [OCCULTATION.] It is easily found in the heavens by the following directions: If a line be drawn through the three conspicuous stars forming the belt of Orion, *towards the head*, it passes just below Aldebaran and the Hyades; if *towards the feet*, it passes through Sirius, which is about the same distance from the belt as Aldebaran. This is shown in the following diagram:—



We subjoin the right ascension and declination of Aldebaran at the beginning of the years 1800 and 1859. The difference is owing to the precession of the equinoxes, as this star has no perceptible proper motion.

Date.	Right Ascension.	North Declination.
1800.	4° 2′ 24″	16° 5′ 52″
1859.	4 27 50	16 13 20

Annual motion in right ascension . . . 3″·4341
——————— declination . . . 7 ·673

ALDEHYDE. [OTHYL, HYDRIDE OF.]

ALDEHYDE-AMMONIA. [OTHYL, HYDRIDE OF.]

ALDEHYDIC ACID, *Acetous Acid* ($HO, C_4H_3O_3$). An acid compound, supposed to be formed when aldehyde is heated in contact with solutions of the salts of silver. Its existence as a distinct acid is however very questionable.

ALDERMAN. This word is from the Anglo-Saxon *ealdorman* or *eoldorman*. The term *ealdorman* is composed of *ealdor*, originally the comparative degree of the adjective *eald* ('old'), and *man*; but the word *ealdor* was also used as a substantive, and as such was nearly synonymous with the old English term *elder*, so often met with in our version of the Bible. In a philological sense, the terms *ealdor* and *ealdorman* were equivalent; but in political acceptation they differ, the former being more general, and, when used to express a specific degree, commonly denoting one lower than ealdorman. In both terms the notion of some high office, as well as that of rank or dignity, seems to be inherent; but ealdorman, at the same time, expressed a definite degree of hereditary rank or nobility which ealdor does not so necessarily imply. Princes, earls, governors of provinces, and other persons of distinction, were generally termed Aldermen by the Anglo-Saxons. This word was also applied to certain officers in particular; thus, there was an Alderman of all England (*Aldermannus totius Angliæ*), the nature of whose office Spelman says "he cannot divine, unless it corresponded to the office of Chief Justiciary" in later times. There was also a King's Alderman (*Aldermannus Regis*), supposed to have been an occasional judge, with a commission to administer justice in particular districts; it is possible however that his duties may have resembled those exercised by the king's sergeant in the time of Bracton, when there are traces of the existence of an officer so called, appointed for each county, and whose duty it was to prosecute pleas of the crown. Besides these, there were aldermen of cities, boroughs, and castles, and aldermen of hundreds, upon whose particular functions it would now be useless to speculate.

In modern times, aldermen are individuals invested with certain privileges and duties in municipal corporations, either as civil magistrates themselves, or as associates to the chief civil magistrate of such corporations.

In the municipal boroughs of England and Wales, remodelled by 5 & 6 Wm. IV. c. 76, the resident burgesses elect councillors. The councillors hold office for three years, and one-third of their number go out annually. The aldermen are elected by the council from its own number for six years, and one-half go out every three years. One-fourth of the municipal council consists of aldermen and three-fourths of councillors. (Blackst. Comm., Mr. Kerr's ed. vol. i. pp. 523, 525.)

In the corporation of London, which is not affected by the 5 & 6 Wm. IV. c. 76, the Court of Aldermen consists of 26 aldermen, including the lord mayor: 25 are elected for life by such freemen as are householders of the 25 wards; the 26th alderman, who belongs to the dependency of Southwark or Bridge-Without, is not elected at all, but when the office is vacant the other aldermen have in seniority the option of taking it. The alderman who does take it holds it for life, and thereby creates a vacancy as to the ward for which he formerly sat. The Court of Aldermen possess the privilege of rejecting, without reason assigned, any person chosen for alderman by the electors, and, after three such rejections, of appointing to the vacancy. The lord mayor is appointed from such of the aldermen as have served the office of sheriff. The aldermen are the magistrates for the city of London, and judges *ex officio* of the Central Criminal Court. They possess various kinds of authority, both of a judicial and legislative nature, in the affairs of the corporation.

ALE. The difference between ale and beer is not very distinctly marked. In London, ale is generally a more costly beverage than beer; whereas in country districts the name of beer is often reserved for the better and stronger kinds of malt liquor. In mild or new ale, there is generally a larger amount of saccharine matter and mucilage than in beer, porter, or stout; but in old ale the fermentation has been carried to a greater extent, and the sweetness nearly or wholly disappears. The differences observable in ale depend upon the proportion between the malt and hops, the degree to which the malting has been carried, the quality of the water employed, the heat of the water in mashing, the temperature at which the fermentation is conducted, and the extent to which that process is carried. Nearly every county has its own peculiar ale, known from others by qualities depending on one or more of the above circumstances; but the mode of preparing the malt seems to have a greater influence than anything else on the quality obtained.

Mr. Cooley, in his 'Cyclopædia of Practical Receipts,' describes the operations for producing those kinds of ale known by the names of Barnstaple, Bavarian, Burton, Dorchester, Edinburgh, Essex, London, Nottingham, Welsh, Windsor, and Yorkshire ales; with the proportions of ingredients employed, and the kinds of malt and hops selected.

Circumstances have recently attracted attention to the quality of Burton ale; and the brewers of that town, in answer to the statements and queries on the subject, have unanimously asserted that no substances whatever are used in the production of that celebrated beverage except malt, hops, and water; the goodness of the materials and the skilful conduct of the processes being the only 'secrets' in the matter. Towards the close of 1858 there was commenced, at Burton-on-Trent, the construction of one of the largest breweries in England, solely for the brewing of 'Pale Ale,' by Messrs. Allsop; and the establishment belonging to the same firm, near the Minories, illustrates the admirable way in which railways are now rendered available for the warehousing of manufactured produce.

As the mode of producing ale differs little from that adopted for beer, it will suffice to refer to BREWING.

ALE-CONNER. An ale-conner is an ale-kenner, one who kens or knows what good ale is. The office of ale-taster or ale-conner is one of great antiquity. Those who held it were called 'gustatores cervisiæ.' Ale-conners or ale-tasters were regularly chosen every year in the court-leet of each manor, and were sworn to examine and assay the beer and ale, and to take care that they were good and wholesome, and sold at proper prices according to the assize; and also to present all default of brewers to the next court-leet. Similar officers were also appointed in boroughs and towns corporate; and in many places, in compliance with charters or ancient custom, ale-tasters are, at the present day, annually chosen and sworn, though the duties of the office are fallen into disuse. In the manor of Tottenham, and in many others, it was the duty of the ale-conner to prevent unwholesome or adulterated provisions being offered for sale, and to see that false balances were not used. In 4 Jac. I. c. 5, which was intended for the prevention of drunkenness, the officers more especially charged with presenting offences against the Act were constables, churchwardens, head-boroughs, tithing-men, ale-conners, and sidesmen. In most places an inspector of weights and measures now performs the duties formerly exercised by the ale-conner.

The duty of the ale-conners appointed by the corporation of the city of London, is to ascertain that the beer sold in the city is wholesome, and that the measures in which it is given are fair. For this purpose they may enter into the houses of all victuallers and sellers of beer within the city. The investigation is made four times in the year; and on each occasion it occupies about fourteen days. The days are not publicly known beforehand. Southwark is not visited. The investigation into the wholesomeness of the article has fallen into disuse. Fairness in the measures is insured by requiring all pots to be stamped with the city arms, and the ale-conners report to the aldermen such houses as do not comply with the rule, and such as have pots with forged stamps. In the municipal boroughs of England and Wales, to which the inquiries of the Commissioners of Corporation Inquiry extended in 1837 (234 in number), there were in 25 boroughs officers called 'ale-tasters;' in 6 they were termed 'ale-founders;' and in 4, 'ale-conners.'

The ancient regulations which the ale-conners were appointed to carry into effect appear to have been dictated by a regard to public health; but in modern times, when ale and beer had become exciseable commodities, the restrictions and provisions introduced from time to time had for their object principally the security of the revenue and the convenient collection of duties.

ALEHOUSES. The adoption of efficient measures, for the regulation of houses appropriated to the sale of intoxicating liquors among the lower orders of the people, has been found to be absolutely necessary to the well-being of society. Upon practical subjects the experience of the past is always the best guide to an opinion for the future; and it may, therefore, be useful to trace, in a summary manner, the history of the laws in this country passed for the regulation of alehouses. By the common law it is as lawful to open a house for the sale of beer and ale as to keep a shop for the purpose of selling any other commodity; subject only to a criminal prosecution for a nuisance if his house be kept in a disorderly manner, by permitting excessive drinking, or encouraging bad company to resort thither, to the disturbance of the neighbourhood. As civilisation and population increased, this restriction was found insufficient; and so early as the 11 Henry VII. (1496) an Act was passed against 'vacabounds and beggers,' which empowered two justices of the peace "to reject and put awey comen ale-selling in tounes and places where they shall convenyent [convene], and to take suretie of the keepers of alehouses of their gode behavying, by the discrecion of the seid justices, and in the same to be avyed and aggreed at the tyme of their sessions." This seems to have been disregarded in practice: and by 5 & 6 Edward VI. c. 25, reciting that intolerable troubles to the commonwealth daily increased through such abuses and disorders as were had and used in common alehouses, power was given to magistrates to forbid the selling of beer and ale at such alehouses: and it was enacted that "none should be suffered to keep alehouses unless publicly allowed at the sessions, or by two justices; and the justices were directed to take security from all keepers of alehouses, against the using of unlawful games, and for the maintenance of good order therein." Authority is then given to the quarter sessions to inquire whether any acts have been done by alehouse keepers which may subject them to a forfeiture of their recognisances. It is also provided that "if any person not allowed by the justices, should keep a common alehouse, he might be committed to gaol for three days, and, before his deliverance, must enter into a recognisance not to repeat his offence; a certificate of the recognisance and the offence is to be given to the next sessions, when the offender is to be fined 20*s*." This statute formed the commencement of the licensing system, and was the first act of the legislature which placed alehouses under the control of the local magistrates.

In 1604 a statute was passed (2 Jac. I. c. 9) expressly, as its preamble states, for the purpose of restraining the "inordinate haunting and tippling in inns, alehouses, and other victualling houses." From this statute it is clear that in the time of James I., it was common for country labourers both to eat their meals and to lodge in alehouses.

The operation of the last-mentioned statute was limited to the end of the next session of parliament, in the course of which a statute (4 Jac. I. c. 4) was passed, imposing a penalty upon persons selling beer or ale to unlicensed alehouse-keepers; and by another statute (4 Jac. I. c. 5) of the same parliament, it was enacted that "every person convicted, upon the view of a magistrate, of remaining drinking or tippling in an alehouse, should pay a penalty of 3*s*. 4*d*. for each offence, and in default of payment be placed in the stocks for four hours." The latter statute further directs that "all offences relating to alehouses shall be diligently presented and inquired of before justices of assize, and justices of the peace, and corporate magistrates; and that all constables, ale-conners [ALE-CONNER], and other officers, in their official oaths shall be charged to present such offences within their respective jurisdictions."

The next legislative notice of alehouses is in the 7 Jac. I. c. 10, which, after reciting that "notwithstanding former laws, the vice of excessive drinking and drunkenness did more and more abound," enacts as an additional punishment upon alehouse-keepers offending against former statutes, that, "for the space of three years, they should be utterly disabled from keeping an alehouse."

The 21 Jac. I. c. 7, declares that the above-mentioned statutes, having been found by experience to be good and necessary laws, shall, with some additions to the penalties, and other trifling alterations, be put in due execution, and continue for ever.

A short statute was passed soon after the accession of Charles I. (1 Car. I. c. 4), which supplied an accidental omission in the statutes of James; and a second (3 Car. I. c. 3) facilitates the recovery of the 20*s*. penalty imposed by the statute of Edward VI., and provides an additional punishment, by imprisonment, for a second and third offence. At this point all legislative interference for the regulation and restriction of alehouses was suspended for more than a century.

The circumstances which led to the passing of the above-mentioned statutes in the early part of the reign of James I., and the precise nature of the evils alluded to in such strong language in the preambles, are not described by any contemporaneous writers. It appears, however, from the Journals, that these statutes gave rise to much discussion in both houses of parliament, and were not passed without considerable opposition. These laws never appear to have produced the full advantage which was expected. During the reign of Charles I. the complaints against alehouses were loud and frequent. In the year 1635 we find the Lord Keeper Coventry, in his charge to the judges in the Star Chamber previously to the circuits, inveighing in strong terms against them. (Howell's 'State Trials,' vol. iii. p. 835.) He says, "I account alehouses and tippling-houses the greatest pests in the kingdom. I give it you in charge to take a course that none be permitted unless they be licensed; and, for the licensed alehouses, let them be but a few, and in fit places; if they be in private corners and ill places, they become the dens of thieves—they are the public stages of drunkenness and disorder; in market-towns, or in great places or roads, where travellers come, they are necessary." He goes on to recommend it to the judges to "let care be taken in the choice of alehouse-keepers, that it be not appointed to be the livelihood of a great family; one or two is enough to draw drink and serve the people in an alehouse; but if six, eight, ten, or twelve must be maintained by alehouse-keeping, it cannot choose but be an exceeding disorder, and the family, by this means, is unfit for any other good work or employment. In many places they swarm by default of the justices of the peace, that set up too many; but if the justices will not obey your charge herein, certify their default and names, and I assure you they shall be discharged. I once did discharge two justices for setting up one alehouse, and shall be glad to do the like again upon the same occasion."

During the Commonwealth, the complaints against alehouses still continued, and were of precisely the same nature as those which are recited in the statutes of James I. At the London sessions, in August, 1654, the court made an order for the regulation of licences, in which it is stated that the "number of alehouses in the city were great and unnecessary, whereby lewd and idle people were harboured, felonies were plotted and contrived, and disorders and disturbances of the public peace promoted. Among several rules directed by the court on this occasion for the removal of the evil, it was ordered that "no new licences shall be granted for two years."

During the reign of Charles II. the subject of alehouses was not brought in any shape under the consideration of the legislature; and no notice is taken by writers of that period of any peculiar inconveniences sustained from them, though in 1682 it was ordered by the court, at the London sessions, that no licence should in future be granted to alehouse-keepers who frequented conventicles. Locke, in his 'Second Letter on Toleration,' published in 1690, alludes to their having been driven to take the sacrament for the sake of their places, or 'to obtain licences to sell ale.'

The next Act of Parliament on the subject passed in the year 1729, when the statute 2 Geo. II. c. 28, § 11, after reciting that "inconveniences had arisen in consequence of licences being granted to alehouse keepers by justices living at a distance, and therefore not truly informed of the occasion or want of alehouses in the neighbourhood, or the character of those who apply for licences," enacts that "no licence shall in future be granted but at a general meeting of the magistrates acting in the division in which the applicant dwells." At this period the sale of spirituous liquors had become common; and in the statute which we have just mentioned a clause is contained, placing the keepers of liquor or brandy-shops under the same regulations as to licences as alehouse-keepers. The eagerness with which spirits were consumed at this period by the lower orders of the people in England, and especially in London and other large towns, appears to have resembled rather the brutal intemperance of a tribe of savages than the habits of a civilised nation. Various evasions of the provisions of the licensing Acts were readily suggested to meet this inordinate demand; and in 1733 it became necessary to enforce, by penalty, the discontinuance of the practice of "hawking spirits about the streets in wheelbarrows, and of exposing them for sale on bulks, sheds, or stalls." (See 6 Geo. II. c. 11.) From this time alehouses became the shops for spirits, as well as for ale and beer; in consequence of which their due regulation became a subject of much greater difficulty than formerly; and this difficulty was increased by the growing importance of a large consumption of these articles to the revenue. Besides this, all regulations for the prevention of evils in the management of alehouses were now embarrassed by the arrangements which had become necessary for the facility and certainty of collecting the Excise duties.

In 1753 a statute was passed (26 Geo. II. c. 31), by the provisions of which, with some trifling modifications by later statutes, the licensing of alehouses continued to be regulated for the remainder of the last century. This statute, after reciting that "the laws concerning alehouses, and the licensing thereof, were insufficient for correcting and suppressing the abuses and disorders frequently committed therein," contains, among others, the following enactments:—1. That upon granting a licence to any person to keep an alehouse, such person should enter into a recognisance in the sum of 10*l.* with sufficient sureties, for the maintenance of good order therein. 2. That no licence should be granted to any person not licensed the preceding year, unless he produced a certificate of good character from the clergyman and the majority of the parish officers, or from three or four respectable and substantial inhabitants, of the place in which such alehouse is to be. 3. That no licence should be granted but at a meeting of magistrates, to be held on the 1st of September in every year, or within twenty days afterwards, and should be made for one year only. 4. Authority is given to any magistrate to require an alehouse-keeper, charged upon the information of any person with a breach of his recognisance, to appear at the next quarter-sessions, where the fact may be tried by a jury, and in case it is found that the condition of the recognisance has been broken, the recognisance is to be estreated into the Exchequer, and the party is utterly disabled from selling ale or other liquors for three years.

By a statute passed in 1808 (48 Geo. III. c. 143), a difference was introduced into the mode of licensing, not with a view to the internal regulation of alehouses, but for purposes connected with the collection of the revenue. The licence, which was formerly obtained from the magistrates, was, by that Act, to be granted by the commissioners, collectors, or supervisors of Excise, under certain specific directions, and upon the production by the applicant of a previous licence or allowance, granted by the magistrates, according to the provisions of the former statutes respecting licensing.

The next Act of Parliament upon this subject was passed in 1822 (3 Geo. IV. c. 77), but as that statute continued in operation for only a few years, it is unnecessary to specify its provisions further than to notice that the preamble states the insufficiency of the laws previously in force respecting alehouses, and that one of its provisions is considerably to increase the amount of recognisances required both from the alehouse-keeper and his sureties.

In 1828 a general Act to regulate the granting of alehouse licences was passed (9 Geo. IV. c. 61), which repealed all former statutes on this subject, and enacts a variety of provisions, of which the following are the most important:—1. Licences are to be granted annually, at a special session of magistrates, appointed and summoned in a manner particularly directed, and to be called the General Annual Licensing Meeting, to be holden in Middlesex and Surrey, within the first ten days of March, and in every other place between the 20th of August and the 14th of September. Any person who is refused a licence may appeal to the quarter-sessions; and no justice is to act in an appeal who was concerned in the refusal of the licence. 2. Every person intending to apply for a licence must affix a notice of his intention, with the name, abode, and calling of the applicant, on the door of the house, and on the door of the church or chapel of the place in which it is situated, on three several Sundays, and must serve a copy of it upon one of the overseers, and one of the peace officers. 3. If a riot or tumult happens, or is expected to happen, two justices may direct any licensed alehouse-keeper to close his house; and if this order be disobeyed, the keeper of the alehouse is to be deemed not to have maintained good order therein. 4. The licence is subjected to an express stipulation that the keeper of the house shall not adulterate his liquors; that he shall not use false measures; that he shall not permit drunkenness, gaming, or disorderly conduct in his house; that he shall not suffer persons of notoriously bad character to assemble therein; and that (except for the reception of travellers) he shall not open his house during divine service on Sundays and holydays. 5. Heavy penalties for repeated offences against the tenor of the licence are imposed; and magistrates at sessions are empowered to punish an alehouse-keeper, convicted by a jury of a third offence against the tenor of his licence, by a fine of 100*l.*, or to adjudge his licence to be forfeited.

The Act of Parliament, 11 Geo. IV. and 1 Wm. IV. c. 64, is entitled an "Act to permit the general sale of beer and cider by retail in England." The following are its most material provisions:—1. Any householder, desirous of selling malt liquor, by retail, in any house, may obtain an excise licence for that purpose, to be granted by the Commissioners of Excise in London, and by collectors and supervisors of excise in the country, upon payment of two guineas. 2. A list of such licences shall be kept at the Excise Office, and be at all times open to the inspection of the magistrates. 3. The applicant for a licence must enter into a bond with a surety for the payment of any penalties imposed for offences against the Act. 4. Any person licensed under the Act, who shall deal in wine or spirits, shall be liable to a penalty of 20*l.* 5. In cases of riot, persons so licensed shall close their houses upon the direction of a magistrate. 6. Such persons suffering drunkenness or disorderly conduct in their houses shall be subject to penalties which are to be increased on a repetition of the offence, and the magistrates before whom they are convicted may disqualify them from selling beer for two years. 7. Such houses are not to be opened before four in the morning nor after ten in the evening, nor during divine service on Sundays and holydays.

The effect of this statute was to withdraw the authority of granting licences to houses opened for the sale of ale, beer, and cider, from the local magistrates, in whose hands it had been exclusively vested for nearly 300 years, and to supersede their direct and immediate superintendence of such houses. The consequence of the facility of obtaining licences upon a small pecuniary payment, and without the troublesome and expensive process directed by former statutes, was a rapid multiplication of alehouses throughout the country, together with very general complaints, especially in the southern and western districts, and amongst the rural population, of a considerable increase of idleness and crime, and of increased and increasing demoralisation among the labouring classes of the people.

A discussion of the justice of these complaints would be foreign to the purpose of this article. It cannot however be too strongly impressed upon the minds of all, that it is a fatal error to consider this question strictly with a view to finance and revenue; these objects, momentous as they undoubtedly are, ought not to supersede those of much more weighty importance, as permanently affecting the moral and intellectual character, as well as the health, comfort, and independence of the lower orders. As a matter of finance, the encouragement of the use of intoxicating liquors is considered, by very competent judges, as of doubtful policy. "For government to offer encouragement to alehouses," says Sir Frederick Morton Eden, in his valuable 'History of the Poor,' "any further than they are wanted for the many useful purposes which they serve among the labouring classes, is to act the part of a *felo de se*. Nor ought the public ever to be lulled into an acquiescence by the flattering bait of immediate gain, which ere long they would be obliged to pay back to paupers, in relief, with a heavy interest."

By 4 & 5 Wm. IV. c. 85, the preamble of which recites that much evil has arisen from the management of houses, in which beer and cider are sold by retail under 1 Wm. IV. c. 64, it is enacted that each beer-seller is to obtain his annual excise licence only on condition of placing in the hands of the excise a certificate of good character, signed by six rated inhabitants of his parish, none of whom must be brewers or maltsters. Such a certificate is not to be required in towns containing a population of 5000 and upwards; but the house to be licensed is to be one rated at 10*l.* a year. This Act makes a difference between persons who sell a liquor to be drunk on the premises and those who sell it only to be drunk elsewhere.

By a Treasury order, beer sold at or under 1½*d.* a quart may be retailed without a licence: the officers of Excise are empowered to enter such houses and to examine all beer therein.

By the 3 & 4 Vict. c. 61, which amends both of the above Acts, a licence can only be granted to the real occupier of the house in which the beer or cider is to be retailed; and the rated value of such house is raised to 15*l.* in towns with a population of 10,000 and upwards; in towns of betwixt 10,000 and 2500, to 11*l.*; and in towns of smaller size the annual value is to be not less than 8*l.* Every person who applies for a licence must produce a certificate from the overseer of his being the real occupier of the house, and of the amount at which it is rated. A refusal to grant this certificate renders the overseer liable to a penalty of 20*l.*; and any person forging a certificate, or making use of a certificate knowing it to be false, is to forfeit 50*l.*

The hours for opening and closing beershops are now regulated by the above Act. In London and Westminster, and within the boundaries of the metropolitan boroughs, they are not to be opened earlier than 5 o'clock in the morning, and the hour of closing is 12 o'clock; but 11 o'clock in any place within the bills of mortality, or any city, town, or place not containing above 2500 inhabitants; and in all smaller places, 5 o'clock is the hour for opening, and 10 o'clock for closing.

Licensed victuallers, and keepers of beershops who sell ale to be drunk on the premises, are liable to have soldiers billeted upon them. Under the 'Metropolitan Police Act' (2 & 3 Vict. c. 37), which under certain conditions may be extended to within 15 miles of Charing Cross, all public houses are to be shut on Sundays until 1 o'clock in the afternoon, except for refreshment of travellers. Publicans supplying liquors to persons under sixteen years of age incur penalties.

The sale of beer and other liquors throughout Great Britain on Sunday, Christmas-day, and Good Friday, or other day appointed for a public fast or thanksgiving, is regulated by the 11 & 12 Vict. c. 49, and the 18 & 19 Vict. c. 118. No person may open his house for the sale of liquors before half-past 12 o'clock, or the termination of morning service, or between 3 and 5 in the afternoon, or after 11 o'clock or before 4 o'clock in the following morning, under the penalty of *5l.* Constables may enter the house at any time, and offenders may be summarily convicted.

ALEMBIC, a chemical vessel used in distillation. Various forms of it have been devised; the simplest consists of a *body, cucurbit*, or *matrass*, which serves as a boiler; a *head* or *capital*, with a pipe and a receiver.

Sometimes all these parts are made of glass, and the head and receiver are usually so; when the body is of this material, it is fitted to the head by grinding; but the apparatus, in this case, is extremely expensive, and very liable to accident. When the body is made of metal, the glass head is secured to it by almond or linseed meal lute.

The fluid to be distilled having been put into the body, the head being fitted to it, and the receiver adapted to its pipe, heat is applied to the body either by a lamp or a sand-bath; the vapour which rises is condensed in the head, and, falling into a depressed channel, runs through the pipe into the receiver, loosely fitted to it with a cork. If the receiver be kept partly immersed in cold water, the condensation will be more readily and economically effected. Sometimes the head is perforated, and furnished with a stopper; by removing this, a supply of the fluid to be distilled may be poured into the body, without disturbing the luting by which the body and head are kept in close contact. An alembic of this kind is not very useful for the general purposes of distillation; it can scarcely be applied to the preparation of acids; and for distilling spirit or water, a retort or a still is much to be preferred. An alembic of this form, the body of which is made of silver, and the head and receiver of glass, is sometimes employed for distilling the spirit from the alcoholic solutions of potash and soda, in the process of purifying these alkalies.

The most ancient alembics were made of metal, and generally of tinned copper; the annexed figures represent that proposed by Baumé in his 'Elements of Pharmacy,' with very slight alteration. It is com-

posed of several parts: *a*, Fig. 1, represents the *cucurbit, body*, or *boiler*, which is made of tinned copper; *b* is a short pipe by which the boiler is replenished with the fluid to be distilled, during the operation, and without disturbing or unluting the apparatus. When in operation, the pipe *b* is stopped with a cork.

Fig. 2 is a section of the *head* or *capital*, which fits into *a*, and is secured by lute; it is divided into two parts, which do not communicate with each other; *c* contains cold water, which, by cooling the vapour that rises from the boiler *a* into *d*, causes it to condense into a fluid, which runs down into a small gutter, and is by it conveyed through the pipe *e* into a receiver; *f* is a cock by which the water is let out from *c* when it becomes hot by condensing the vapour.

Fig. 3 represents a *worm* or *serpentine*, *g*, into which is conveyed the vapour that may escape condensation in *d*; it is surrounded by cold water in the vessel *h*, which, as it becomes hot, is let out near the top of the vessel, and a fresh supply of cold water introduced near the bottom; the condensed vapour is received at the end of the worm in the receiver *k*. The cock *i* serves to remove the whole of the water from the vessel *g*.

Fig. 4 represents a *water-bath*, also made of tinned copper; it fits into the body *a*, and is heated by the medium of the boiling-water contained in the space between it and *a*, instead of the fire directly applied. When the water-bath is used, the head, Fig. 2, is fitted into it in the manner already described with respect to the body *a*, Fig. 1.

Fig. 5 shows the whole apparatus placed in the furnace, with the worm attached to the pipe of the head.

The alembic, in the form now described, is but little used; the addition of the worm surrounded with cold water has rendered it unnecessary to employ any refrigeratory round the head; and the apparatus thus simplified is the common still, which will be described under the article DISTILLATION.

ALEUROMETER. One of the novelties of 1849 was a contrivance called an Aleurometer, invented by M. Boland, a Paris baker, for ascertaining the panifiable or bread-making qualities of wheaten flour. This determination depends upon the expansion of the gluten contained in a given quantity of flour when freed from its starch. A ball of gluten being placed in a cylinder to which a piston is fitted, the apparatus is exposed to a temperature of 150°; and as the gluten dilates, its degree of dilatation is marked by the piston-rod. The greater the dilatation, the better is the flour fitted for making bread.

ALEXANDRA, one of the group of small planets revolving between Mars and Jupiter. [ASTEROIDS.]

ALEXANDRIAN CODEX, a manuscript of the Old and New Testament, in Greek, now preserved in the British Museum. It was sent by Cyrillus Lucaris, patriarch, first of Alexandria, then of Constantinople, to Charles I.; was placed in the royal library in 1628; and continued there until that collection was removed to the British Museum in 1753. The history of the manuscript, before its transfer to Charles I., is involved in much uncertainty; and the real age and value of it have been much controverted. These points have been minutely discussed by Dr. Woide, formerly librarian of the British Museum, who published a fac-simile of the New Testament, in his preface. He is a staunch advocate of the excellence of the manuscript. A second edition of the preface ('Notitia Codicis Alexandrini') was published by Spohn, who controverted many of Woide's opinions, showed that the manuscript was by no means free from blunders of transcription, and reduced both its age and authority to a much lower standard.

The manuscript is contained in four volumes, of the shape and size of large quarto, of which the New Testament fills the last. It is written on vellum, in double columns, in uncial or capital letters, without spaces between the words, accents, or marks of aspiration. The letters are round and well formed. Some words are abbreviated, but they are not very numerous. There is a variety both in the colour of the ink and the form of the letters. The manuscript is on the whole in good condition, but sometimes the ink has eaten through the parchment; the shape of the letters however can generally be traced; sometimes the ink itself has scaled off.

The New Testament has been more fully described and more carefully collated than the Old; from which however Grabe published his splendid edition of the Old Testament, Oxford, 1717–20. They are uniform in appearance and execution, but the Old Testament seems to be in rather better condition. It contains, besides all the canonical and most of the apocryphal books found in our editions, the third and fourth books of the Maccabees, the Epistle of Athanasius to Marcellinus, prefixed to the Psalms, and fourteen hymns, the eleventh in honour of the Virgin. Ecclesiasticus, the Song of the Three Children, Susannah, and Bel and the Dragon, do not appear to have formed part of the collection. The New Testament contains the genuine epistle of Clement to the Corinthians, and part of the other which has been attributed to him. This is the only known manuscript in which the genuine epistle exists. A fac-simile of the Old Testament has been published by the Rev. H. Baber, of the British Museum.

ALEXANDRIAN LIBRARY, a collection of books, formed by Ptolemæus, the first king of Egypt, and probably the largest which was made before the invention of printing. It is said to have been founded about B.C. 284, in consequence of the suggestions of Demetrius Phaléreus, who had seen the public libraries at Athens. Demetrius was appointed superintendent of the new establishment, and busied himself diligently in collecting the literature of all nations, Jewish, Chaldee, Persian, Ethiopian, Egyptian, &c., as well as Greek and Latin. Eusebius says, that at the death of Ptolemæus Philadelphus there were 100,000 volumes in the library. It was situated in the quarter of Alexandria called Brucheion. Philadelphus purchased the library of Aristotle, and it was increased by his successors. Almost all the Ptolemies were patrons of learning; and at last the Alexandrian

Library is said to have amounted to 700,000 volumes. But the rolls (*volúmina*) spoken of contained far less than a printed volume; as, for instance, the 'Metamorphoses' of Ovid, in fifteen books, would make fifteen volumes. This consideration will bring the number of books within the bounds of credibility.

After the capture of Alexandria by Julius Cæsar a large part of the library was burnt. Gibbon (chap. xxviii.) asserts that the old library was totally consumed, and that the collection from Pergamus, which was presented by Marcus Antonius through Cleopatra, was the foundation of the new one, which continued to increase in size and reputation for four centuries, until, at the destruction of the Serapeion by Theophilus, patriarch of Alexandria, it was dispersed, A.D. 390. Still the library was re-established; and Alexandria continued to flourish as one of the chief seats of literature till it was conquered by the Arabs in 640. The library was then burnt, according to the story generally believed, in consequence of the fanatic decision of the Khalif Omar,—"If these writings of the Greeks agree with the Book of God, they are useless, and need not be preserved: if they disagree, they are pernicious, and ought to be destroyed." Accordingly, it is said, they were employed to heat the 4000 baths of the city; and such was their number, that six months were barely sufficient for the consumption of this precious fuel. (Gibbon, chap. li.) Gibbon has employed his ingenuity to discredit this account, which in itself appears by no means improbable. The library was at all events dispersed, if not destroyed; it ceased to exist as a public institution.

Connected with the library of Brucheion was a college, or retreat for learned men, called the Museum, where they were maintained at the public expense, in unbroken leisure, and with every facility for the pursuit of knowledge. This establishment was subsequently transferred to the Serapeion, and continued to flourish till the destruction of the temple by Theophilus. The sciences of mathematics, astronomy, and geography, were especially cultivated: witness the names of Euclid, Apollonius, Eratosthenes; and, in later times, of Ptolemæus the geographer. Criticism, philology, and antiquities, were also much studied. [ALEXANDREIA, in GEOG. DIV.] Alexandria continued, until its capture by the Saracens, one of the most noted seats of learning in the world.

(*Acad. des Inscriptions*, tom. ix. p. 397; Gibbon, chap. li., and the original authorities quoted in these works.)

ALEXANDRINE VERSE, a species of verse so called from having been first employed, according to some authorities, in a French translation, by Alexander de Paris and Lambert Lieon, of a Latin poem called the Alexandriad, according to others in an original work in the former language, on the life of Alexander the Great, composed by these poets in association with Jean le Nivelois and others. After its first introduction, it appears to have fallen for a long time into disuse among the French poets, until it was revived by Jean Antoine de Bœuf (one of the seven called the Pleiades), in the reign of Francis I. The first, however, who attuned the national ear of France to this verse, was the celebrated Ronsard, since whose time it has become the regular heroic verse of the French language: or that in which all their epic, tragic, and other greater poetical works are composed. It consists of twelve syllables, subject to the rule that it shall always be broken into two regular hemistichs, or, in other words, that its sixth syllable shall always terminate a word. The English Alexandrine verse consists in like manner of twelve syllables; but among us it has been rarely used throughout a whole poem. The longest and most remarkable poetical work in our language, written wholly in Alexandrine verse, is Drayton's 'Polyolbion.' In general, it is employed only occasionally in poems written in our usual heroic verse of ten syllables, and never except in the concluding line of the couplet or triplet. In Dryden, by whom it has been used in this manner most frequently, and with the finest effect, it most commonly winds up a triplet—such as that in which Pope has at once described and exemplified the manner of his great predecessor:

> "Waller was smooth; but Dryden taught to join
> The varying verse, the full resounding line,
> The long majestic march, and energy divine."

The Alexandrine verse in English also forms the closing line of what is called the Spenserian stanza. Regularly, it ought always, as in French, to be divisible into two hemistichs; but, in the freer spirit of our poetry, this rule is occasionally violated.

ALGAROTH, or ALGAROTTI, POWDER OF. [ANTIMONY, OXYCHLORIDE OF.]

ALGEBRA. This word is derived by contraction from the Arabic phrase *Al jebr e al mokâbalah*, the nearest English translation of which is *restoration and reduction*. So short a definition is of course useless; we shall endeavour to give the first and most simple view of this science, our limits not permitting us to go, even in the smallest degree, into its operations.

In establishing the rules of arithmetic, it is always necessary to use general reasoning: that is, reasoning the nature of which would not be altered if other numbers had been chosen, different from those which were really employed in the question. For example, if 2 acres let for 13*l.*, how much will 17 acres let for? It is shown immediately that the number of pounds required is that obtained by multiplying 13 and 17 together, and dividing the product by 2: and it appears moreover, that, by the same reasoning, a similar rule might be established when the numbers are different from those given above, provided the form of the question remain the same. That is, if any number of acres we please to name, cost a certain number of pounds, the price of any other number of acres may be found by multiplying that other number by the number of pounds the first acres cost, and dividing by the number of the first-mentioned acres. Thus we have established a general rule, and the steps by which we translate this into an algebraical expression are as follows. We invent short signs, to signify that multiplication and division are to take place: we express the former by putting × between the numbers which are to be multiplied together, the latter by writing the divisor under the dividend, and drawing a line between them. The foregoing rule then stands as follows:

$$\left\{\begin{array}{l}\text{Price in pounds of}\\ \text{second No. of acres.}\end{array}\right\} \text{ is } \frac{\text{Second No. of acres} \times \left\{\begin{array}{l}\text{Price in pounds of}\\ \text{first No. of acres.}\end{array}\right\}}{\text{First No. of acres.}}$$

So far we have abbreviated by using two *symbols of operation;* to which we may add that we write + between two numbers which are to be added together, and — between two numbers of which the second is to be taken away from the first. Now suppose that, to catch the eye, we put a letter whenever a number is named in the question, in order that by looking for that letter we may quickly find out in what part of the result the aforesaid number is used. For example: If a certain number of acres (a) cost a certain number of pounds (b), how many pounds will another number of acres cost (c)? The answer is, as above,

$$\frac{\text{Second No. of acres } (c) \times \left\{\begin{array}{l}\text{Price in pounds of}\\ \text{first No. of acres.}\end{array}\right\} (b)}{\text{First No. of acres } (a)}$$

The last step is, to let the letters themselves stand for the several numbers, which will save the necessity of writing words in the result. Our final algebraical way of writing the question will then be—If a acres cost b pounds, how much will c acres cost? The answer is,

$$\frac{c \times b}{a} \text{ pounds, usually written } \frac{c\,b}{a} \text{ pounds.}$$

To take another instance, which we first write algebraically: If a pounds of sugar, at m pence a pound, be mixed with b pounds of sugar, worth n pence a pound, the worth of a pound of the mixture is

$$\frac{m\,a + n\,b}{a + b} \text{ pence,}$$

which in the usual language cannot be stated more shortly than as follows:—To find the worth of a pound of mixed sugar, knowing how much of each sort was in the mixture, and how much each was worth per pound, multiply the number of pounds of each sort by the number of pence which a pound of it costs, add the products together, and divide by the whole number of pounds in the mixture.

This will be sufficient to give the reader an idea of the notation of algebra, and the very great abbreviation which it introduces into the details of processes. For further explanations, see ADDITION, &c., POSITIVE, NEGATIVE, EQUALITY, EXPONENT, INDEX, POWER, ROOT, and the article NOTATION.

We have said nothing of the reasoning of algebra, because it differs in no respect from that of arithmetic, or any other science, at least in the elementary part. It proceeds upon such fundamental and self-evident principles as the following:—that two equal numbers remain equal when the same number has been added to or subtracted from them, or when they have been both multiplied or both divided by the same number—that no number is altered by the addition of any number followed by the subtraction of the same, or by being multiplied by any number, if the product be afterwards divided by the same number; and so on. To take a very simple case, suppose we ask, What number is that, which multiplied by 3 and the product increased by 6, gives 30? Without knowing the number, we can see that if three times the number, together with 6, gives 30, three times the number must be 24, or the number required must be the third part of 24, or 8. The algebraical method of expressing this is as follows, where = means that the numbers between which it is placed are the same.

Let x stand for the number; then by the question

$$\begin{array}{ll} & 3\,x + 6 = 30 \\ \text{Therefore } 3\,x & = 30 - 6 = 24 \\ \text{or } x & = \dfrac{24}{3} = 8 \end{array}$$

We give the preceding, not as a specimen of the advantages of algebra, but of its language only, for we have purposely chosen such a question as needs no assistance, in order to make the method of expression more evident. [AXIOM; EQUATION; PROBLEM.]

The operations of algebra are to be considered in a very different light from those of arithmetic. In the latter science, absolute numbers are given, and an absolute number is sought: in the former it is rather the nature of the question which is given, and it is required to find, not so much the answer to any particular case, as a general method of solving any case whatever. The symbols used are not numbers, but *general* representations of them, that is letters, each of which may stand for any number we please, provided that it keeps the same meaning throughout the question. Hence in what are called addition, multiplication, &c., of algebraical quantities, we do not ask, 'What *number* does this multiplication give,' but '*what set of operations* are equivalent to, and, if we please, may supply the place of, this multiplication?' For example, suppose it occurs in a question that one number is to be added to, as well as subtracted from, another, and that the two results are to be multiplied together. Let a and b stand for the two numbers, of which let a be the greater. So long as we use *general* symbols, that is, so long as we do not assign some particular numbers, which a and b are to signify, we cannot perform the above operations, but can only indicate them by the marks above mentioned; for example, $a+b$ stands for the sum of a and b, $a-b$ for the difference, and

$$(a+b) \times (a-b)$$

for the product of this sum and difference. So far we need nothing more to tell us what to do, so soon as a and b shall have their values assigned to them: for instance, if a be 7, and b be 3, $a+b$ is 10, and $a-b$ is 4, and the above product is 10×4, or 40. But, in the meanwhile, we see in the above a sort of double operation: there is inside each pair of brackets something to be done, while the results of the brackets themselves are connected by a further process. It is asked then, what simple processes will supply the place of the preceding, so that whatever numbers a and b may stand for, the product of this sum and difference may be obtained from them? The answer to this is obtained by the process of algebraic *multiplication*, and proves to be $aa-bb$, or b multiplied by itself, and the result subtracted from a multiplied by itself. In the preceding example, this is $7 \times 7 - 3 \times 3$, or $49-9$, or 40, as before. For details of various operations, see the general heads already quoted, and BINOMIAL THEOREM, DEVELOPMENT, SERIES.

The earliest treatise on algebra of which we can fix the date within two centuries is that of Diophantus, an Alexandrian Greek, who lived in the sixth century. It is very unlike a modern treatise on algebra, being almost destitute of general symbols, and consisting altogether of a species of problems which have since received the name of *Diophantine*, in which it is required to solve certain questions, the answers to which shall be whole numbers only. It is so like the Hindoo algebra in its character, that it is impossible to suppose the two wholly unconnected. But as the Hindoo algebra is of a much higher cast than that of Diophantus, we are obliged to suppose, either that Diophantus obtained from the East a part of their knowledge, or that the Hindoos, setting out with the Greek algebra only, made considerable improvements after the sixth century. As the Hindoo algebra has been very much extolled by some, and more than proportionally cried down by others, we quote from Delambre, who is distinguished among the latter. "The Hindoos had algebra of the first and second degrees; they knew how to solve indeterminate problems; and they made these acquisitions themselves; they are also the authors of the system of arithmetic now universally received by us."—'Histoire de l'Astronomie Ancienne, vol. i., p. 556. To these we might add many minor points, and also that, in the solution of indeterminate equations of the second degree, they had made as much progress as ever was made in Europe before the middle of the eighteenth century. [VIGA GANITA, in BIOG. DIV.]

The Persians and Arabs confessedly derived their knowledge of the subject from the Hindoos. We do not, however, find that they proceeded as far as their masters: for the Arabic treatises, so far as we know, contain only the solution of equations of the first and second degree, and their application to various arithmetical questions, excluding all mention of indeterminate equations.

It was by means of the treatise of Mohammed Ben Musa, who lived in the time of the Caliph Al Mamun, that the science was introduced into Europe. A complete and able translation of this work, by Dr. Rosen, with the original Arabic, was published in 1831, by the Oriental Translation Fund.

Thus much of the science was introduced into Europe, or rather into Italy only, at the beginning of the thirteenth century, by Leonardo Bonacci of Pisa. Algebra lay dormant in Italy, without receiving any material improvement, till the middle of the sixteenth century, when it was introduced into Germany, France, and England, nearly about the same time by Stifelius, Peletarius, and Robert Recorde, respectively. The Hindoos, instead of using the letters of the alphabet, designated various unknown quantities by the names of different colours; the Persians and Arabs employed the word answering to 'thing' in their language for the unknown quantity, and the Italians adopted the word '*cosa*' for the same purpose: hence algebra came to be called the *Regola de la Cosa* in Italy, and the *Cossike Art* in England. It is to be observed, however, that in no country, up to the time of Vieta, were letters used to signify anything but quantities sought; those *given* being always certain numbers, and never arbitrary representations of numbers in general. Hence the simple word '*thing*,' or any abbreviation of it, was sufficient for their purpose.

While algebra was being introduced into the various countries of Europe, the Italians began to make the first steps towards its improvement. The solution of an equation of the third degree was discovered by CARDAN and TARTAGLIA; that of the fourth by FERRARI; while various other discoveries were made by BOMBELLI and MAUROLICO. We must refer the reader to the several lives of these mathematicians, in the BIOG. DIV. of this work. VIETA, a Frenchman, who died in 1603, made the grand improvement of using letters to stand for known as well as unknown quantities, and with the additional power derived from this improvement, laid the first steps of the general theory of equations. In England, HARRIOT, who died in 1621, carried on and extended the discoveries of Vieta; and from the time of the two latter we must date the modern form of the science.

Our limits will not allow us even to name the crowd of discoverers who have extended this branch of pure mathematics since the time of Vieta. We must refer to the work of Hutton already cited, to Bonnycastle's translation of Bossut's 'Histoire des Mathématiques,' or to the original work itself: to the preface of the mathematical part of the French Encyclopædia; or to the histories of Montucla and Cossali. The first and second are the most likely to fall in the way of the English reader. Libri's 'History of Italian Science' has much information on early Italian algebra; and several very ancient treatises have been recently printed, for the first time, by Prince Boncompagni.

The only necessary preliminary to the study of algebra is a good knowledge of the four rules of arithmetic, and of common and decimal fractions. Without so much it is impossible to read any work with profit; and in the want of it we must look for the reason why the science appears repulsively dry to most persons. On this subject, we refer the student to some remarks in page 59 of the treatise on the 'Study of Mathematics' published by the Society for the Diffusion of Useful Knowledge.

We shall now give some notion of the form which algebra has taken in the last thirty years. Instead of attempting to make our work of reference supply the place of a school-book, we prefer to give those to whom the common elementary work was unnecessary, some of the notions which are gradually enlarging the boundary of the science, and assisting, beyond what was once imagined possible, in clearing the difficulties which it presented to reflecting minds.

1. In *pure arithmetic* the subject matter is simple number. Its symbols are 0, implying the absence of all number; 1 or unity; 2, the abbreviation of $1+1$; 3, that of $1+1+1$, &c. Also the symbols $+ \; - \; \times \; \div$ and those of powers and roots. All these symbols have specific meanings, and the symbols of operation are connected with known operations. There are also *general* symbols of number, a, b, c, &c., definite but not specific: that is, each one stands for a different number, known or unknown, throughout any one train of thought, though it need not represent the same number in all investigations.

2. The fundamental direct symbols of operation, seen in $a+b$, ab or $a \times b$, a^b, are connected with inverse operations, seen in $a-b$, $\frac{a}{b}$ or $a \div b$, $\sqrt[b]{a}$ or $a^{\frac{1}{b}}$. Each inverse operation offers certain difficulties; those of $a \div b$ are overcome by the introduction of the notion of fractions; those of $\sqrt[b]{a}$ by the considerations in LIMIT, applied to what is called the approximate extraction of roots. But $a-b$ presents cases of absolute impossibility, as in $3-7$; and this impossibility is incapable of being removed as long as the symbols are the symbols of pure arithmetic.

3. The rules by which operations of pure arithmetic are performed are found to be capable of classification under five heads: no step in any train of thought leads to anything but the use of one of these five simple rules, or of complex rules obtained by their combination. Of course these rules are understood as applied only when they give intelligible results.

I. *Rule of signs.*—Whenever two of the signs + and — both act upon any symbol, the result is that like signs give +, unlike signs give —.

II. *Convertibility of additions and subtractions,* as in $a+b-c=a-c+b=-c+a+b$, &c.

III. *Convertibility of multiplications and divisions,* as in $\frac{a}{b} \times c = \frac{a \times c,}{b}$, &c.

IV. *Distributiveness of multiplications and divisions,* as in $a(b+c-d) = ab+ac-ad$, and $\frac{c+d}{a} = \frac{c}{a} + \frac{d}{a}$.

V. *Rules of exponents.* These are $a^b \times a^c = a^{b+c}$, $a^b \div a^c = a^{b-c}$, $a^b c^b = (ac)^b$, and $(a^b)^c = a^{bc}$.

Every master of the use of these rules can perform all the steps of an arithmetical operation, including all that is commonly called algebraical, but provided that no steps enter except those which are arithmetically intelligible. Even the common rules of computation, so far as they are not acts of mere memory or trial, consist in uses of the first four rules.

4. On examining problems into which the impossible subtraction enters, whether in process or result, whether from inconsistency in the problem or in the mode of solving it, the impossibility is always to be traced to a diametrically wrong sense put upon the meaning of some one quantity, as reading gain for loss, or ascent for descent, &c. And since the impossible subtraction can always be reduced to the form $0-a$, or $-a$ (thus $3-7$ is $3-3-4$, or -4), and since this is found always to require, as a correction, that a units should be taken of the sort *diametrically opposite to what was supposed when* $0-a$ *was being*

found, it suggests itself to let $+1$ and -1 mean, not merely the addition and subtraction of 1, but any two opposite kinds of units whatever, addition and subtraction being only one of the infinite number of opposite meanings which may be signified.

5. Extensive induction shows, not only that the five rules remain true when the last augmentation of meaning is adopted, but that the want of symbolic distinction between the different meanings of $+$ and $-$ is of no consequence whatever. Complete opposition of character in $+$ and $-$ is all that is necessary to the permanence of the rules; and $+1$ may stand in the same problem for a unit of gain, a unit of ascent, a unit of future time, a unit of addition, &c.; while -1 stands for a unit of loss, a unit of descent, a unit of past time, a unit of subtraction, &c.

6. The algebra thus established, having all the processes of pure arithmetic, *and no more*, and completely containing pure arithmetic within its range of subjects (for $+1$ and -1 mean addition and subtraction of 1, as well as other things), may be called *single algebra*. Space of one dimension (length) is, so to speak, wide enough for it: if $+1$ signify a unit measured in one direction upon a straight line from a given point, then -1 signifies a unit measured in the opposite direction. Every positive and negative quantity may find its interpretation in this line.

7. On proceeding to ulterior results, it is found that the extension of meaning which is sufficient to admit such symbols as $3-7$ or $0-4$ within the range of intelligible quantities will not do the same for their roots of the second, or fourth, or any even order. Thus, even in the complete single algebra, $\sqrt{-1}$, $\sqrt[4]{-1}$, &c., are as void of meaning as $4-7$ in pure arithmetic: they are not positive quantities; they are not negative quantities; and there are no other sorts. Under the name of *impossible quantities* they were long used without being understood, because they were found to lead to true results. Some defended them on different theories, but the sentiment of Professor Woodhouse must have been the one which guided the class of mathematicians who think on first principles; "since they lead to true results, they *must have a logic*." The question was to find that logic: and till it was found, a great part of algebra was *art*, not *science*.

8. Since it has appeared that extension of meaning has succeeded in clearing away one class of difficulties, the means of removing the rest must probably be sought in further extension; but it will give a better idea of the subject to begin by throwing away all meanings, treating the symbols as symbols only, subject to certain five rules of operation. Let the only symbol which retains its meaning be $=$, denoting the identity of what precedes with what follows. We then stand thus: Let it be granted that there are certain symbols, 0, 1, a, b, c, &c., and symbols of connection, $+ - \times \div a^b$ (we cannot here dispense with the letters, since the symbol consists in the manner of placing the letters): let $0+a$ and a be synonymes, and also $0-a$ and $-a$, and $1\times a$ and a, and $a\div 1$ and a: let $1+1$ be abbreviated into 2, $2+1$ into 3, &c.: let $+a-a$ be 0, and let $\times a \div a$ be equivalent to $\times 1$: let the five rules in § 3 be perfectly and universally true, and let a, b, &c., be competent to represent (among other things, perhaps) 0, 1, 2, &c., or any formations from them or from one another. Let no idea of meaning be attached, for the present, to any symbol or to any of the words by which operations are described. Required all manner of methods of forming symbols which must be considered as identical. The collection of such methods is *symbolical algebra*, nothing but symbols and prescribed laws of use. For instance, required a necessary transformation for $(a+b)(c+d)$. By the fourth rule this is $(a+b)c+(a+b)d$, which, by the third rule, is $c(a+b)+d(a+b)$, which again, by the fourth rule, is $ac+bc+(ad+db)$, or $ac+bc+(+ad)+(+db)$, which, by the first rule, is $ac+bc+ad+db$. This symbolical algebra is not a science, but an art: it may be illustrated as follows: Suppose a person to join the pieces of a boy's dissected map by the backs, without looking at the countries engraved on the fronts; he is then going through the dead and (by itself) uninstructive process of symbolical algebra; the pieces are his symbols, the forms of the edges are his rules for guidance. But another, who turns the map the right way, and puts the countries which he knows into their right places at once, and helps himself to the position of those which he does not know by trying to fit edges together, is going through the improving process of geographical acquirement, which corresponds to an algebra with meanings attached to the symbols. Symbolical algebras may be invented without end: how many of them would be worth anything for the value of their possible systems of meaning, is another question. We avowedly make a retrograde step when we introduce symbolical algebra; we throw away the arithmetic and single algebra which suggested the symbols and their rules, and retain for the moment only the unmeaning symbols and their laws of combination.

9. The next step is, given the symbols, rules, and consequent trains of legitimate transformation, of a system of symbolic algebra, how many and what systems of meanings may be attached to the symbols, so that all the fundamental rules may be true of those meanings, and all the symbolic identities which follow from those rules may be necessary consequences, also with intelligible meanings. Every such system of meanings, superadded to the symbolical algebra, is a *logical algebra*, or one in which every process of transformation is a reasoning or a collection of reasonings. In all probability there is an infinite number of logical algebras to every self-consistent system of symbolical algebra: we merely note down the list of those which have hitherto been traced from the ordinary system, originally suggested by arithmetic. Since these sentences were first written, Professor Boole, in his 'Laws of Thought,' has shown that all the processes of logic, actual or possible, are capable of representation under the symbols of common algebra, and the rules of common algebra.

I. *Pure arithmetic*, in which the subject matter is number. II. *Single algebra*, in which the symbols represent numbers derived from concrete magnitude, considered as being, in every case, of one or another of two diametrically opposite kinds. III. *Double algebra*, the main subject of the present remarks, in which each symbol represents a line of definite length, and in some definite direction out of the infinite number which may be taken *in one plane*. IV. *Triple and quadruple* * *algebra*, in which the directions are not confined to one plane (this subject is in its earliest infancy). V. The *geometry* of the second book of Euclid, and the corresponding solid geometry. Here AB actually means the area of the rectangle under the lines A and B, and ABC the content of the rectangular parallelopiped (or right solid) under the lines A, B, and C: the fundamental rules can be demonstrated, and propositions can rigorously be proved. The ordinary and incomplete mode of demonstrating the second book of Euclid might thus be rendered unobjectionable. VI. The *calculus of operations*, in which the symbols, or as many of them as we choose, are ***not magnitudes at all***, but directions to perform certain operations on a variable quantity. [OPERATION.]

10. It does not follow that every species of logical algebra admits of explanation for every symbol or combination of symbols. Thus I. just mentioned rejects $0-1$; II. rejects $\sqrt{-1}$; III. is perfect; and IV. may perhaps be made so: in V. AB + C means no more than AB, if it have meaning, and A^B is wholly inexplicable; and VI. is incumbered with difficulties of new and serious kinds as soon as its elements are passed. It may happen that the proper meaning of a symbol or formula cannot be assigned at the commencement of a logical algebra, but can afterwards be deduced from its symbolic consequences. When this is the case, the deduced meaning must not disturb any one of the five rules. This process is the *interpretation* to which we have alluded, and symbols of which the meaning is laid down from the commencement may be said to be *explained*.

11. It is impossible that a perfect algebra can be founded on ideas of time, loss and gain, or any in which only two directions can be imagined. Space, from the infinity of directions which it admits, is, as yet, the only perfect medium of explanation. Time before and time after a certain epoch may be represented by the positive and negative quantity, but what is there in the idea of time to which $\sqrt{-1}$ can possibly apply? Again, show us a commercial operation which, performed upon a gain, produces a sort of result which can neither be called gain nor loss, but which repeated *two* or more times upon a gain, turns it into a loss—and we can immediately construct a system of commercial algebra, in which $\sqrt{-1}$ shall be intelligible. But, as yet, the necessary ideas are found in geometry only, which causes some persons to object to the extension of algebra. But these surely forget that even common single algebra must derive its theory of oppositions from concrete quantity; -1, standing alone, is unintelligible in the science of pure number.

12. Remark the manner in which [RELATION] the definitions of $a+b$ and ab can be given, even in arithmetic, in terms of process, without mention of subject-matter: $a+b$ requires us to proceed from a as we proceed from 0 to form b: ab requires us to proceed with a as we should with 1 to form b.

13. Let the common symbol of algebra signify a length in a direction in a certain plane, change either of length or direction demanding change of symbol. Take a point O for the *zero point* or *origin*, and let 0 signify that we do not leave that point. From O draw any line at pleasure for the *axis of length*, and take a length OU upon it for 1: continue the unit axis both ways. Draw a perpendicular though O to the axis of length, and call it the *axis of direction*: the reasons for these terms will appear in the sequel.

14. Let A + B denote the distance and direction from the origin which is gained by going over first A and then B; and let A − B denote that gained by going over first A and then a line equal and contrary in direction to B. Let AB denote a line whose length has units equal to the product of the units in the lengths of A and B, and the sum of the angles which they make with the unit line for the angle it makes with the unit line. Similarly, let A ÷ B have the quotient of the lengths of A and B for its length and the difference of the angles for its angle. These definitions are fully explained in NEGATIVE, &c., and RELATION.

15. From the last it appears as an actual consequence of definition, that − A means simply a line equal and opposite to A: and also that $+1+1$ or $+2$ can mean nothing but 2 units extended on the unit-side of the axis of length, and so on; while -2 means 2 units extended on the opposite side of the axis of length. It also appears that A + B and A − B are the operations of single algebra whenever

* By the quadruple algebra we mean Sir W. Hamilton's *quaternions*, which we call quadruple because its author calls it so; but inasmuch as it finds its complete interpretation in space of three dimensions, we consider it as *triple*. Its symbolic rules are not altogether those of ordinary algebra.

the two lines are in the same direction. And if all lines be on the axis of length, all the four operations are those of single algebra; while, if they be all on the unit-side of the axis of length, there is nothing but pure arithmetic; except when an impossible subtraction obliges us either to reject the process, or to enlarge the definition and pass to the opposite side of the axis of length.

16. Make a positive and negative direction on the axis of direction, thus: Choose a direction of revolution in which a line revolving round the origin, and setting out from the axis of length, shall be said to revolve positively. Let the unit revolve positively, and let the first side of the axis of direction which it meets be considered the positive side of that axis. Let the opposite direction of revolution be called negative. But if any difficulty arise about the use of negative angles, remember that this is merely matter of convenience, and can as well be dispensed with. Four right angles may be added to any angle of direction, without altering the direction indicated: and it is perfectly indifferent whether we speak of —160° in the negative direction, or + 200° in the positive direction.

17. By $A = (a, \alpha)$, let us agree to mean that A signifies a line of a units of length, inclined at an angle α to the positive side of the axis of length. Use the theoretical mode [ANGLE] of measuring angles. Then (a, α), $(a, \alpha \pm 2\pi)$, $(a, \alpha \pm 4\pi)$, &c., are all representations of the same line A. The peculiar symbols of the new algebra, so long as they are wanted, shall be capital letters; small letters denoting the symbols of the single algebra.

18. The first four of the fundamental rules in § 3 may be easily shown to be true. The geometrical propositions principally required are two. First, that any number of lengths being given and their directions, if we set off from a point through those lengths and in those directions, one after the other, we reach one and the same point in whatever order the lines of progress are taken. Secondly, that if any polygon revolve about one of its angular points, while at the same time the sides and diagonals which meet in that point are all changed in the same ratio, the figure always remains similar to what it was at the outset. With these propositions and the following,

$$(a, \alpha) \times (b, \beta) = (ab, \alpha+\beta) \quad \frac{(a, \alpha)}{(b, \beta)} = \left(\frac{a}{b}, \alpha - \beta\right),$$

which are merely expressions of the definitions, there will not be much difficulty in establishing the first four of the rules.

19. Let the square, cube, fourth power, &c., of A, as yet, be denoted in full by AA, AAA, AAAA, &c., and their corresponding roots by $\sqrt{A}$, $\sqrt[3]{A}$, $\sqrt[4]{A}$, &c. There is then no difficulty in establishing, as in NEGATIVE, &c., that the mth power of the nth root of (a, α) is derived from

$$\left(\sqrt[n]{a^m},\ \frac{m\alpha \pm 2k\pi}{n}\right)$$

k being any integer; that $\sqrt[n]{A}$ has n values and no more; that $\sqrt{-1}$ stands for a unit on one side (say on the positive side) of the axis of direction, and $-\sqrt{-1}$ for a unit on the negative side. Also, as in the article cited, that, if p and q be the projections of A, on the axis of length and direction, that A is identical in meaning with $p + q\sqrt{-1}$ and with $a(\cos\alpha + \sin\alpha \,.\, \sqrt{-1})$. Indeed, at this point it will be advisable for the student to review the imperfect system in NEGATIVE, only reading exponents as is done just above, powers at full length, roots with the old radical sign.

20. Why do we not hitherto admit the exponent, and define A^2 to mean AA, &c.? Because we are not prepared with a definition which will include *all* exponents. In the article just cited, we get the meaning of $\epsilon^{\theta\sqrt{-1}}$ by interpretation, and it seems only a sort of accident that it should have an intelligible meaning. In order to provide beforehand a complete definition of the exponent, which shall make $(a + b\sqrt{-1})^{c+d\sqrt{-1}}$ as fully explained as any other symbol, *ab initio*, we must premise knowledge of the arithmetical theory of Naperian LOGARITHMS, and must lay down the definition of a line which answers to, and performs all the functions of, a *logarithm*. But as it is inconvenient to retain this name, let us substitute for it the word *logometer*, reserving the word *logarithm* for arithmetical use. By λA, the logometer of A or (a, α), is meant a line of which the projections on the axes* of length and direction are $\log a$ and α; a line, in fact, of the length $\sqrt{(\log a + \alpha^2)}$ inclined to the unit-line at an angle whose tangent is $\alpha \div \log a$. Conversely, the line whose logometer is B or (b, β) has $b\cos\beta$ for the logarithm of its length, and $b\sin\beta$ for the angle (number of theoretical units in the angle). Every line has an infinite number of logometers; for the angle α may be read as $\alpha \pm 2m\pi$, where m is any integer; and thus we have an infinite number of logometers, hypothenuses to a set of right-angled triangles, whose common base is $\log a$ on the axis of length. But no logometer belongs to more than one primitive line.

21. The logometer has the fundamental properties of a logarithm: thus $\lambda A + \lambda B = \lambda(AB)$, meaning that any logometer of A added (bear in mind the extended meaning of all terms of operation) to any logometer of B gives one of the logometers of AB. We shall endeavour to give short heads of demonstration to this and the following propositions. It is readily shown that the projections of two lines on either axis must be added (with their proper signs) to give the projection of the sum. Now in $\lambda A + \lambda B$, the sums of the projections are $\log a + \log b$ and $\alpha + \beta$; but the projections of $\lambda(AB)$ or $\lambda(ab, \alpha+\beta)$ are by definition $\log(ab)$ and $\alpha+\beta$; whence the proposition follows.

22. Denoting by ϵ, as usual, the base of Napier's logarithms, it is easy to see that $(\epsilon, 0)$ has the simple unit line for one of its logometers, or $(1, 0)$, or 1; also that $\theta\sqrt{-1}$ is one of the logometers of a unit of length inclined at the angle θ, or of $(1, \theta)$, or of $\cos\theta + \sin\theta \,.\, \sqrt{-1}$. And by ϵ we must agree to mean (ϵ, o), never $(\epsilon, 2\pi)$, &c.

23. Now let A^B be defined to mean the line which has for one of its logometers B multiplied into any one of the logometers of A: accordingly A^B has as many meanings as we can derive different lines by this process from the different logometers of A. And we shall show, first, that the fundamental rules are satisfied by this definition; secondly, that whenever B means a length of b units *in the axis of length*, the symbol A^B is exactly the A^b of common algebra. It is sufficiently obvious that A^B has meaning or meanings for all possible assigned lengths and directions of A and B.

24. Since ϵ^A means the line whose logometer is $A\lambda\epsilon$ or A, it follows that $\epsilon^{\lambda A}$ is the same as A. Hence $\epsilon^{B\lambda A}$ is the same as A^B, the line whose logometer is $B\lambda A$.

25. The sum of $B\lambda A$ and $C\lambda A$ (the logometers of A^B and A^C) is $(B+C)\lambda A$, which is, by definition, the logometer of A^{B+C}. Hence A^{B+C} and $A^B A^C$, having the same logometers, are identical. Again, $A^B C^B$ has for its logometer $B\lambda A + B\lambda C$ or $B\lambda(AC)$, which is also the logometer of $(AC)^B$; hence $A^B C^B$ and $(AC)^B$ are identical. Thirdly, the logometer of $(A^B)^C$ is $C \times \lambda(A^B)$ or $C \times B \times \lambda A$, which is also the logometer of A^{BC}: hence $(A^B)^C$ and A^{BC} are identical. Consequently the fifth fundamental rule is true of A^B as here defined.

26. Let B be a line on the axis of length, represented by $(b, 0)$ or (b, π) according as it is positive or negative. Then $B\lambda A$ is made simply by multiplying the length of λA by b, and leaving it otherwise unaltered in the first case, or turning it through two right angles in the second. In the first case the projections of $B\lambda A$ are b times those of λA, in the second they have also their signs changed. In the first case then $b\log a$ and $b\alpha$ are the projections of the logometer of A^B, or A^B is $(a^b, b\alpha)$, agreeing with A^b in common algebra: in the second case A^B is $(a^{-b}, -b\alpha)$, agreeing with A^{-b}.

27. The meaning of $\epsilon^{\theta\sqrt{-1}}$ is the line whose logometer is $\theta\sqrt{-1} \times \log(\epsilon, 0)$, or $\theta\sqrt{-1}$. This line is $(1, \theta)$, or $\cos\theta + \sin\theta \,.\, \sqrt{-1}$, whence the equation

$$\epsilon^{\theta\sqrt{-1}} = \cos\theta + \sin\theta \,.\, \sqrt{-1} \;\ldots\; (\theta)$$

is a necessary consequence of the various trains of definition. Now, as all we know of these trains of definition is that the meanings of the symbols satisfy the five rules in § 3, it may seem to be too much that so remarkable an equation as the last should be actually involved in the definitions, instead of being the result of a long sequence of reasonings. And in truth it is too much in one point; for since all our preceding reasoning on the subject of A^B would apply equally to any base we might choose for logarithms, and any unit for measuring angles, what have we done but prove the preceding equation true for any base and any angular unit? And we reply that so far as the definition of A^B is concerned, our proof is perfectly general: but that, on looking back, we find a restrictive connection between the logarithmic base and the angular unit, as follows: It is very easy to see that in our prior definitions, the equation

$$\{(1, \theta)\,.\,(1, \theta)\,.\,(1, \theta)\ \ldots\ (m \text{ times})\} = (1, m\theta)$$

leads to the following

$$\{\cos\theta + \sin\theta \,.\, \sqrt{-1}\}^m = \cos m\theta + \sin m\theta \,.\, \sqrt{-1}$$

in which we may use m as an exponent, since for the simple integer, representing a line in the axis of length, the definition in § 23 gives $A^m = AAA \ldots (m \text{ times})$. Let θ be the angular unit; then we have

$$(\cos 1 + \sin 1 \,.\, \sqrt{-1})^m = \cos m + \sin m \,.\, \sqrt{-1}.$$

But the last is $\epsilon^{m\sqrt{-1}}$, if we introduce the complete exponent from § 23; therefore it must be an equation of connection between ϵ and the mode of assigning angle 1, that

$$\epsilon^{m\sqrt{-1}} \text{ should be } (\cos 1 + \sin 1 \,.\, \sqrt{-1})^m$$

* Any two perpendicular lines would do; but to choose any other except the axis of length and direction would be a step precisely equivalent to preferring some other base to the Naperian in the logarithms of common algebra.

for all integer values of m: and this not merely from equation (θ) but from comparison of what $\cos 1 + \sin 1 . \sqrt{-1}$ must mean in the definitions prior to that of the exponent, with the complete exponential meaning of $\epsilon^{\sqrt{-1}}$. Hence we must have ϵ, the base of the logarithms, connected with the angular unit by the equation

$$\epsilon^{\sqrt{-1}} = \cos 1 + \sin 1 . \sqrt{-1}$$

and any base and angular unit which satisfy this condition will do. The most simple way of doing this is to take $\epsilon = 2{\cdot}71828 \ldots$ as usual, and the angular unit such that there shall be π or $3{\cdot}14159 \ldots$ units in two right angles: but if any one should prefer $\sqrt[2]{(2{\cdot}71828 \ldots)}$ for a base, and $\pi \times 3{\cdot}14159 \ldots$ for the number of units in two right angles, he might get into trouble, but not into error.

28. Another difficulty of the sort which arises when the result seems above the means employed in the demonstration is, that we have a complete system of trigonometry ready for demonstration by mere algebraical mechanism, without casting a further thought on the meaning of the symbols $\cos\theta$ and $\sin\theta$, or more on those of $\tan\theta$, $\cot\theta$, $\sec\theta$, $\operatorname{cosec}\theta$, than to make them, by definition, severally mean, $\sin\theta \div \cos\theta$, $\cos\theta \div \sin\theta$, $1 \div \cos\theta$, and $1 \div \sin\theta$. All we have done with $\cos\theta$ and $\sin\theta$ is to take them into our system as expressing the numerical values of the projections of a unit inclined at the angle θ upon the axes of length and direction. We have not even directly used $\sin^2\theta + \cos^2\theta = 1$. But it should be remembered, that in proving generally $A(B+C) = AB + AC$, we have used the property of *similar figures*; an assumption which is quite sufficient to be the basis of the demonstration of Euclid I. 47, on which $\sin^2\theta + \cos^2\theta = 1$ depends. And those who attentively read Euclid see that he does, in the sixth book, prove I. 47 over again, without any use of it, in showing that all similar figures described on the three sides of a right-angled triangle have the two smaller together equal to the greater. [HYPOTHENUSE.]

In the above definition of $\sin\theta$ and $\cos\theta$ it is clear that $\cos(-\theta) = \cos\theta$ and $\sin(-\theta) = -\sin\theta$, whence the first of the following, being universally true, gives the second:

$$\epsilon^{\theta\sqrt{-1}} = \cos\theta + \sin\theta . \sqrt{-1}$$

$$\epsilon^{-\theta\sqrt{-1}} = \cos\theta - \sin\theta . \sqrt{-1}$$

Whence we have

$$(\cos\theta + \sin\theta \sqrt{-1})(\cos\theta - \sin\theta . \sqrt{-1}) = \epsilon^0$$

Now ϵ^0, by definition, has $0 \times \lambda\epsilon$, or 0×1, or 0, for its logometer, and is therefore $(1, 0)$ or 1. And the first side is, by common application of rules, $\cos^2\theta + \sin^2\theta$. If any one, instead of merely applying rules to the equation

$$(\cos\theta + \sin\theta . \sqrt{-1})(\cos\theta - \sin\theta . \sqrt{-1}) = 1,$$

should proceed to demonstrate the rules upon this instance, he would, in a circuitous way, be led to a perfect geometrical demonstration of $\sin^2\theta + \cos^2\theta = 1$.

29. No equation of this system, which hitherto admits of expression, presents any difficulty as to the meaning of its sides, or any combination of symbols for which the meaning is to be found by interpretation. Perhaps one of the most remarkable results of the ancient system of algebra is the equation

$$\pi = \frac{\log(-1)}{\sqrt{-1}}$$

Some algebraical writers have stated that -1 has neither square root nor logarithm, and without further warning, have afterwards made the non-existent logarithm, divided by the non-existent square root, give the ratio of the circumference of a circle to its diameter. Others have given fair warning that, in using what they called imaginary quantities, they were appealing, more or less, to experience; seeing that operations so conducted always led to truth, when, by the ultimate disappearance of $\sqrt{-1}$, the result could be interpreted. They were content to use such an equation as $\pi\sqrt{-1} = \log(-1)$ as an instrument of which the power was known, though its mechanism was concealed. In the complete system it is visibly obvious that $\pi\sqrt{-1}$ is *one* of the logometers of -1, or of $(1, \pi)$.

30. In ordinary working, there is no objection to dropping the distinction between the logometer and the logarithm, there being no difference between the two in operations.

For fuller account of the whole of this system, we refer to De Morgan, 'Trigonometry and Double Algebra.'

That this system will finally be introduced into elementary instruction we entertain no doubt whatever. But how soon will this take place? The school-books hardly yet teach the interpretation of the negative quantity; so that there is but little hope of the speedy success of the complete system. But truth must conquer at last; and the respect with which the memory will be preserved of the mathematicians who were neither discouraged by the difficulties nor rendered incredulous by the mysteries of the ancient system, will not protect from ridicule those who shall obstinately refuse to see light because there was once darkness, or shall wilfully continue in the imperfect system from which those who wish the exact sciences to be in all their parts the perfection of reason are most glad to be delivered. With respect to those parts of the doctrine of series, and of the integral calculus, which still present difficulties, though of a different character from those here treated, the lesson taught by the victory over what was rashly called *impossible*, which many heads have required many years to gain, is—Never refuse to examine, and to continue in the examination of, all consequences of the symbolic laws of algebra: there is every reason to hope that the symbols are always right, even though the views of their explanation may require correction.

ALGEBRAIC. An expression is said to be *algebraic*, as distinguished from *transcendental*, when its number of terms is finite, and when each term contains only addition, subtraction, multiplication, division, and extraction of roots, the exponents of which are given. Thus all infinite series, as well as expressions containing

$$\log. x,\ a^x,\ \sin x,\ \cos x,\ \&c.$$

though used in algebra, in the widest sense of the word, are improperly said to be not *algebraic*, but *transcendental*. Similarly, a curve is said to be *algebraic* when its equation (CURVE) contains no transcendental quantities.

ALGEBRAIC GEOMETRY. A name given to the application of algebra to the solution of geometrical problems. For the principal points of interest connected with it, see ABSCISSA, ORDINATE, CO-ORDINATES, CURVE, CURVATURE, EQUATION, TANGENT. The regular treatises in this, as in every other case, cannot be dispensed with by any of our readers who are desirous of acquiring it. But in this article, as in the last, we are led to write by the paucity of elementary works which explain a new and useful modification of the mode of viewing a part of the subject.

In geometry of two dimensions, the number of co-ordinates is not so great as to make symmetrical disposition extremely necessary at the outset. We should not, for instance, gain much by forming the equation of the straight line thus: $ay + bx + c = 0$ instead of $y = ax + b$; in fact, the writers who have preferred the symmetrical course have rather overloaded themselves with symbols, to an extent which makes the burden thus imposed on the memory greater than that from which symmetry relieves it. But it is not so in geometry of three dimensions. There are here three co-odinates to every point; and, as it happens, symmetry, even when obtained by augmentation of the number of symbols, is found to be, on the whole, an assistance in the remembrance of formulæ. Accordingly, the equations of the plane and straight line, and formulæ connected with them, are expressed with great convenience in the manner of which the following is a summary; the first use of which, as far as we know, is found in the celebrated work of Malus, 'Théorie de la double Réfraction,' 4to, Paris, 1810.

1. In arranging expressions containing three quantities or different sets of three, symmetry requires that no one letter shall ever appear at the beginning of one expression without appearing at the end of another; and that in every set of expressions which are formed by combination of pairs, an interchange of any two letters, or of the corresponding pairs taken out of different sets, shall reproduce the same set of expressions in another order, or at most with different signs. Thus, $a-b$, $b-c$, $c-a$, are symmetrical, and so are $ay-bx$, $bz-cy$, $cx-az$.

2. When there are two equations of the form $ax+by+cz=0$, $a'x+b'y+c'z=0$, the quantities are not given, but their proportions are: and x, y, and z are in the proportion of

$$bc'-cb',\ ca'-ac',\ ab'-ba'$$

3. An expression of the form

$$(ay-bx)^2+(bz-cy)^2+(cx-az)^2$$

is identical with

$$(a^2+b^2+c^2)(x^2+y^2+z^2)-(ax+by+cz)^2$$

4. The form of the equation of a plane is $Ax+By+Cz+D=0$; the common form $z = Ax+By+C$ is unsymmetrical. The plane which passes through the point whose co-ordinates are p, q, r, which call the point $(p\,q\,r)$, is

$$A(x-p)+B(y-q)+C(z-r)=0$$

The plane which passes through the three points $(p\,q\,r)$, $(p'\,q'\,r')$, $(p''\,q''\,r'')$, is

$$\left\{(q'-q)(r''-r)-(r'-r)(q''-q)\right\}(x-p)+\&c.=0:$$

one term of which is enough; symmetry will point out the rest. Remember the order pq, qr, rp.

5. When such symmetrical expressions as $ab'-ba'$, $bc'-cb'$, $ca'-ac'$, are to be constructed, the best way is to write down a, b, c, a, and a', b', c', a', under one another, and to calculate from the left to the end, without returning to the beginning. Thus from

$$\begin{array}{cccc} 8 & 1 & 3 & 8 \\ 2 & 4 & 6 & 2 \end{array}$$

we have

$$30,\ -6,\ -42$$

6. The most convenient form of the equations of a straight line is as follows: Let (abc) be a point on the straight line, and let A B C be any three quantities proportional to the cosines of the angles which the straight line makes with the directions of x, y, z. Then the equations of the straight line are

$$\frac{x-a}{A} = \frac{y-b}{B} = \frac{z-c}{C}$$

The following system is sometimes convenient :—

$$x = a + \mathrm{A}v,\ y = b + \mathrm{B}v,\ z = c + \mathrm{C}v$$

where $v\sqrt{(\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2)}$ is the distance between (abc) and (xyz).

7. The plane whose equation is $\mathrm{A}(x-a)+$&c. $=0$ may be called the plane (ABCabc), and the straight line just mentioned may be called the straight line (ABCabc). Throughout this article capitals are generally proportional to cosines of angles, and small letters are co-ordinates of points. The order of co-ordinates is xyz, and all letters connected with co-ordinates run in consecutive triplets, as ABC, PQR, &c. But when triplets of pairs are made, as AB, BC, CA, then AB particularly belongs to the co-ordinate to which C is attached, BC to that of A, and CA to that of B.

8. The angles made by the straight line (ABC, &c.) with the axes have for their cosines $\mathrm{A} \div \sqrt{(\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2)}$, &c.; and the angle made by the two straight lines (ABC, &c.), (A′B′C′, &c.), has for its cosine

$$\frac{\mathrm{AA}' + \mathrm{BB}' \times \mathrm{CC}'}{\sqrt{(\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2)}\sqrt{(\mathrm{A}'^2+\mathrm{B}'^2+\mathrm{C}'^2)}}$$

When the lines are perpendicular, $\mathrm{AA}'+\mathrm{BB}'+\mathrm{CC}'=0$; and when they are parallel, A, B, C are in the same proportion as A′, B′, C′.

9. The angles made by the plane (ABC, &c.) with the planes of yz, zx, and xy, are $\mathrm{A} \div \sqrt{(\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2)}$, &c.; the cosine of the angle made by the planes (ABC, &c.) and (A′B′C′, &c.) with one another is as in the last, and also the conditions of perpendicularity and parallelism.

10. The plane (ABCabc) is at right angles to the line (ABCpqr), whatever a, b, c, p, q, r may be. And the plane (ABC, &c.) is at right angles to the line (A′B′C′, &c.) whenever A, B, C, are proportional to A′, B′, C′. But the plane (ABC, &c.) is parallel to the line (A′B′C′, &c.) when $\mathrm{AA}'+\mathrm{BB}'+\mathrm{CC}'=0$.

11. The straight line (ABCabc) lies entirely in the plane (PQRpqr) when

$$\mathrm{P}(a-p) + \mathrm{Q}(b-q) + \mathrm{R}(c-r) = 0$$
$$\mathrm{AP} + \mathrm{BQ} + \mathrm{CR} = 0.$$

12. The intersection of the two planes (PQRpqr) and (P′Q′R′$p'q'r'$) is the straight line (ABCabc) in which A, B, C, are proportional to $\mathrm{QR}'-\mathrm{RQ}'$, $\mathrm{RP}'-\mathrm{PR}'$, $\mathrm{PQ}'-\mathrm{QP}'$ and

$$\mathrm{P}(a-p) + \mathrm{Q}(b-q) + \mathrm{C}(c-r) = 0$$
$$\mathrm{P}'(a-p') + \mathrm{Q}'(b-q') + \mathrm{C}'(c-r') = 0$$

13. The intersection of the plane (PQRpqr) and the straight line (ABCabc) is at the point whose co-ordinates are $a+\mathrm{A}v$, $b+\mathrm{B}v$, $c+\mathrm{C}v$, where

$$v = \frac{\mathrm{P}(p-a) + \mathrm{Q}(q-b) + \mathrm{R}(r-c)}{\mathrm{AP} + \mathrm{BQ} + \mathrm{CR}}$$

14. Two straight lines (ABCabc) and (A′B′C′ $a'b'c'$) do not, generally speaking, intersect at all; their shortest distance is $(\mathrm{BC}'-\mathrm{CB}')(a-a')+$&c., divided by $\sqrt{\{(\mathrm{BC}'-\mathrm{CB}')^2+\text{\&c.}\}}$, and they meet when the numerator of this fraction is nothing. The plane (PQRpqr) is parallel to both straight lines when P, Q, R, are proportional to $\mathrm{BC}'-\mathrm{CB}'$, $\mathrm{CA}'-\mathrm{AC}'$, $\mathrm{AB}'-\mathrm{BA}'$.

15. The equation of a plane which passes through the straight line (ABCabc) and is perpendicular to the plane (PQRpqr) is

$$(\mathrm{BR}-\mathrm{CQ})(x-a) + (\mathrm{CP}-\mathrm{AR})(y-b)$$
$$+ (\mathrm{AQ}-\mathrm{BP})(z-c) = 0.$$

16. The perpendicular distance from the point (abc) to the plane (PQRpqr) is $\mathrm{P}(a-p)+\mathrm{Q}(b-q)+\mathrm{R}(c-r)$ divided by $\sqrt{(\mathrm{P}^2+\mathrm{Q}^2+\mathrm{R}^2)}$, independently of sign. And the perpendicular distance between the parallel planes (PQRpqr) and (PQR$p'q'r'$) is $\mathrm{P}(p-p')+$ &c., divided by $\sqrt{(\mathrm{P}^2+\text{\&c.})}$

17. The perpendicular from the point (lmn) upon the straight line (ABCabc) meets it in a point of which the co-ordinates are $a+\mathrm{A}v$, &c., where

$$v = \frac{\mathrm{A}(l-a) + \mathrm{B}(m-b) + \mathrm{C}(n-c)}{\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2};$$

and the square of the length of that perpendicular is

$$(l-a)^2 + \text{\&c.} - \frac{\{\mathrm{A}(l-a) + \mathrm{B}(m-b) + \mathrm{C}(n-c)\}^2}{\mathrm{A}^2+\mathrm{B}^2+\mathrm{C}^2}.$$

This is sufficient for a specimen of the method, and even for a summary of the most important propositions respecting the straight line and plane. On the good effect of symmetry it is hardly necessary to make much remark; not only are formulæ more easily remembered, since the whole can be formed from recollection of a part—and more easily used, since an unsymmetrical result is an indication of error—but the actual expression can be shortened in type, of which the above is a sufficient proof. It would have been impossible safely to write down as many results in twice the space, if the ordinary plan of notation had been adopted. The best mode of treating the ordinary forms for the straight line, such as $y = ax + \alpha$, $z = bx + \beta$, is to reduce them to the preceding, thus:

$$\frac{x-0}{1} = \frac{y-\alpha}{a} = \frac{z-\beta}{b}$$

ALGORITHM, a corruption from the Arabic, the root being a word which means calculation, or at least refers to calculation or reckoning. When the Indian numerals were introduced from the East, this word came with them, and the new figures were denominated (by Chaucer for example) *augrime* (or algorithm) figures. The word is tolerably well naturalised among the French mathematicians, as meaning the system of notation: thus there is an algorithm of functions, and an algorithm of the differential calculus, &c. It has also been used by English writers, but our language does not want it; the word *notation* does just as well. Hard words sometimes lead to misconception; those who attempt to interpret them find them not only spelt in different ways, but with very different meanings. Daniel Fenning (‘Young Algebraist's Companion,’ 1750) tells us that some writers are so short and intricate, that it is almost impossible to learn the *algorithm* from them, much less the *algorism*. In a note he informs us that the first of these hieroglyphics means the first principles, and the second their application to practice. Our old mathematical dictionaries define the word algorithm in probably its real imported sense, namely, as meaning the great rules of arithmetic.

ALGUACIL, an officer in Spain, answering to the English bailiff. The name is from the Arabic *el-vazil*, or from the Hebrew verb *gazal*, which means to catch. The alguacil mayor is a superior officer, whose functions are the same as those of the common alguacil. The duty of an alguacil is at present confined to the apprehension of criminals; the office of executioner being discharged by the verdugo.

ALIAS, a term used in legal proceedings to denote a second or further description of a person who has gone by two or more different names. If the same person is known by the name of John Smith as well as the name of John Thomson, he is described in legal language as John Smith, *alias dictus* (otherwise called) John Thomson.

ALIBI, a Latin term signifying "in another place," of frequent occurrence in criminal courts. Thus, where a person charged with an offence committed at a certain time and place, shows that he was *elsewhere* at that time, he is said to prove an *alibi*. If true, this is obviously the best proof of innocence; but no kind of defence offers so ready an opportunity for false evidence: and the *setting up an alibi* is therefore, in practice, always regarded with suspicion.

ALIEN. An alien is one who is born out of the legiance (allegiance) of the king. (Littleton, 198.) The word is derived from the Latin, *alienus*; but the word used by the English or other law writers in Latin is *alienegena*. The condition of an alien, according to this definition, is not determined by place, but by allegiance [ALLEGIANCE], for a man may be born out of the realm of England, or without the dominions of the king, and yet he may not be an alien. It is essential to alienage that the birth of the individual occurred in a situation and under circumstances which gave to the sovereign of this country no claim to his allegiance.

The following instances will serve to illustrate the description of an alien. The native subject of a foreign country continues to be an alien, though the country afterwards becomes a part of the British dominions. Thus, persons born in Scotland *before* the accession of James I., were aliens in England even *after* that event; but those who were born afterwards were adjudged to be natural-born subjects. This question was the subject of solemn discussion in the reign of that prince; and the reported judgment of the court has guided lawyers in all similar controversies. Persons born in those parts of France which formerly belonged to the crown of England, as Normandy, Guienne, and Gascony, were not considered as aliens so long as they continued so annexed; and, upon the same principle, persons born at this day in any of our colonial possessions are considered native subjects. A man, born and settled at Calais whilst it was in the possession of the English, fled to Flanders with his wife, then pregnant; and there, after the capture of Calais by the French, had a son; the issue was held to be no alien. If, however, enemies invade the kingdom, and a child is born among them, the child is an alien.

The children of ambassadors, and other official residents in foreign states, have always been held natives of the country which they represent and in whose service they are. This rule prevailed even at a time when the law was stricter than it now is. It has been since so far extended by various enactments, that all children born abroad, whose *fathers*, or *grandfathers* on the father's side, were natural subjects, are now deemed to be themselves natural-born subjects, unless their fathers were liable to the penalties of treason or felony, or were in the service of a prince at war with this country. (25 Ed. III. st. 2; 7 Anne, c. 5; 4 Geo. II. c. 21; 13 Geo. III. c. 21.) The children of a British *mother* by an alien, though aliens if born out of the king's allegiance, are now enabled to take property by devise, purchase, or succession. (7 & 8 Vict. c. 66.)

The children of aliens born in England are, as a general rule, the same as natural-born subjects; they are entitled to the same rights and owe the same allegiance.

It follows from the general principles of our law that a man may be subject to a double and conflicting allegiance; for, though he may become a citizen of another state (the United States of America, for instance), or the subject of another king, he cannot divest himself of the duty which he owes to his own. So that, in the event of a war between the two states, he can take no active part on behalf of one, without incurring the penalty of treason in the other. This predicament may occur without any fault of the party; for the children of aliens are (except under peculiar circumstances) natural subjects of the state in which they were born: yet they may still be regarded as natural-born subjects of the state to which their parents owed allegiance.

An alien cannot hold lands in England, except for a term not exceeding twenty-one years, and in that case only for the purpose of residence or trade. (7 & 8 Vict. c. 66.) If he purchase lands, he takes them, but they are forfeited to the crown after the fact of purchase has been ascertained by a jury. These disabilities of an alien are founded on the nature of the tenure of land in England, which always implies fealty to some superior lord. It follows from the notion of an alien, that he cannot take land by descent, nor can he be entitled to land by the courtesy of England. An alien woman was not at common law entitled to dower of her husband's lands, unless she had been either made a denizen or naturalised. It is said that she was entitled to dower if she had married an Englishman by licence from the crown. (Cruise, 'Digest,' i. 159.) Now, however, an alien woman by marriage with a British subject is *ipso facto* naturalised. (7 & 8 Vict. c. 66.) It has been said that an alien cannot take land by devise; but there seems to be no legal principle which shall prevent him from *taking* by devise, any more than from taking by purchase: the only question is, for whose benefit he *takes*, for he cannot hold it for his own benefit. An alien cannot be returned to serve on a jury, except where he is one *de medietate linguæ*, that is, a jury of which one-half are foreigners.

An alien may possess himself of goods, money in the funds, and other personal effects, to any extent. The law has, from a very early period, recognised his right to reside without molestation within the realm for commercial purposes. "All merchants shall have safe and secure conduct to go out and to come into England; and to stay there, and to pass as well by land as by water, to buy and sell by the ancient and allowed customs, without any evil tolls, except in time of war, or when they are of any nation at war with us." ('Magna Charta,' art. 48.) Notwithstanding which express provision, aliens were formerly subject to higher duties at the custom-house, and several statutes prohibited alien artificers from working for themselves in this kingdom. Aliens cannot hold British registered shipping nor shares therein. (17 & 18 Vict c. 104, s. 18.) An alien cannot be a member of parliament, nor can he vote in the election of a member of parliament. The Municipal Corporations Act (5 & 6 Wm. IV. c. 76, s. 4), also debars aliens from exercising the municipal privileges of a burgess.

An alien can bring an action or suit in the English courts in respect of personal property or contracts; and may dispose of his property by will. The *droit d'aubaine*, or right of succeeding to the effects of a deceased alien, formerly claimed by the crown of France, never prevailed in this country. Nor was it customary to enforce it even in France, except as against the natives of a state in which a similar right was exercised. For some time previous to its abolition by the first Constituent Assembly in 1791, it was generally stipulated by foreign countries in their treaties with France, that their subjects should be exempt from the law. [AUBAINE.] This doctrine of reciprocity was adopted by the French Code ('Code Civil,' art. 726), but was abrogated in 1819, so far as the right of succession is concerned: so that aliens are now on the same footing in this respect with native Frenchmen throughout that kingdom. Aliens who are subject to any criminal proceeding in our courts of justice are in most cases entitled to trial by a jury *de medietate linguæ*.

The disabilities of aliens may be partially removed by letters-patent constituting the party a free denizen. From the date of the grant he is entitled to hold land, and transmit it to his after-born children, and to enjoy many other privileges of a native subject. The partial effect of Letters of Denization give rise to the practice of obtaining naturalisation by act of parliament, which conferred on the alien every right of a natural-born subject, except the capacity of sitting in parliament or the privy council, or of holding grants and offices of trust under the crown; an exclusion originally dictated by the jealous policy of the legislature on the accession of the House of Orange. A temporary naturalisation may now, however, be obtained by the order of the Home Secretary. [DENIZEN.]

The rights of aliens, enumerated above, must be understood to apply only to alien *friends*. Alien *enemies*, or subjects of a foreign state at war with this country, are in a very different condition, and may be said to possess very few rights here.

As examples of the policy which has at different times been pursued in this country with reference to aliens, the following historical notices may be interesting:—

Magna Charta stipulates, in the article already cited, for the free access of foreign merchants for the purposes of trade, and its provisions were enforced and extended under the reigns of succeeding princes.

In the 18th year of Edward I. the parliament rolls contain a petition from the citizens of London, "that foreign merchants should be expelled from the city, because they get rich, to the impoverishment of the citizens;" to which the king replies, that "they are beneficial and useful, and he has no intention to expel them."

In the reign of Edward III. several beneficial privileges were conferred on aliens for the encouragement of foreign trade.

Under Richard II. and his successor, statutes were made imposing various restraints on aliens trading within the realm, and especially prohibiting internal traffic with one another. Similar restrictions were introduced in the reign of Richard III., chiefly with a view to exclude them from retail trade; and in that of Henry VIII. violent insurrections against aliens were followed by repeated statutes, reciting the mischievous consequences attributed to the influx of foreigners, and laying greater impediments in the way of their settlement within the realm. Several Acts of this description are still in force, though they have fallen into practical disuse; but the courts of law have always put on them a construction the most favourable to foreign commerce, agreeably to the opinion of Lord Chief Justice Hale, that "the law of England hath always been very gentle in the construction of the disability, and rather contracting than extending it severely." (Ventris's 'Reports,' vol. i. p. 427.)

In the reign of James I. the king was strongly petitioned to adopt exclusive measures against the aliens, who had flocked into the kingdom from the Low Countries; but James, though he acquiesced to a certain extent in the object of the petitioners, seems by no means to have participated in their feelings of enmity to aliens; for he professes his intention "to keep a due temperament between the interests of the petitioners and the foreigners;" and he especially commends "their industrious and sedulous courses, whereof he wished his own people would take example."

In the reign of Charles II. aliens were invited to settle in this country, and to engage in certain trades, by an offer of the privileges of native subjects. (15 Charles II. c. 15.) This statute was repealed by 12 & 13 Wm. III. c. 2; but there is an unrepealed Act of 6 Anne, which naturalises all foreigners who shall serve for two years on board any ship of her majesty's navy or a British merchant-ship.

In the early part of the last century (1708) a bill was brought into parliament for the general naturalisation of all foreign Protestants, upon their taking certain oaths and receiving the sacrament in any Protestant church, and it passed notwithstanding the strenuous opposition of the city of London, who represented that they would sustain loss by being obliged to remit certain dues which aliens were obliged to pay. After remaining in operation for three years, it was repealed on a suggestion of its injurious effects upon the interests of natural-born subjects; but a previous bill for effecting this object was rejected by the Lords. The reasons for and against the measure will be found in the fourth volume of Chandler's 'Commons' Debates,' p. 119-122. In 1748 and 1751, a measure similar to the Act of 1708 was brought forward, and in 1751 it was read a second time, but was dropped in consequence of the death of the Prince of Wales, which disarranged the public business.

Upon a review of the history of our policy, the inference seems to be, that although the maxims prevalent in our courts of law have been generally favourable to aliens, and although the government appear to have been at all times sensible of the advantages resulting from a liberal reception of foreign settlers engaged in trade, yet popular prejudices have been on the whole successfully exerted in impressing upon the legislature a more jealous and exclusive system.

The Alien Acts (33 Geo. III. c. 4; 34 Geo. III. c. 43, 67, and others) were passed entirely from political motives, and were mainly enacted on account of the great number of foreigners who came to England in 1792 and 1793. There is reason to believe that the crown has always had the power of banishing aliens from the realm, which these acts, however, expressly gave to it: at all events, the power has undoubtedly been often exerted; and it seems almost to be included in the ampler prerogative of declaring war against the whole, or any part, of a foreign state. However, either from want of recent authentic precedents, or from a desire to accompany the measure with provisions not within the ordinary exercise of the prerogative, this power has not been exercised of late years without the sanction of parliament. In 1827 a measure was introduced (7 Geo. IV. c. 54) for the general registration of all aliens visiting this country, and every foreigner was required to present himself at the Alien office. This Act was repealed by 6 & 7 Wm. IV. c. 11, but new provisions of a similar character were introduced. Masters of vessels arriving from foreign parts are to declare what aliens (mariners navigating the vessel excepted) are on board or have landed, under a penalty, for omission or for false declaration, of 20*l*., and 10*l*. for each alien omitted. Every foreigner on landing is required immediately to exhibit any passport in his possession to the chief officer of customs at the port of debarkation, and to state to him, either verbally, or in writing, his name, birth-place, and the country he has come from, under a penalty, for neglect or refusal, of 2*l*. The officer of customs is to register this declaration, deliver a certificate to the alien, and transmit a copy of the declaration to the secretary of state. On leaving the country the alien is required to transmit to the secretary of state the certificate granted him on landing. The act does not affect foreign ministers or their servants, nor aliens under fourteen years. The proof of non-alienage lies on the person alleged to be an alien. Under the former act aliens were required to present themselves at the Alien-office; but this is no longer necessary. The registration clause, it may be added, is generally disregarded by foreigners, and is never enforced, for there is no provision in the Act for recovering the penalty. ('Blackst. Comm.,' Mr. Kerr's ed., v. i. pp. 254, 308, 367, et seq.)

The same classes of persons who are aliens according to the law of England, are aliens according to that of Scotland, and the statute law on the subject extends to that part of the empire. When an alien resident in Scotland wishes to acquire the privileges of a British subject, the same forms which, as above described, are applicable to England, are gone through with the same effect. They are consistent with the constitutional doctrine of the separate kingdom of Scotland, in which, anterior to the Union, it appears that letters of denization could give a portion, but an Act of Parliament only could communicate the whole of the privileges of a born subject of the crown. The institutional writers maintain that an alien cannot hold any kind of heritable property in Scotland, but in the books there are only two cases on the subject, and in one the general question was evaded; in the other an alien was found not to have a sufficient title to pursue a reduction of a conveyance of an estate. If the rule that aliens cannot hold heritage were strictly interpreted, it would affect property which all classes of persons are in the practice of holding in Scotland without molestation, but in the general case it would be difficult to find a form in which an alien's title could be brought in question. It is questioned whether an alien in Scotland who holds the statutory qualification may vote for a member of the House of Commons. The sheriffs, who are judges in the registration courts, have given conflicting judgments on this point.

The following are the laws as to aliens in France and the United States of North America, two countries with which Englishmen are more closely connected than any other:—

A child born in France, of foreign parents, may, within one year after he has attained the age of twenty-one, claim to be a Frenchman; if he is not then resident in France, he must declare his intention to reside there, and he must fix his residence there within one year after such declaration. An alien enjoys in France the same civil rights as those which Frenchmen enjoy in the country to which the alien belongs; but he enjoys the right of succession in France, although this right may not be granted to French citizens in his own country. An alien is allowed by the king's permission (*ordonnance du roi*) to establish his domicile in France; and so long as he continues to reside there, he enjoys all civil but not political rights; but this enjoyment ceases immediately the domicile is lost. After an uninterrupted residence during ten years, by permission of the king an alien may become naturalised. ('Code Civil,' liv. 1, tit. i. s. 9.) A foreigner can buy and hold land in France without obtaining any permission from the crown or legislature.

Upon the recognition of the independence of the United States of North America by the treaty of Paris, 1783, the natural-born subjects of the king of England who adhered to the United States became aliens in England; and it was decided that they became incapable of inheriting lands in England. It had been previously decided in America that natives of Great Britain were aliens there, and incapable of inheriting lands in the United States. Kent defines an alien to be "a person born out of the jurisdiction of the United States;" but this definition is not sufficiently strict, for the son of an alien, which son is born in the United States, is also an alien.

Congress has several times altered the law respecting naturalisation, but chiefly as to the period of previous residence. In 1790, only two years' residence was required; in 1795 the term was prolonged to five years; and in 1798, to fourteen years. In 1802, the period of five years was again adopted, and no alteration in this respect has taken place. The benefits of naturalisation have always been confined to "free white persons;" persons of mixed blood are excluded, as well as the African and other pure races, whether black or copper-coloured. At what point a person of mixed blood could claim naturalisation is doubtful. By an old law of Virginia, which was not repealed up to a recent period, a person with one-fourth of negro blood is deemed a mulatto. An alien in the United States cannot have full and secure enjoyment of freehold of land; and if he does, the inheritance escheats. He can neither vote at elections nor hold public offices. Two years at least before he can obtain the privileges of a natural-born citizen he must appear in one of certain courts, or before certain officers, and declare on oath his intention to become a citizen of the United States, and to renounce his allegiance to his own state or prince. When the two years have expired, and if the country to which the alien belongs is at peace with the United States, he is next required to prove to the court, by his oath as well as otherwise, that he has resided five years at least in the United States, and one year in the state where the court is held; and he must show that he is attached to the principles and constitution of the United States, and is of good moral character. The court then requires that he should take an oath of fidelity to the constitution, and likewise an oath by which he renounces his native allegiance. He must also renounce any title or order of nobility, if he has any. The children of persons naturalised according to this form, if they were minors at the time, are deemed citizens if they are then dwelling in the United States. If an alien dies in the interval between having taken the preliminary steps towards his naturalisation and the time of his admission, his widow and children become citizens. If an alien resided in the United States previously to the 18th of June, 1812, the preliminary notice of two years is not necessary, nor if he be a minor under twenty-one and has resided in the United States during the three years preceding his majority. In the case of an alien who has arrived in the United States after the peace of 1815, it is required that he should not at any time have left the territory during the five years preceding his admission to citizenship. A naturalised alien immediately acquires all the rights of a natural-born citizen, except eligibility to the office of President of the United States, and of governor in some of the states. A residence of seven years, after naturalisation, is necessary to qualify him to be a member of Congress. (Kent's 'Commentaries,' vol. ii. p. 50-75.)

In 1804 Congress passed an Act supplementary to the Act of 1802, which contains a clause respecting the children of American citizens born abroad, but it applies only to the children of persons who then were or had been citizens; and Kent remarks ('Commentaries,' vol. ii. p. 53) that the rights of the children of American citizens born abroad are left in a precarious state; and in the lapse of time there will soon be no statute which will be available, in which case the English common law will be the only principle applicable to the subject.

Before the adoption of the present constitution of the United States, the several states had each the privilege of conferring naturalisation. Each state can still grant local privileges. There is a considerable diversity in the laws of different states respecting aliens. By a permanent provision in the state of New York, an alien is enabled to take and hold lands in fee, and to sell, mortgage, and devise (but not to demise and lease the same), provided he has taken an oath that he is a resident of the state, and has taken the preliminary steps towards becoming a citizen of the United States. There are similar provisions in several of the other states. In New York resident aliens holding real property are liable to be enrolled in the militia, but they are not qualified to vote at any election, of being elected to any office, or of serving on a jury. In North Carolina and Vermont the constitution provides that every person of good character who comes into the state and settles, and takes an oath of allegiance, may hold land, and after one year's residence he becomes entitled to most of the privileges of a natural-born citizen. In Connecticut the superior court, on the petition of any alien who has resided in the state six months, has the power of conferring upon him the same privileges in regard to holding land, as if he were a natural-born citizen. In Pennsylvania aliens may purchase lands not exceeding 5000 acres, and hold and dispose of the same as freely as citizens. In Georgia aliens can hold land, provided they register their names in the Superior Court. No alien can act as executor or administrator in this state. In Kentucky, after a residence of two years, an alien can hold land. In Indiana, Missouri, and Maryland the disqualification of an alien holding land is done away with on his giving notice of an intention to become a citizen. Most, if not all, of the state legislatures are in the habit of granting to particular aliens, by name, the privilege of holding real property. ('Law relating to Aliens in the United States,' in 'Boston Almanac,' 1835.)

In the States generally, perhaps in all, as in England, the alienage of a woman does not bar her right of dower.

The following information is abstracted from evidence given by Harvey Gem, Esq., before the Select Committee on aliens, in 1843, and the information was stated to have been obtained from the ambassadors or ministers of the different Powers in London:—

In Prussia, from the moment when an alien becomes a resident and places himself under the protection of the laws, he enjoys the same rights as a natural-born subject, and not only has he a right to vote in the election of members to the Provincial States, but he is also eligible himself as a member.

In Saxony, by a law passed in 1834, an alien may acquire the privileges of a natural-born subject by right of domicile, granted by the local authorities of each district, or by the purchase of real property, and in towns by obtaining the freedom of the corporation. In the two latter cases, the alien must have been in possession of his real property or of his freedom for five years, during which period he must have resided in the place where the property is, or in the town of which he has obtained the freedom. The right of voting, eligibility as a representative of the Chambers of the Kingdom, &c., depend upon the nature and value of the real property acquired, whether a manor, a house in a town, &c.

In Bavaria aliens can possess landed property, without the condition of residence, but they are liable to the duties which attach to the property. Naturalisation is obtained either by marriage of a foreign woman with a Bavarian, by domicile and renouncing foreign allegiance, or by royal decree; but a residence of six years is necessary before the full citizenship can be obtained. The privileges of an alien in Bavaria depend in some degree on the policy of the state of which he is a subject towards foreigners in general or Bavarians in particular.

In Würtemberg an alien who wishes to be naturalised, first purchases landed property in or near the place where he intends to settle, by which he obtains the consent of the local authorities to reside among them (bürger-recht). These conditions having been fulfilled and the sanction of government obtained, the alien acquires the Staatsbürger-recht, which gives him all the privileges of a natural-born subject, and with them its obligations, as liability to the military conscription, &c. The burger-recht may give an alien all the municipal rights of a citizen in a town, while, as respects the Staatsbürger-recht, which makes him a citizen of the state, he may still be an alien.

In Hanover naturalisation is acquired in one or other of the following ways: by marriage of a foreign woman with a Hanoverian subject; by the adoption by a Hanoverian of a foreigner as his child; by holding any office under the government; by becoming a member of a commune; by the purchase of a residence or freehold in any commune; by the authority of the State, independently of the will of the commune; and by a residence of five consecutive years in any commune with the express approbation of the bailiff or mayor—the conditions in the two last cases being the possession of sufficient means of subsistence and an irreproachable character.

In Austria a residence of ten years is sufficient in all cases to obtain naturalisation. Whoever holds any office, either civil or military, under the crown, is thereby naturalised. Merchants or manufacturers who come to settle in the country with their families can obtain naturalisation at once, if they are of good reputation and not in needy circumstances. Naturalisation confers, without any exception, all the rights and privileges of natural-born subjects.

The Act of the German Confederation, Art. 18, gives to every German the right of holding civil and military offices in the different states of the Confederation.

In Denmark, every foreigner who settles there with the intention of remaining, and who owns land of the value of 30,000 crowns, or houses in the towns of the value of 10,000 crowns, or a capital of 20,000 crowns in trade, acquires by that alone the right of demanding letters of naturalisation. Children born in Denmark of foreign parents, and persons naturalised, are eligible to all public offices, with one exception, which is this, a naturalised foreigner does not become eligible as a deputy of the provincial States until he has resided for five years in the European dominions of Denmark, and renounced his foreign allegiance.

In the Hanseatic towns naturalisation is acquired in the following manner:—In Lübeck and its territory, any person of respectability, especially after a prolonged residence, is admitted as a citizen without difficulty, on showing, if required, that he has sufficient means of subsistence. Letters of naturalisation confer all the rights which natural-born subjects enjoy. In Hamburg an alien cannot hold landed property, but any persons taking up their bonâ-fide residence there may obtain letters of naturalisation on payment of a moderate sum (a few pounds, it is stated), upon which they enjoy all the rights of native citizens, with the exception of not being eligible to the order of the bürgerschaft; but the restrictions in this case apply only to age and some other qualifications, which are equally applicable to native citizens. No business can be transacted by foreigners until they have obtained the privilege of citizenship, and become members of some one of the guilds. Any foreigner may become a citizen by purchase. Jews cannot become citizens. In Bremen an alien obtains the rights of citizenship for a money payment, and by becoming a member of a commune. In Frankfort naturalisation is obtained by gift for public services, by marriage, or by purchase, if the person desirous of becoming a citizen can give satisfactory references as to character, station, and property.

In Sardinia the power of conferring naturalisation rests entirely with the king, and is never refused on any bonâ fide application: a naturalised person enjoys all the privileges of a natural-born subject.

In Portugal an alien of not less than twenty-five years of age can obtain letters of naturalisation after two years' residence, and provided he has the means of subsistence. The two years' residence is dispensed with if the alien has married a Portuguese woman; or has opened or improved a public road; embarked money in trade; improved any branch of arts; introduced any new trade or manufacture; or otherwise performed some service of public utility.

In Belgium an alien cannot purchase or hold land. There are two kinds of naturalisation, the petite naturalisation and the grande naturalisation. The first gives the alien some advantages, as the right to sue, &c.; and the second, which is an act of the legislature, confers political privileges, in addition.

In Switzerland naturalisation is conferred in some cantons by the legislature, and in others by the executive. In Tessin a naturalised foreigner can only enjoy the full rights of citizenship after five years have elapsed from the date of his naturalisation. In Thürgau no one can hold any office under the government unless he has been a burgess of the canton at least five years. In Berne, Zürich, Vaud, Geneva, and most of the cantons, an alien obtains the full citizenship from the date of his naturalisation.

In Russia no foreigner, who does not become a "perpetual subject," can enjoy the rights and privileges attached to the guild of merchants. The commercial rights belonging to merchants are enjoyed in their character as guests, or as itinerant merchants. A foreigner who imports goods must sell them to Russians only.

ALIMENT. [ALIMONY.]

ALIMONY, from the Latin *alimonium* or *alimonia*, signifying "maintenance," or "support." By the law of England, a wife is presumed to have surrendered the whole of her property to her husband upon marriage, and consequently to be entirely dependent upon him for her future maintenance. Upon this principle it is considered reasonable that if a separation is decreed, the wife should have a portion of her husband's estate allotted for her subsistence; and this allowance is termed in law "alimony." The right of the wife to this provision depends upon the fact whether she has or has not sufficient means, independently of her husband, to support her in her appropriate station in life. Where the wife has a sufficient income beyond the husband's control, she is not entitled to alimony.

Alimony, as incidental to questions relative to or arising from marriage, fell until recently under the exclusive cognisance of the ecclesiastical courts; but the jurisdiction of these tribunals has now been transferred to the Court for Divorce and Matrimonial Causes; which is, however, directed to act on the principles of the ecclesiastical courts in matrimonial causes. The giving of alimony is necessarily incidental to a decree of judicial separation or divorce, and may be temporary or permanent. While the proceedings in the suit are pending, the court will, generally speaking, allot alimony to the wife during the continuance of the litigation. When a decree has been obtained, a permanent provision will be given to her. In both cases it is an annual allowance proportionate to the estate of the husband.

The amount of alimony depends wholly upon the discretion of the court, equitably exercised with a view to the circumstances of each particular case. After a separation on account of the husband's misconduct, the wife is alimented as if she were living with him as his wife. The court attends carefully to the nature as well as to the amount of the husband's means, drawing a distinction between substantial property and an income derived from personal exertion. The station in life of both parties, and the fortune brought by the wife, are also considered; and much stress is laid upon the disposal of the children and the expense of educating them.

The conduct of the parties forms also a very material consideration. Where the wife has eloped from her husband, or where a sentence of divorce proceeds upon the ground of her adultery, alimony is not granted. Adultery in a wife involves a forfeiture of her dower. For the same reason the adulteress shall not partake of the husband's estate while living.

In assigning alimony, it should be observed, that during the continuance of a suit it is always much less in amount than when permanently decreed. Thus in the former case the proportion usually allowed is one-fifth of the net income of the husband; in the latter, a moiety of the whole income is not unfrequently given. No general rule can, however, be laid down upon this subject, as the amount granted must always depend upon the infinitely varied combinations of facts brought before the court.

The assignment of alimony during the continuance of a suit does not discharge the husband from liability for his wife's contracts. When the court has allotted her a permanent maintenance, the wife is liable for her own contracts, and the husband is discharged from them.

The equivalent in Scottish law for alimony, is *Aliment*. A wife is entitled to aliment when deserted by her husband, when judicially separated from him, and during a suit for a divorce whether at her own or at his instance, the aliment in this last case including what may be necessary for the expenses of the defence. She has no right to aliment in the case of a voluntary contract of separation.

ALIQUOT PART. One number or fraction is said to be an aliquot part of a second number or fraction, when the first is contained an exact number of times in the second. Thus, 6, 3, 4, 2, 1½, $\frac{3}{7}$, $\frac{1}{8}$, &c., are all aliquot parts of twelve, being contained in it respectively 2, 4, 3, 6, 8, 28, 96, &c. times. The word is principally used in the arithmetical rule called *practice*, and the convenience of using it is as follows: If we want to know how much 30½ yards cost at 1*l.* 15*s.* 6*d.* a yard, the direct process of common arithmetic would be to turn 30½ yards into half yards, giving 61, and 1*l.* 15*s.* 6*d.* into sixpences, giving 71. Then multiplying 61 by 71, and dividing the product by 2, we have the number of sixpences which 30½ yards cost, which must then be reduced into pounds, shillings, and pence. But if we observe that 1*l.* 15*s.* 6*d.* is made up of 1*l.*, 10*s.* the half of one pound, 5*s.* the half of 10*s.*, and 6*d.* the tenth of 5*s.*, we can proceed as follows:—

	£	*s.*	*d.*		£	*s.*	*d.*
30½ yards at	1	0	0	per yard, cost	30	10	0
"	0	10	0	"	15	5	0
"	0	5	0	"	7	12	6
"	0	0	6	"	0	15	3
"	1	15	6	"	54	2	9

in which each line is derived from the preceding by simple division, on the obvious principle that at 6*d.* a yard we give the tenth part of what we give at 5*s.* a yard, and so on.

The object therefore is, to be ready in dividing a sum of shillings and pence into parts, each of which shall be the aliquot part of a pound, or of one of the preceding parts. The following table contains the simple aliquot parts of a pound, arranged so that the aliquot part of an aliquot part shall be visible on inspection. Figures written by themselves are shillings, and the semicolons separate shillings from pence.

The aliquot parts omitted contain fractions of farthings, and are useless.

		Half.	Third.	Fourth.	Fifth.	Sixth.	Eighth.	Tenth.	Twelfth.	Twentieth.	Fortieth.
	£1	10	6; 8	5	4	3; 4	2; 6	2	1; 8	1	;6
Half,	10	5	3; 4	2; 6	2	1; 8	1; 3	1	;10	;6	;3
Third,	6;8	3; 4		1; 8	1;4		;10	;8		;4	;2
Fourth,	5	2; 6	1; 8	1; 3	1	;10	; 7½	;6	; 5	;3	;1½
Fifth,	4	2	1; 4	1		; 8	; 6		; 4		
Sixth,	3;4	1; 8		;10	;8		; 5	;4		;2	;1
Eighth,	2;6	1; 3	;10	; 7½	;6	; 5	; 3¾	;3	;2½	;1½	; ¾
Tenth,	2	1	; 8	; 6		; 4	; 3		;2		
Twelfth,	1;8	;10		; 5	;4		; 2½	;2		;1	; ½
Twentieth,	1	; 6	; 4	; 3		; 2	; 1½		;1		
Fortieth,	;6	; 3	; 2	; 1½		; 1	; ¾		; ½		

This table shows all the aliquot parts of a pound down to one halfpenny: for example, we see ;2½, signifying twopence-halfpenny, opposite to *twelfth* under *eighth*, which shows us that 2½ is the twelfth part of the eighth part of a pound. If, therefore, we wished to find how much 3715 yards cost at 2½*d.* a yard, instead of multiplying by 2½, and dividing by 12 and 20, we should divide by 8 and 12, as follows:—

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 8 ) 3715
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12 ) 464  7  6
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   £38 13 11½
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[PRACTICE.]

ALIZARIC ACID. [MADDER.]

ALIZARIN ACID. [MADDER.]

ALKALIES. Although the term *alkali* (compounded of the Arabic prefix *al*, and *kali* the name of plant-ashes, from which potash is obtained) was formerly rather loosely applied to a variety of basic substances, yet its use is now generally restricted to three metallic oxides, namely, potash (KO), soda (NaO), and lithia (LiO), which from their non-volatility at a red heat are termed the *fixed* alkalies, and to ammonia, a compound of nitrogen, hydrogen, and oxygen (NH_4O), which on account of its volatility, even at ordinary temperatures, is sometimes called the *volatile* alkali.

The chemical properties of the alkalies are the following: their aqueous solutions turn vegetable blues green, and vegetable yellows reddish-brown; hence infusion of red cabbage and infusion of turmeric, or papers stained with them, are used as tests of the presence of an alkali. The alkalies restore the colour of vegetable blues—as of litmus, for instance—which have been reddened by acids, and, on the other hand, the acids restore vegetable colours which have been altered by the alkalies. These properties are also common to lime, baryta, and strontia.

The alkalies have great affinity for, and readily combine with, acids, forming *salts*, and the power of both in altering vegetable colours, is then destroyed. The alkalies are separated at the negative pole of the voltaic decomposition cell.

Potash and soda destroy the skin when applied to it in concentrated solution. These alkalies, together with lithia, are inodorous, but possess a peculiar acrid taste. Ammonia has a similar taste, and possesses a very pungent odour, like *hartshorn*, or *smelling salts*. All the alkalies are very soluble in water. For their preparation, special properties, and uses, see POTASH, SODA, LITHIA, and AMMONIA.

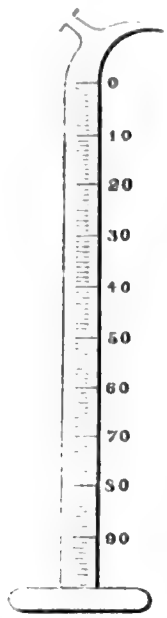
ALKALIES, *Medical Properties of.* It is impossible to exclude magnesia and lime from consideration when treating of alkalies, but the remarks which follow are chiefly intended to apply to soda, potassa, and ammonia. The two former are termed *fixed*, the latter *volatile*: soda is likewise termed the *mineral* or *fossil* alkali; while potassa is termed the *vegetable* alkali, or sometimes merely *kali*. The salts formed with alkalies are apt to *effloresce*, and resolve the crystals into the state of powder, or to absorb water from the air, and *deliquesce* or become liquid.

Alkalies in a pure state are extremely caustic, destroying the tissues with which they come in contact, and forming an eschar which is deep if the alkali be confined, extensive and superficial if allowed to spread. This seems to depend on their strong affinity for water: hence they act as violent corrosive poisons, and are never used in a pure state, save in surgery to open abscesses or to form caustic issues. Diluted with oils they constitute rubefacients, particularly ammonia. Their causticity is also greatly lessened by combination with carbonic acid, and is more subdued by an excess of the acid; hence bi-carbonates are less caustic than sesqui-carbonates, and these last than carbonates. Carbonate of ammonia will altogether disappear if not kept in a well stopped bottle; this tendency is one source of its utility when used as smelling salts.

When suitably diluted with water or by combination with carbonic acid, so as to be safely applied to the tongue, alkalies have a taste peculiar, and to most persons unpleasant, which is designated *alkaline*, for want of anything similar to which to liken it. Ammonia and its carbonates are likewise pungent. They exercise an immediate influence on the fluids of the mouth and alimentary canal, as far as they pass unchanged. They neutralise all acids they meet with in their course, and render the mucus, and perhaps some other secretions, thinner and more watery. That they are readily absorbed into the circulating mass, on which they have a marked influence, is certain; but they are for the most part speedily eliminated, the kidneys appearing to be the channels by which they are thrown out of the system. Many alkaline compounds, as well as the uncombined but diluted alkalies, increase the secretion of urine, and change its nature, if long persevered in, altering it from an acid to an alkaline state. This is particularly the case when the compound is one of carbonic acid, or of a *vegetable* acid with the base, all of which are decomposed *in transitu*, as first remarked by Sir Gilbert Blane, and produce on the urine, and the system generally, ultimately the same effects as the pure alkalies. The alkalies possess a power of rendering albumen soluble: unboiled white of egg is an albuminate of soda. The albumen of the blood is rendered more fluid by alkalies; hence in excess they impair the plastic power of that fluid.

These facts seem all that are requisite to form a correct estimate of their therapeutic powers and employment. Their caustic and rubefacient properties fit them for external use. Their internal employment is regulated by a variety of indications, but it is chiefly as antacids, or to counteract acidity in the stomach and *primæ viæ*, and as diuretics, and to dissolve *calculi* in the kidneys or bladder, and as refrigerant or cooling medicines in inflammatory diseases, that they are used. Many persons, soon after food has been taken into the stomach, are distressed with heartburn and other signs of indigestion, and either have the urinary secretion in an unhealthy state, or, if they be of a gouty disposition, have frequent attacks of gout. Such persons feel relief by taking some alkaline medicine after meals, or have recourse to them because others use them. When uric or lithic acid exists in the urine, such means may be proper; but this point should be ascertained before having recourse to measures which, when not appropriate, are far from being harmless. Some acid, either hydrochloric or acetic, is essential to sound digestion: to neutralise these is to retard and disturb that process. Other acids, especially lactic, in bilious persons and those who use sugar or saccharine fruits in excess, occur, and require to be obviated; but the proper time for taking, as well as the proper quantity to be taken, requires much judgment. Assuming that some alkali is proper, Sir B. Brodie thinks from three to four hours after each of the principal meals, especially dinner, the most suitable time. ('Lectures on the Urinary Organs,' 3rd ed. p. 203; and 'Medical Gazette,' vol. xxiii. p. 151.) Dr. Prout makes a similar remark with respect to alkaline mineral waters. A variety of circumstances regulate the alkali to be selected. From their greater causticity, the pure alkalies can rarely be persevered in sufficiently long, even when taken in such bland vehicles as veal-broth. The alkaline carbonates are better borne, and bi-carbonate of potass more easily than carbonate of soda. Their unpleasant taste constitutes an objection with many: this is in some degree obviated by giving them in the condensed form recently devised by Mr. Brockedon, or in an effervescing state with an excess of alkali, as recommended by Sir Gilbert Blane. If taken unnecessarily or persevered in too long, much evil is done: not only is an alkaline state of urine induced, with a deposition of the phosphates, as indicated by a white sabulous sediment, or an iridescent pellicle on the surface of the urine, but much general debility is caused. "Other ill consequences follow the too liberal use of alkalies: they alter the quality of the blood. After some time the patient is liable to petechiæ; he perspires too easily, becomes low-spirited, and less capable than when in health of physical exertion." (Brodie, *l. c.* p. 202.) As effervescing or saline draughts, made with a *vegetable* acid and some alkaline carbonate, are much used at the beginning of inflammatory diseases for their reducing and refrigerant effects, the same caution is requisite lest they be pushed too far. This is also needful in the case of soda-water (when it really contains soda, and not merely carbonic acid, as is frequently the case), citrated alkali, imperial, and other drinks much used in warm weather. Scrofulous persons can least of all bear up against the abuse of these, yet for such are they unfortunately most employed. Weak vegetable acids will be found more beneficial.

ALKALIMETRY, a term applied to certain ready methods of estimating the commercial value of the alkalies, more especially of potash and soda, and of certain of their salts which possess an alkaline reaction. The most simple method of performing this operation consists in ascertaining the amount of a dilute acid of known strength required exactly to neutralise 100 grains of the sample of alkali. The alkalies and alkaline salts generally tested in this way are potash, soda, and their carbonates. For most of the purposes to which these materials are applied in the arts, their value depends upon the quantity of the alkali which they contain, either in a caustic state or in the condition of carbonate; other alkaline salts or compounds that may be present being useless, if not deleterious. As soda is much more largely used in the arts than potash, the standard acid, or *test acid*, as it is termed, is often made with reference to this alkali, and is graduated to such a strength that 1000 grain measures of it exactly neutralise 100 grains of anhydrous caustic soda (NaO); but the following method of preparing the test-acid, recommended by Faraday, is the most convenient and generally applicable, both to potash, soda, and their carbonates. The test-acid employed is measured from an instrument termed an *alkalimeter*, which consists of a glass tube supported upon a foot, and graduated into 100 equal parts, the space between every two of such divisions being capable of containing 10 grains of distilled water. The upper part of the instrument is shaped as shown in the figure, for the convenient introduction of the test-acid and its subsequent delivery in drops.



The dilute sulphuric acid, or test-acid, is prepared by adding eight volumes of distilled water to one volume of concentrated sulphuric acid. After cooling, this mixture ought to have a specific gravity of 1·1268. In order to ascertain that it is of the exact strength, 100 grains of pure and dry carbonate of potash are to be dissolved in about 4 ounces of boiling water, and the solution tinged blue by the addition of a few drops of infusion of litmus. The alkalimeter must now be filled up to the 65th division with the dilute acid, and afterwards with water to the point of the scale marked 0. The two liquids being then thoroughly mixed by agitation, the contents of the alkalimeter must be gradually added to the hot solution of carbonate of potash until the blue colour changes to red, indicating that the acid is then in slight excess. If the acid be of the proper strength, exactly 100 measures, or the total contents of the alkalimeter, ought exactly to produce this effect, showing that each measure of the acid is equivalent to one grain of carbonate of potash. If less than 100 measures have been required, the acid is too strong; if more than 100 measures, it is too weak. Let us suppose that 90 measures produced the reddening effect: it is evident that in this case the 90 measures are equivalent to 100 grains of carbonate of potash, and consequently the acid is $\frac{1}{9}$th too strong; each 90 measures of the original test-acid must therefore be diluted with 10 measures of water. If the acid were too weak, a similar but inverse correction must be had recourse to. The test-acid having been thus prepared of the proper strength, it must be preserved in well-stoppered bottles for subsequent use.

To employ it for estimating the amount of carbonate of potash in any sample of pearlash, weigh out 100 grains of the ash, dissolve them in boiling water as above described, filtering if necessary, and tinge blue with infusion of litmus; then fill the alkalimeter to 65 with the test-acid, diluting with water to 0°, and add the diluted acid gradually and cautiously until the reddening effect is produced. The number of measures of acid required represents the percentage of carbonate of potash in the sample.

To estimate the amount of potash contained in the sample, either as caustic potash or carbonate of potash, fill the alkalimeter to 49 with the test-acid, the 100 measures being again made up with water. The number of divisions of this dilute acid required to neutralise 100 grains of the sample will correspond to the percentage of pure potash in the sample.

For the determination of carbonate of soda, the alkalimeter must be filled to 54·6 with the test-acid, which must then be used as before; whilst for the estimation of caustic soda, the operator will require to fill the instrument to 23·4. The number of measures required to change the blue of the solution to red, will then in both cases correspond to the percentages of caustic or carbonated alkali required. Care must be taken in all cases to have the alkaline solution nearly at the boiling point when the test-acid is added, and also not to confound the port wine red produced by carbonic acid with the bright red resulting from the slightest excess of sulphuric acid; the latter tint is of course the one which indicates that the neutralisation has been completed.

It is obvious that the foregoing method might also be employed for testing the strength of ammonia and its carbonate.

Fresenius and Will propose to ascertain the value of samples of the carbonates of the alkalies by ascertaining the weight of carbonic acid expelled on neutralising them with sulphuric acid, but the process is more troublesome than the one just mentioned, and as it has not been adopted in this country, it need not be here described. For a description of it, see Miller's 'Elements of Chemistry,' vol. ii. p. 740.

ALKALOIDS. [ORGANIC BASES.]

ALKALOIDS, *Medical Properties of.* These substances, which modern chemistry has made known, are termed *organic* alkalies, from requiring, in general, a vital power to effect their formation; *urea* is an exception. They possess alkaline properties in the lowest degree, and are either tasteless or have a bitter acrid taste, existing generally in a solid, mostly crystalline, form; some however are amorphous (Aconitina), occasionally in a liquid state (Conia and Nicotina), the latter very volatile, and readily undergoing decomposition, with an evolution of ammonia, at a moderate temperature. Sometimes one only exists in a plant, sometimes several in the same plant, *ex.* opium. Generally they are combined with an acid; most frequently it is a peculiar acid. Many of them are with difficulty soluble in water, more so in alcohol; they rarely completely neutralise acids, but the salts which they form are more soluble than the bases; hence various of their salts are used in medicine in preference to the primitive article. Their great characteristic is the extraordinary action most of them have on the human system in a very small dose, and indeed several of them are, in very minute quantity, deadly poisons. Having been first detected in plants long used as medicines (Cinchona), it is chiefly among medicinal plants that they have been sought for and found. By many they are regarded as the active principle of these, and their extraction has had the great advantage of enabling medical men to administer their remedies in a smaller bulk and more convenient form. As the most important of them are treated of under the names of the plants which yield them, it is not necessary to notice any of them further here, except to state that chemists have recently rendered a great service in forming a neutral sulphate of quinine, which is much more soluble than the disulphate, and called Bullock's Neutral Sulphate of Quinine.

ALKARSIN. [CACODYL.]

ALKERMES is the name of a cordial made in some of the northern countries of Europe. It is made from bay-leaves, mace, nutmegs, cinnamon, cloves, brandy, syrup of kermes, and orange-flower water. The first six ingredients are distilled, and the last two are employed to give flavour.

ALLA-BREVE, in music, an Italian term signifying a quick time, in which the notes take only half their usual length. It is very rarely used in modern music. The fine fugue in the 'Messiah,' 'And with his stripes we are healed,' is an example of this measure.

ALLAH is the Arabic name of the Supreme Being, which through the Koran has found its way into the language of all nations who have embraced the Mohammedan religion. It is properly a contraction of al-ilâh: al is the Arabic definite article, and ilâh, which corresponds to the Hebrew words Eloah and Elohim, signifies a deity generally: the prefixed article restricts the meaning, and al-ilâh or Allah signifies the True God, as opposed to the deities worshipped by idolaters. The word Allah is frequently met with as a component part of Arabic proper names: for example, 'Abd-allah,' that is, 'the servant of God.' 'Allah akbar,' 'God is great,' is the common battle-cry of the Mohammedans. The phrase 'Bism Allah' or 'Bism-illah,' 'in the name of God,' is invariably uttered by devout Mussulmans before the commencement of any undertaking, and before their meals: it is also put at the beginning of their books.

ALLANTOIN. [URIC ACID, DERIVATIVES OF.]

ALLANTURIC ACID. [URIC ACID, DERIVATIVES OF.]

ALLEGATION, ECCLESIASTICAL, was the term applied to the first pleading in testamentary causes in the Courts Christian, whose jurisdiction in these matters is now transferred to the Court of Probate. In criminal proceedings the first plea is called *Articles*; in ordinary causes the first plea is called the *Libel*. This first pleading in each instance is analogous to a Declaration at common law or to a Bill in equity. The term Allegation is also applied to every subsequent plea in all causes; the first by a defendant being called a Responsive Allegation, and the plaintiff's answer a Counter Allegation. There are also exceptive allegations, when a witness's credit is impeached, and these, when admitted, are proceeded upon in the same manner as the others.

ALLEGIANCE, or LIGEANCE, is the true and faithful obedience of a liegeman or subject to his liege lord or sovereign, "Ligeantia est vinculum fidei: ligeantia est legis essentia." The notion of ligeance, or allegiance, is that of a bond or tie between the person who owes it and the person to whom it is due. (Co. Lit. 129 a.) Allegiance is due from natural-born subjects, and also from those who have been naturalised.

The allegiance of a subject, according to the law of England, is permanent and universal. He can, by no act of his own—as by being naturalised in a foreign country—repudiate the duties which it involves; nor can he by any change of residence escape its legal consequences.

An alien owes a temporary allegiance so long as he continues within the dominions of the Queen; and he may, therefore, be prosecuted for treason.

An usurper, in the undisturbed possession of the crown, is entitled to allegiance. Treason committed against Henry VI. was punished in the reign of his successor, even after parliament had declared the former an usurper.

An oath of allegiance has, from the earliest period, been exacted from natural-born subjects; but its form has undergone variation. Anciently, the party promised "to be true and faithful to the king and his heirs, and truth and faith to bear of life and limb and terrene honour, and not to know or hear of any ill or damage intended him without defending him therefrom." The statutory oath, since the Revolution, has been more simple—as: "I do sincerely promise and swear that I will be faithful and bear true allegiance to her Majesty Queen Victoria." By the statute 21 & 22 Vict. c. 48, these words are preserved in the *one* oath thereby substituted for the oaths of allegiance, supremacy, and abjuration, formerly used.

The alteration of the form has never, in any degree, varied the nature of the subject's duty, which is owing from him independently of any oath, and although he may never have been called upon to take it. The oath is imposed by way of additional security for the performance of services inherently due from the subject from his birth, who is, in like manner, entitled to the protection of the sovereign before the latter has formally accepted the duties of sovereignty by taking the coronation oath. The Crown can, by proclamation, summon the liegemen to return to the kingdom. An instance of this occurred in 1807, when it was declared, by proclamation, that the kingdom was menaced and endangered; all seamen and seafaring men who were natural-born subjects were recalled from foreign service, and ordered to return home, on pain of being proceeded against for a contempt.

By the ancient law every male subject of the age of twelve years (with certain exceptions) was bound to take the oath of allegiance when summoned to the Courts Leets and Tourns; and various statutes, from the reign of Elizabeth to the present time, expressly require it from public functionaries and other persons before they enter upon their respective duties, or practise in their several professions. By 1 George I. c. 13, two justices of the peace, or other commissioners appointed by the Crown, may tender the oath to any person suspected of disaffection.

From a violation of allegiance results the highest offence known to the law—TREASON.

(Blackst. *Comm.*, Mr. Kerr's ed. vol. i. p. 367, et seq.; Hale's *Pleas of the Crown*, vol. i. p. 58, et seq.; and Mr. Justice Foster's *Discourse on High Treason*.)

ALLEGORY, literally, a discourse which has another meaning than what is directly expressed. Thus, the address of Menenius Agrippa to his fellow-citizens of Rome, as recorded by Livy, in which he described a rebellion of the industrious against the wealthier orders of a state, under the figure of a conspiracy of all the other members of the human body against the stomach, was an allegory. An allegory, however, is not intended to deceive or perplex, in which respect it differs from an enigma or riddle.

Allegory has been a favourite mode of composition in all countries and ages. Sometimes it has been recommended by seeming to afford the only or the fittest available means of giving a lively or intelligible representation of certain subjects or notions. The poets of different nations, for example, have resorted to this method, in order to convey sufficiently vivid conceptions of the different virtues and vices, and other abstractions which they have wished to set before their readers. They have personified these notions, as it is termed; that is to say, they have figured them in the shape of living beings invested with the forms and qualities naturally adapted to the character of each. Such pictures are allegories, and are to be found abundantly scattered over nearly all poetry.

Of all poets who have dealt in allegories of this description, our own Spenser is the most famous and the greatest; no other has either produced so vast a number of these vivified idealities, or put into them such a spirit of life and air of actual existence. A long allegory, it is commonly said, has been usually unsuccessful as such; and, in illustration of this assertion, the instance of the 'Faerie Queen' has been often quoted, as that of a work which, with all its attractions in parts, is wearisome as a whole. The plan of the general allegory upon which Spenser's poem is framed, is certainly in a remarkable degree complicated, cumbersome, and uninteresting; and, if he had aimed at composing a mere tale of romance, without fettering himself with any scheme of allusion either to the moral virtues or the achievements of Queen Elizabeth, both of which subjects he has endeavoured to illustrate, he would have doubtless done better, as well as saved himself much needless labour. But, on the other hand, nobody complains of fatigue in reading Swift's 'Tale of a Tub,' which is likewise a tolerably long allegory; and Bunyan's 'Pilgrim's Progress' has always been a popular work. These, and other examples which might be quoted, seem to prove that, if the allegory be sufficiently simple and natural, it may be protracted to a considerable extent without becoming tiresome.

ALLEGRET'TO, in music, an Italian diminutive of *Allegro*, neither so fast nor so brilliant as that term denotes, though rather quick, and moderately gay.

ALLE'GRO, in Music, signifies *gay, sportive*, and, by inference, quick in time. An allegro is not understood to be so fast in vocal as in instrumental music. Its quickness is likewise modified by the number and value of the notes in a bar. Thus it is always more rapid, *cæteris paribus*, in two-crotchet time than in four-crotchet—in three-quaver time than in six-quaver; and as the speed of this movement has many degrees of difference, other words are commonly added, more exactly to explain the composer's intention. This term is also used substantively; thus, we say, an *Allegro* of Mozart, of Beethoven, &c. It is often combined with other terms, such as 'agitato,' 'brillante,' &c., to denote varieties of quickness and effect.

ALLEMANDE, in music, a dance supposed to have derived its name from the country, Germany, in which it originated. It is written in two-crotchet time, and is now understood to be moderately quick; but anciently it was a slow dance. Handel, and other composers of his period, wrote it in four-crotchet time.

ALL-HALLOWS, ALL-HALLOWMAS, or simply **HALLOWMAS**, the old English name for *All Saints' Day*, or the 1st of November.

All-Hallowmas derives its importance from the popular usages, which in our own and various other countries have distinguished sometimes the day itself, but more generally the night preceding, called its Eve or Vigil. There is reason to believe that this was a pagan before it was transformed into a Christian festival; and there can at any rate be no question that the ceremonies to which we refer are of Druidical origin. Bonfires, bell-ringings, and domestic merry-makings, in which lamb's wool (ale or wine mixed with the pulp of roasted apples) was the principal beverage, marked the eve of Hallowmas. The season called for such demonstrations. The harvest was over; the winter was at hand.

But the eve of All-Hallows is especially famous for those observances which have been wont to take place on it, connected with the superstitious wish of prying into futurity. The same ceremonies of this description appear to have been anciently practised in England, Ireland, and Scotland; but they are now almost universally disused. The well-known poem of Burns, the 'Halloween,' will immortalise the memory of the ancient ceremonies to which it relates.

ALLIANCE, THE HOLY. [TREATIES, CHRONOLOGICAL TABLE OF.]

ALLIGATION, derived from the Latin *ad* and *ligare*, signifying to bind together, or unite. It is a rule in arithmetic, by which the price of a mixture is found when the price of the ingredients is known. This is an application to commercial arithmetic only, but the following questions, which fall under the rule, will show its scope better than any general definition.

How much wine at 60*s*. a dozen must be added to a pipe worth 95*s*. a dozen, in order that the mixture may be worth 70*s*. a dozen?

If a cubic foot of copper weighs 8788 ounces, and of zinc 7200 ounces, in what proportions must copper and zinc be mixed, so that a cubic foot of the mixture may weigh 8000 ounces?

For the algebraist we may say, that all questions fall under the rule of alligation which involve the solution of such an equation as,

$$ax + by + cz = n\,(x + y + z)$$

in which n must be intermediate between a, b, and c; which is indeterminate unless further relations between x, y, and z are given. Any person moderately skilled in algebra may reduce a question of alligation to an equation of this form; and as the number of cases is infinite, and several of those given in the books of arithmetic are practically useless, we shall here confine ourselves to an example of one process for the algebraical student, and two rules of the most simple cases for all other readers.

There are three ingredients, worth a, b, and c shillings per ounce: in what proportions must a mixture of m ounces be made, so as to be worth k shillings an ounce; it being understood that the quantities of the two first ingredients must be in the proportion of p to q? Let px be the quantity of the first ingredient; then qx is that of the second; let y be that of the third. Then by the question,

$$px + qx + y = m. \quad . \quad . \quad . \quad (1)$$

But px ounces, at a shillings an ounce, cost apx shillings; therefore the price of the whole is

$$apx + bqx + cy \text{ shillings},$$

which by the question is km shillings: hence,

$$apx + bqx + cy = km. \quad . \quad . \quad . \quad (2)$$

and which two equations, with two unknown quantities, can be solved by the common method.

Rule I. Where the quantity of each ingredient, and its price, are given, to find the price per pound, gallon, or whatever it may be, of the mixture; multiply the quantity of each ingredient by its price, and add; then divide the sum of all these products by the sum of all the quantities in the ingredients.

Example. What is the worth per ounce of a mixture of 25 ounces of sugar at 10*d*. with 15 ounces at 11*d*.?

25 ounces at 10*d*. is worth 250*d*.
15 „ 11*d*. „ 165*d*.
—
40 40) 415 ($10\frac{15}{40}$*d*.
40
—
15

Answer, $10\frac{15}{40}$*d*. or $10\frac{1}{4}$*d*. very nearly.

Rule II. To find in what proportions per cent. two ingredients must be mixed, in order that the price per ounce, &c., of the mixture may be one which has been previously determined upon. To find the proportion of the *first* ingredient, take the difference of price between the mixture and the *second* ingredient, multiply by 100, and divide by the difference between the prices of the ingredients.

Example. I wish to know in what proportion wines at 45*s*. and 70*s*. a dozen must be mixed, in order that the mixture may be worth 55*s*. a dozen?

Price of the mixture . . 55*s*.
„ second ingredient 70*s*.
—
difference 15
multiply 100
—
difference of price of ingredients 25) 1500 (60
150
—
0

There must, therefore, be 60 per cent. of the first, and consequently 40 per cent. of the second.

Instead of finding the proportions per cent., the proportion in which any other number must be divided, may be found by using that number of dozen, &c., instead of 100, and the three prices may be *all* multiplied by any number which will clear them of fractions.

Example. How must 80 gallons, worth $6\frac{1}{2}d.$ a gallon, be made of ingredients worth $1\frac{3}{4}d.$ and $11d.$ per gallon?

Price of mixture.	Price of first ingredient.	Price of second ingredient.
$6\frac{1}{2}$	$1\frac{3}{4}$	11
4	4	4
26	7	44

difference of 26 and 44   18
80

difference of 7 and 44   37) 1440 ($38\frac{34}{37}$
111
330
296
34

Answer, $38\frac{34}{37}$ gallons of the first, and $41\frac{3}{37}$ of the second.

ALLITERATION. This term is usually employed to signify the juxtaposition, or frequent recurrence in composition, of words commencing with the same letter, when introduced with a view to its rhetorical effect. Byron's line in the concluding stanza of the second canto of 'Childe Harold,'

> "*W*hat is the *w*orst of *w*oes that *w*ait on age,"

may be given as an example; and another instance occurs in the same stanza, in the line

> "O'er *h*earts *d*ivided, and o'er *h*opes *d*estroyed."

Churchill has at once ridiculed and exemplified the figure in his well known verse

> "And apt alliteration's artful aid,"

where every word begins with the same letter. Modern critics have detected numerous instances of alliteration both in the Latin and Greek poets. (See the dialogue entitled 'Actius,' in the 'Latin Dialogues' of Joannes Jovianus Pontanus; and Harris's 'Philological Enquiries,' part ii. chap. iv.) Alliteration, however, has been most systematically used as an ornament of diction in the Celtic and Gothic dialects. Gerald Barry, commonly called Giraldus Cambrensis, who lived in the twelfth century, tells us, in his 'Description of Wales,' that in his day, both the English and Welsh were so fond of this figure of speech which he calls *Annomination*, that they deemed no composition to be elegant, or other than rude and barbarous, in which it was not plentifully employed. The same tendency is also said to have formed a striking peculiarity in the genius of the Irish language. (See Warton's 'History of English Poetry,' vol. ii. p. 106, note d, ed. of 1840.) Dr. Percy, in an essay published in his 'Reliques of Ancient English Poetry,' has traced the origin and history of alliterative verse down from the compositions of the old Icelandic poets. Nearly all the varieties of Runic verse, which were very numerous, appear to have depended for their prosodial character entirely upon alliteration. It was necessary that so many words in every line should begin with the same letter; and this was all that was required to make good metre. According to the learned Wormius, there were no fewer than 136 kinds of Icelandic verse formed upon this principle, and without including rhyme, or a correspondence of final syllables. If we may trust the following curious statement, given in a note by Mr. Park to Warton's 'History of English Poetry' (vol. ii. p. 106, ed. 1840), the harmonies of alliterative verse were sometimes of the most complicated description, and such as were likely, one would suppose, to elude any except the nicest and most practised ears:—"An objection has been taken to the antiquity of the Welsh poetry, from its supposed want of alliteration. But this is not the case: for the alliteration has not been perceived by those ignorant of its construction, which is to make it in the middle of words, and not at the beginning, as in this instance:

> Yn ias ir ei naws eirian.

This information was imparted to Mr. Douce, by the ingenious Edward Williams, the Welsh bard."

Of Anglo-Saxon poetry, alliteration is the most distinctive characteristic; though somewhat curiously, Mr. Tyrwhitt, in his essay on the 'Language and Versification of Chaucer,' has gone so far as to say, "For my own part, I confess myself unable to discover any material distinction of the Saxon poetry from prose, except a greater pomp of diction, and a more stately kind of march." In fact, in all Anglo-Saxon verse the alliteration is very decided, but it is especially so in narrative poetry. In the first line of every couplet there are two principal words beginning with the same letter, and this letter is the initial letter of the first emphatic word, or that on which a stress is laid in pronunciation, in the second line. The two letters in the first line are, by some authorities, called the sub-letters, the single letter in the second line the chief letter. Occasionally there is only one subletter in the first; and there is never more than one chief letter in the second line. The subject of Anglo-Saxon alliteration is fully treated by Rask, in his Anglo-Saxon Grammar, p. 136, &c.; and by Mr. T. Wright, in his 'Biographia Britannica Literaria,' p. 7, &c.; see also Conybeare's Introductory Essay to 'Illustrations of Anglo-Saxon Poetry.' The following lines from the poem of Béowulf (Kemble's ed., lines 637, &c.) will sufficiently illustrate the Anglo-Saxon form of alliteration:—

> "*S*træt wæs *s*tán-fáh
> *s*tíg wisode
> *g*umum æt-*g*ædere;
> *g*uð-byrne scán,
> *h*eard, *h*ond-locen;
> *h*ring-íren scír," &c.

The Anglo-Norman versifiers introduced rhyme into English poetry; but the popular ear retained its liking for alliteration, and rhyme and alliteration became freely intermingled—the alliteration being most used in addressing a vulgar audience. The most famous poem in the English language, entirely composed in alliterative metre, is that entitled 'The Vision of Piers Ploughman,' written about the middle of the 14th century, and attributed to William or Robert Longland, a secular priest, and a fellow of Oriel College, Oxford. This is a long work, consisting of twenty-one parts or books, and composed throughout in verses, the cadence of which appears to be generally anapæstic, but which are evidently designed to derive their chief metrical beauty from a certain artificial disposition, in each, of the words beginning with the same letter. The poem has been frequently printed. An excellent edition was published in 1856, by Thomas Wright, M.A., who, in his Introduction, says of it, that along with the alliteration it accurately preserves the other characteristic of the metre of Anglo-Saxon verse, namely that of "having two rises and two falls of the voice in each line . . . . making allowance for the change of the slow and impressive pronunciation of the Anglo-Saxon for the quicker pronunciation of Middle English, which therefore required a greater number of syllables to fill up the same space of time." The opening lines of 'The Vision of Piers Ploughman' will enable the reader to perceive these peculiarities:—

> "In a somer season
> Whan softe was the sonne,
> I shoop me into shroudes
> As I a sheep weere,
> In habit as an heremite
> Unholy of werkes,
> Wente wide in this world
> Wondres to here;" &c.

Dr. Percy, in the essay above referred to, has shown that poems continued to be written in English, the verse of which was merely alliterative, or in which, at least, alliteration served as the substitute for rhyme, down to the commencement of the 16th century, and in the Scottish dialect even to a later period. One of the compositions of this description which he cites is entitled 'Scottish Field,' and is a narrative of the battle of Flodden, which was fought in 1513. Another is a Scottish poem composed by Dunbar, who lived till about the middle of the 16th century. It is preserved in the Maitland Manuscript, and has since been published by Pinkerton. The practice of alliterative verse, as Percy has remarked, seems to have been longest preserved in the north. In the 'Canterbury Tales,' Chaucer makes his Parson, when asked for his story, reply, with a sneer at this antiquated habit of the northern versifiers of that day,

> "——— Trusteth well I am a Southern man;
> I cannot *geste, rom, ram, ruff, by my letter*,
> And, God wot, rhyme hold I but little better;
> And therefore, if you list, I woll not glose;
> I woll you tell a little tale in prose."

So strongly had alliteration obtained possession of the English ear, that even for some time after the introduction of rhyme, it appears to have been still considered an important embellishment of verse. Some fragments of our old poetry exhibit both the consonance of final syllables, and a rigid observance of all the regularities of alliteration. Even after the latter came to be neglected as a systematic accessory, it was still lavishly employed as an occasional ornament. Our popular ballad and lyrical poetry is full of such lines as those with which the Scotch song commences:—

> "*M*erry may the maid be
> That *m*arries the *m*iller;
> *F*or *f*oul day and *f*air day," &c. &c.

Down even to the present day, the use of alliteration, to a considerable extent, has continued to characterise English versification in its most polished form, and in the hands of some of our greatest poets.

Nor has the employment of this artifice of style been confined to compositions in verse. In the early part of the 17th century it was carried to a greater excess by some of our prose writers than it ever had been by our poets; grave discourses being elaborated, in which nearly all the words of each separate sentence commenced with the same letter. The longer this torture of the unfortunate sound could be protracted, the greater was deemed to be the feat of eloquence.

Those who recognise rhyme, or what Milton calls "the jingling sound of like endings," as one of the legitimate adjuncts of poetry, can hardly repudiate alliteration, which, after the same fashion, may be termed "the jingle of like beginnings." There can be no doubt that the latter artifice, judiciously employed, may be made to communicate a portion, at least, of the same sort of gratification which is conveyed by the former. The general principle upon which the pleasure we experience in both cases depends, is the similarity in dissimilarity, as it has been called, or variety combined with regularity, which is the occasion of so many of our intellectual, and of some also of our moral pleasures. Of course, the degree in which alliteration is employed, as an ornament of style, ought to be regulated by its importance, as compared with other rhetorical decorations, and by its appropriateness to the subject and the general character of the composition. Being a mere artifice of diction, it can in no case be compared with the higher beauties of thought and expression, and should never be obtruded so as to interfere with them. It sometimes serves, however, to help in what may be called the setting of a brilliant thought; and, if it have the air of coming naturally, will frequently add to the effect of an otherwise happy phrase. Its aptitude to catch the popular ear is proved by its almost universal adoption in proverbs, traditional rhymes, and other brief sayings of wit or wisdom, which their mere natural vitality has kept alive without the aid of letters, and even in a vast number of those idiomatic expressions which form the sinew and chief strength of our language. Mr. Price, the learned editor of the last edition of Warton, announced a volume which was to contain, among other matters, an essay upon alliterative metre, together with the 'Aunter of Sir Gawaine,' a romance in alliterative metre, from a MS. of the 14th century; but the work was never completed in consequence of his premature death.

ALLITURIC ACID. [URIC ACID, DERIVATIVES OF.]

ALLO'DIUM, or ALO'DIUM, is property held in absolute dominion, without rendering any service, fealty, or other consideration whatsoever to a superior. It is opposed to Feodum or Fief [FEUDAL SYSTEM], which means property the use of which was bestowed by the proprietor upon another, on condition that the person to whom the gift was made should perform certain services to the giver, upon failure of which, or upon the determination of the period to which the gift was confined, the property reverted to the original possessor. Hence arose the mutual relation of lord and vassal.

It is the general opinion that the lands which the Germanic tribes, Franks, Burgundians, and Visigoths, seized during the decline of the Roman empire, were distributed among the members of these tribes in some way, and held free from all service or duty. Land so held was called Allod, or Alod, and in the Latinised form, Allodium. The system of fiefs, or the feudal system, as it is called, was posterior to that of this allodial holding of lands; and it was not completely established, at least in France, till towards the end of the 10th century.

In England there is no allodial land, for all land is held mediately or immediately of the king. The name for the most absolute dominion over property of this nature is a fee (feodum), or an estate in fee, a word which implies a feudal relation. When a man possessed of an estate in fee dies without heirs, and without having devised his property, the estate escheats, or falls back to the lord of whom it was holden: or, where there is no intermediate lord, to the king as lord paramount.

The Latinised forms of this word are various:—alodis, alodus, alodium, alaudum, and others. The French forms are—aleu, aleu franc, or frank aleu, franc-alond, franc-aloy, and franc-aleuf. In many old charters alodum is explained by hereditas, or heritable estate. But it is very difficult to collect any theory from the numerous passages in which the word occurs which shall satisfactorily explain its etymology. (Du Cange, 'Gloss.' Alodis; Spelman, 'Glossarium.')

There is a very elaborate article on allodial land in the 'Staats-Lexicon' of Rotteck and Welcker, under the head 'Alodium;' and there are some remarks by Guizot, 'Histoire de la Civilization en France,' vol. iii.

ALLOPHANIC ACID ($HO, C_4N_2H_3O_5$). This acid is unknown in the hydrated or separate state. It forms crystallisable salts with baryta, potash, and soda. It is produced by the action of hydrated cyanic acid on alcohol. The water of the alcohol unites with the cyanic acid and forms the new compound which combines with the oxide of ethyl and forms an allophanate of the oxide of ethyl.

$$\underbrace{2(HO, C_2NO)}_{\text{Cyanic Acid.}} + \underbrace{C_4H_6O_2}_{\text{Alcohol.}} = \underbrace{C_4H_5O, C_4N_2H_3O_5}_{\text{Allophanic Ether.}}.$$

By the action of solutions of caustic, baryta, potash, or soda upon allophanic acid, the allophanates of these bases are produced. Thus, with baryta water, the re-action is

$$\underbrace{C_4H_5O, C_4N_2H_3O_5}_{\text{Allophanic Ether.}} + BaO\,HO = \underbrace{BaO, C_4N_2H_3O_5}_{\text{Allophanate of Baryta.}} + \underbrace{C_4H_6O_2}_{\text{Alcohol.}}.$$

The re-action must be effected without heat, otherwise the allophanate of baryta is decomposed, with the production of carbonate of baryta, carbonic acid, and urea:

$$\underbrace{(BaO, C_4N_2H_3O_5)}_{\text{Allophanate of Baryta.}} + HO = CO_2 + BaO\,CO_2 + \underbrace{C_2N_2H_4O_2}_{\text{Urea.}}.$$

ALLOTROPY. Several elementary substances are known to undergo remarkable changes in their appearance, and in their physical and chemical properties, without entering into combination with any other body, or in any way losing their elementary character. Such elements are said to be *allotropic*, and their different forms are termed *allotropic* modifications. Thus the element sulphur is generally met with as a bright yellow brittle solid, and if it be fused by a heat of about 240°, and then allowed to cool, it assumes again its original appearance, but if whilst fused it be heated more strongly, to 500° for instance, and be then suddenly cooled by pouring it into cold water, it forms a soft amber-brown coloured tenaceous mass, which may be drawn out into threads that are elastic like caoutchouc. At ordinary temperatures this elastic sulphur very slowly returns to its ordinary state, but if it be heated to 212° the transformation is instantaneous, and accompanied with the evolution of heat. There are also other allotropic forms of sulphur all exhibiting marked differences in their properties, but all consisting of the same material—elementary sulphur. Phosphorus and many other elements also exhibit the same phenomenon. The cause of these allotropic modifications is at present enveloped in great obscurity, but it is generally supposed that such modifications are due to a difference in the grouping of the ultimate molecules of the allotropic elements.

ALLOWANCE, in commerce, a deduction from the gross weight of goods, agreed on between merchants, according to the customs of particular countries and ports, the chief of which is known by the name of TARE.

ALLOXAN. [URIC ACID, DERIVATIVES OF.]

ALLOXANIC ACID. [URIC ACID, DERIVATIVES OF.]

ALLOXANTIN. [URIC ACID, DERIVATIVES OF.]

ALLOY. This word is employed to designate either a natural or artificial compound of two or more metals, except when mercury is one of them, and then the mixture is termed an *amalgam*. The natural alloys are far less important substances than those which are artificially procured: thus, arsenic occurs combined with the following metals, namely, antimony, bismuth, cobalt, iron, nickel, and silver; there is also found a native alloy of antimony and nickel, and of antimony, cobalt, and nickel; some others might also be mentioned. But there is no instance of a native alloy, strictly speaking, being applied to any useful purpose, whereas the artificial alloys are of the highest importance both for the uses of common life and for manufacturing purposes; since by uniting different metals, compounds are formed which possess a combination of qualities not occurring in any one metal. Platina is always employed in a pure state, and copper, iron, lead, and zinc, are also very commonly so used; but gold, silver, tin, antimony, and bismuth are generally alloyed; the first three, on account of their softness, and the two latter because they are extremely brittle. Gold and silver are hardened by alloying with copper; copper is hardened by zinc, &c.

The formation of alloys appears to depend upon the chemical affinity of the metals for each other; and in some instances this affinity seems to be wanting, for no combination occurs: thus, according to Gellert, bismuth and zinc do not combine. Various facts may be assigned for supposing the combination to be the result of chemical union. M. Boussingault ('An. de Ch. et de Ph.,' t. 34, p. 408) has described and analysed six different native alloys of gold and silver, and he found in all cases that the metals were combined in definite proportions. The change of properties which metals undergo by combining, furnishes strong evidence of the intervention of chemical affinity and action: thus, with respect to colour, copper, a reddish metal, by union with zinc, a white one, gives the well-known yellow alloy, brass: the fusing point of a mixed metal is never the mean of the temperature at which its constituents melt; and it is generally lower than that of the most fusible metal of the alloy; whilst the power of the latter to conduct heat and electricity, also indicates that chemical combination has occurred.

All alloys formed of brittle metals are brittle; those made with ductile metals are in some cases ductile, in others brittle; when the proportions are nearly equal, there are as many alloys which are brittle as ductile; but when one of the metals is in excess, they are most commonly ductile. In combining ductile and brittle metals, the compounds are brittle, if the brittle metal exceed, or nearly equal the proportion of the ductile one; but when the ductile metal greatly exceeds the brittle one, the alloys are usually ductile. The density of alloys sometimes exceeds, and in other cases is less than, that which would result from calculation; the following alloys afford examples of increased and diminished density.

Increased.		Diminished.	
Gold	and zinc	Gold	and silver
Gold	„ tin	Gold	„ iron
Gold	„ bismuth	Gold	„ lead
Gold	„ antimony	Gold	„ copper
Gold	„ cobalt	Gold	„ iridium
Silver	„ tin	Gold	„ nickel
Silver	„ bismuth	Silver	„ copper
Silver	„ antimony	Iron	„ bismuth
Silver	„ zinc	Iron	„ antimony
Silver	„ lead	Iron	„ lead
Copper	„ zinc	Tin	„ lead
Copper	„ tin	Tin	„ palladium
Copper	„ palladium	Tin	„ antimony
Copper	„ bismuth	Nickel	„ arsenic
Copper	„ antimony	Zinc	„ antimony
Lead	„ bismuth		
Lead	„ antimony		
Platina	„ molybdenum		
Palladium	„ bismuth		

Not only are the properties of metals altered by combination, but different proportions of the same metals produce very different alloys. Thus, by combining ninety parts of copper with ten parts of tin, an alloy is obtained of greater density than the mean of the metals, and it is also harder and more fusible than the copper; it is slightly malleable when slowly cooled, but on the contrary when heated to redness, and plunged into cold water, it is very malleable: this compound is known by the name of *bronze*. If eighty parts of copper be combined with twenty parts of tin, the compound is the extremely sonorous one called *bell-metal;* an alloy consisting of two-thirds copper and one-third tin, is susceptible of a very fine polish, and is used as *speculum metal*.

It is curious to observe in these alloys, that in bronze, the density and hardness of the denser and harder metal are increased by combining with a lighter and softer one; while, as might be expected, the fusibility of the more refractory metal is increased by uniting with a more fusible one. In bell-metal, the copper becomes more sonorous by combination with a metal which is less so: these changes are clear indications of chemical action.

It has been already observed, that the natural alloys, considered as such, are not important bodies; the only one, if indeed that may be so reckoned, is the alloy of iron and nickel, constituting meteoric iron, and of which the knives of the Esquimaux appear to be made. The artificial metallic alloys are of the highest degree of utility: thus, gold is too soft a metal to be used either for the purposes of coin or ornament, it is therefore alloyed with copper; silver, though harder than gold, would also wear too quickly, unless mixed with copper; and copper is improved, both in hardness and colour, by combination with zinc, forming brass.

The following, among other useful alloys, will be treated of under their specific names, viz., BELL-METAL, PEWTER, BRASS, BRONZE, GUN, PRINCE'S, SPECULUM, BRITANNIA, and TYPE METAL, GERMAN SILVER, NICKEL SILVER, TUTENAG, and SOLDERS. Other alloys will be described when the more important metal entering into their composition comes under consideration.

ALLYL. [ALCOHOLS; ORGANIC RADICALS.]

ALLYL—SULPHOCARBAMIC ACID. [SULPHOSINAPIC ACID.]

ALLYL, SULPHIDE OF. [GARLIC, OIL OF.]

ALLYL, SULPHOCYANIDE OF. [MUSTARD, OIL OF.]

ALLYLAMINE. [ORGANIC BASES.]

ALLYLUREA. [UREA.]

ALMACANTER, an Arabic term now disused, but which, with many others, was formerly employed in astronomy. The name is given to all the small circles parallel to the horizon; so that two stars which have the same almacanter, have the same altitude. Almacanter would now be called a circle of altitude, in the same way as a small circle parallel to the equator, all whose points have therefore the same declination, is called a circle of declination.

ALMAGEST, a name given by the Arabs to the μεγάλη σύνταξις, or *great collection*, the celebrated work of Ptolemy, the astronomer of Alexandria. It was translated into Arabic about the year A.D. 827, under the patronage of the Caliph Al Mamun, by the Jew Alhazen ben Joseph, and the Christian Sergius. The word is the Arabic article *al* prefixed to the Greek word *megistus*, 'greatest,' a name probably derived from the title of the work itself, or, as we may judge from the superlative adjective, partly from the estimation in which it was held.

ALMANAC. The derivation of this word has given some trouble to grammarians. The most rational derivation appears to us to be from the two Arabic words *al*, the article, and *mana* or *manah*, 'to count.'

An almanac, in the modern sense of the word, is an annual publication, giving the civil divisions of the year, the moveable and other feasts, and the times of the various astronomical phenomena, including in the latter term not only those which are remarkable, such as the eclipses of the moon or sun, but also those of a more ordinary and useful character, such as the places of the sun, moon, and planets, the position of the principal fixed stars, the times of high and low water, and such information relative to the weather as observation has hitherto furnished. The agricultural, political, and statistical information which is usually contained in popular almanacs, though as valuable a part of the work as any, is comparatively of modern date.

It is impossible that any country in which astronomy was at all cultivated could be long without an almanac of some species. Accordingly, we find the first astronomers of every age and country employed either in their construction or improvement. The belief in astrology, which has prevailed throughout the East from time immemorial, rendered almanacs absolutely necessary, as the very foundation of the pretended science consisted in an accurate knowledge of the state of the heavens. With the almanacs—if indeed they had them not before—the above-mentioned absurdities were introduced into the west, and strange to say, it is only within the last twenty years that astrological predictions have not been contained in nine almanacs out of ten. It is not known what were the first almanacs published in Europe. That the Alexandrian Greeks constructed them in or after the time of Ptolemæus, appears from an account of Theon, the celebrated commentator upon the Almagest, in a manuscript found by M. Delambre at Paris, in which the method of arranging them is explained, and the proper materials pointed out. It is impossible to suppose that at any period almanacs were uncommon; but in the dearth of books whose names have come down to us, the earliest of which Lalande, an indefatigable bibliographer, could obtain any notice, are those of Solomon Jarchus, published in and about 1150, and of the celebrated Purbach, published 1450–61. The almanacs of Regiomontanus, said by Bailly, in his 'History of Astronomy,' to have been the first ever published, but which it might be more correct to say ever printed, appeared between 1475 and 1506, since which time we can trace a continued chain of such productions, of which our limits will not allow us to give even the names of the authors. They may be found in the 'Bibliographie Astronomique' of Lalande, and in Hutton's 'Mathematical Dictionary,' article 'Ephemeris.' The almanacs of Regiomontanus, which simply contained the eclipses and the places of the planets, were sold, it is said, for ten crowns of gold. An almanac for 1442, in manuscript we presume, is preserved in the 'Bibliothèque du Roi,' at Paris. The almanacs of Engel, of Vienna, were published from 1494 to 1500; and those of Bernard de Granolachs, of Barcelona, from about 1487. There are various manuscript almanacs of the 14th century in the libraries of the British Museum, and of Corpus Christi College, Cambridge.

The first astronomical almanacs published in France were those of Duret de Montbrison, in 1637, which series continued till 1700. But there must have been previous publications of some similar description; for, in 1579, an ordonnance of Henry III. forbade all makers of almanacs to prophesy, directly or indirectly, concerning the affairs either of the state or of individuals. In England the royal authority was less rationally employed. James I. granted a monopoly of the trade in almanacs to the universities and the Stationers' Company. The universities however were only passive, having accepted an annuity from their colleagues, and resigned any active exercise of their privilege.

In 1775 a blow was struck which demolished the legal monopoly. One Thomas Carnan, a bookseller, whose name deserves honourable remembrance, had some years before detected or presumed the illegality of the exclusive right, and invaded it accordingly. The cause came before the Court of Common Pleas in the year above mentioned, and was there decided against the Company. Lord North, in 1779, brought a bill into the House of Commons to renew and legalise the privilege, but, after an able argument by Erskine in favour of the public, the House rejected the ministerial project by a majority of forty-five. The defeated monopolists managed to regain the exclusive market, by purchasing the works of their competitors. The astrological and other predictions still continued; but it is some extenuation that the public, long used to predictions of the deaths of princes and falls of rain, refused to receive any almanacs which did not contain their favourite absurdities. It is said (Baily, 'Further Remarks on the Defective State of the Nautical Almanac,' &c., p. 9) that the Stationers' Company once tried the experiment of partially reconciling Francis Moore and common sense, by no greater step than omitting the column of the moon's influence on the parts of the human body, and that most of the copies were returned upon their hands.

The 'British Almanac' was published by the Society for the Diffusion of Useful Knowledge in 1828. Its success induced the Stationers' Company to believe that the public would no longer refuse a good almanac because it only predicted purely astronomical phenomena, and they accordingly published the 'Englishman's Almanac.' We may also add that other almanacs have diminished the quantity and tone of their objectionable parts. But astrology still puts forth a timid voice in the name of Francis Moore; and there are professedly astrological almanacs, which have their purchasers, and probably their believers.

Of the professedly astronomical almanacs, the most important in England is the 'Nautical Almanac,' published by the Admiralty, for the use both of astronomers and seamen. This work was projected by Dr. Maskelyne, then Astronomer Royal, and first appeared in 1767. The employment of lunar distances in finding the longitude, of the efficacy of which method Maskelyne had satisfied himself in a voyage to St. Helena, required new tables, which should give the distances of the moon from the sun and principal fixed stars, for intervals of a few hours at most. By the zeal of Dr. Maskelyne, aided by the government, the project was carried into effect, and it continued under his superintendence for forty-eight years. During this time it received the highest encomiums from all foreign authorities, for which see the French 'Encyclopédie,' art. 'Almanach,' and the Histories of Montucla and Delambre. From 1774 to 1789 the French 'Connaissance des Tems' borrowed its lunar distances from the English almanac. On the death of Maskelyne it did not continue to improve, and, without absolutely falling off, was inadequate to the wants either of seamen or astronomers. In consequence of complaints of this work, which were almost universally allowed by astronomers to contain a great deal of truth, the government, in 1830, requested the opinion of the Astronomical Society upon the subject, and the Report of the Committee appointed by that body, which may be found in the fourth volume of their 'Transactions,' is a sufficient proof of the opinion of practical astronomers on the previous state of the work. The alterations proposed by the Society were entirely adopted by the government, and the first almanac containing them was that for 1834. It is now conducted under the superintendence of J. R. Hind, F.R.A.S.

The 'Supplements' which it had been customary to publish have been discontinued. The 'Nautical Almanac' is brought out two or three years in advance.

This country was forestalled in most of the important changes just mentioned by the Berlin 'Ephemeris,' published under the superintendence of Professor Encke. Its predecessor, the 'Astronomisches Jahrbuch,' was conducted for fifty years by the celebrated Bode; and was entirely remodelled by Encke in 1830. Of other works of the same kind, published on the Continent, those of Coimbra and Milan are among the most valuable; the latter was commenced in 1755, by M. de Cæsaris.

The oldest national astronomical almanac is the French 'Connasisance des Tems,' published under the superintendence of the Bureau des Longitudes at Paris. It was commenced in 1679 by Picard, and continued by him till 1684. It then passed through the hands of various astronomers till 1760, when the conduct of it was given to Lalande, who, besides other alterations, first introduced the lunar distances, which have been already alluded to. At present the plan is very similar to that of the new 'Nautical Almanac,' with the addition of very valuable original memoirs which appear yearly. In fact, we may say generally, that the original contributions to the various Continental almanacs are among their most valuable parts; and, as Professor Airy remarks ('Reports of the British Association,' &c., p. 128), "In fact nearly all the astronomy of the present century is to be found in these works," that is, in certain periodicals which are mentioned, "or in the 'Ephemerides' of Berlin, Paris, or Milan." The 'British Almanac,' from its commencement, endeavoured to attain somewhat of a similar character, by the issue of a 'Companion to the Almanac,' not confining the subjects to astronomy only, but embracing a variety of scientific and statistical information. 'The Book of Almanacs,' by A. de Morgan, published in 1851, is furnished "with an Index of Reference by which the almanac may be found for every year up to A.D. 2000, with the means of finding the day of any new or full moon from B.C. 2000 to A.D. 2000;" a useful and valuable work for reference.

Next to the 'Nautical Almanac,' ranks, as an astronomical almanac, White's 'Ephemeris,' a work nearly as old as the monopoly previously described. For many years past this publication has given astronomical data sufficient to enable the seaman to find his latitude and time. The 'Gentleman's Diary,' commenced in 1741, and the 'Ladies' Diary,' in 1705, powerfully aided in keeping up a mathematical taste, to a certain extent, throughout the country, by annually proposing problems for competition. Several persons who afterwards became celebrated in mathematics, have commenced their career by the solution of these problems.

The stamp duty on Almanacs, which, at fifteen-pence per copy, produced on an average about 31,000*l*. a-year, was repealed by the 3 & 4 Will. IV. c. 57, August 13th, 1834. Since that period many important improvements have been effected in almanacs of older standing, and numerous excellent new publications of this class have appeared, many of them at a very low price, which have commanded an extensive sale; but many others of a low and worthless character are also continually springing into existence. A great number of local almanacs, were also called into existence, which in many cases are excellent supplements to the general almanacs of London.

ALME, or **AL-MAI**, that is, 'the learned,' the name given by the modern Egyptians and Arabs to the singing girls of Egypt. The word *alma* seems to be corrupted from the Arabic *âlimeth*, the feminine form of the active participle *âlim, sciens, sapiens.* The professional male singers, who are also frequently dancers, are called Alewayeeh. These Almai live together in bands, which are distributed in the various towns, or travel about the country in quest of employment. They are present at festivals and marriages, and other ceremonies. Those who are admitted into the society have generally a fine voice; they learn by heart the best songs on romance and love; and some are able to sing extempore verses, after the manner of the Italian improvisatori. They are admitted into the harems of the great, where they instruct the women in dancing and singing, or amuse them by reciting poems. They excel in singing pathetic ballads: dwelling upon plaintive tones, they inspire a feeling of melancholy, which, insensibly increasing, draws tears from the eyes. The Turks, enemies as they are to the arts, pass whole nights in listening to them.

The Almai also accompany funerals, at which they sing dirges, and utter groans and lamentations, like the Præficæ of Sardinia, Corsica, and other European countries. The higher and more accomplished class of the Almai attend none but wealthy people, and their price is high. The common people however have also their Almai, who try to imitate the superior class, but have neither their elegance, grace, nor knowledge. They are seen everywhere; the public squares and the walks round Cairo abound with them. Their morals are as licentious as their songs. Although there are Almai in Syria and other parts of the Ottoman empire, yet Egypt seems to have been at all times their favourite and, as it were, their native country.

The Almai have been not unfrequently confounded with the Ghawazee, or dancing girls of Egypt; but though some of the lower class of Almai may sometimes dance, the professions are distinct. The Ghawazee are accustomed to perform in the public streets; they are never admitted into a respectable harem, but are not unfrequently hired to entertain parties of dissolute men. They dance unveiled, with little grace; but the suppleness of their bodies is very great, as well as the flexibility and expression of their features, and the indecency of their attitudes is excessive. They, as a class, are among the most abandoned of the courtesans of Egypt; but in 1834 the government interfered, and public female dancing was prohibited; the punishment for infringing the regulation was, for the first offence, fifty stripes, and for subsequent offences, imprisonment with hard labour. Men committing a similar offence were to be punished by the bastinado. It is feared however, that this law, though well intended, may be, and is, too frequently and too easily evaded. The Bayaderes of India combine, to some extent, the characteristics of the Almai and Ghawazee.

(Savary, *Letters on Egypt*; Lane's *Modern Egyptians*; Mrs. Poole's *Englishwoman in Egypt.*)

ALMONER, anciently written Amner, was an officer in a king's, prince's, prelate's, or other great man's household, whose business it was to distribute alms to the poor. Previous to the Dissolution, every great monastery in England had its almoner. The almoner of the king of France was styled his Grand Aumonier, and there was a similar office at a very early period attached to the household of the popes.

'Fleta,' a juridical treatise of the time of Edward I., describes the duties of the high almoner as they then stood in England. He was to collect the fragments of the royal table, and distribute them daily to the poor; to visit the sick, poor widows, prisoners, and other persons in distress; he reminded the king about the bestowal of his alms, especially on saints'-days; and was careful that the cast-off robes, which were often of high price, should not be bestowed on players, minstrels, or flatterers, but their value given to increase the king's charity.

In modern times, the office of lord high almoner has been long held by the archbishops of York. There is also a sub-almoner. The hereditary grand-almoner is the Marquis of Exeter. An account of the lord almoner's annual distribution in the sovereign's name, on the Thursday before Easter, will be found under MAUNDY THURSDAY. There is an office at Westminster appropriated to the business of the almonry.

Ducange in his 'Glossary,' gives other meanings of the word almoner. It was sometimes used for those who distributed the legacies of others, and who have been since called executors; sometimes for a person who had left alms to the poor; and sometimes for the poor upon whom the alms were bestowed. The 'eleemosynarii regis,' or persons who were supported by the king's bounty, occasionally noticed in the Domesday Survey, were of this last description. Almoner is a name also given in ecclesiastical writers to the deacons of churches.

ALMS-HOUSE, an edifice, or collection of tenements, endowed, generally, by private benevolence, with a revenue for the maintenance of a certain number of poor, aged, or disabled people. England is the only country which possesses alms-houses in abundance, though many such exist in Italy. In England they appear to have succeeded the incorporated hospitals for the relief of poor and impotent people, which were dissolved by King Henry VIII.

ALOES.—*Medical Properties of.*—Though known to the ancients and largely used in modern times, the sources of this drug are not accurately determined. It seems better to follow the plan of the 'Edinburgh Pharmacopœia,' and assign it to an undetermined species of the genus Aloe. Barbadoes aloes would appear to be procured from the *A. vulgaris*, a plant native of Greece, and which furnished the aloes of the ancients, and which is now cultivated in the West Indies, as well as Spain, Italy, and Sicily, from which latter countries France and other Continental nations, but not Britain, are often supplied. This plan seems the more judicious, as the commercial varieties, however designated, or whencesoever derived, are to be found of nearly every degree of excellence or worthlessness, if care be not taken in the mode of obtaining the article. Sir W. O'Shaughnessy, whose position in the East gives him good opportunities of observing, states, in his 'Bengal Dispensatory,' that "the quality of the product is apparently more dependent on soil, climate, and preparation, than on specific differences in the plant." Not only has Barbadoes aloes become less valuable from changes in the mode of collection, but even the real Socotorine aloes has become deteriorated, from any person in the island of Socotra being at liberty to cut as many leaves of the now neglected plant as he pleases, and prepare it in any way he likes, instead of the care formerly bestowed on it. "Formerly every part of the island produced the aloe; and the whole was farmed out to different individuals, the produce being monopolised at a fixed price by the Sultan. The boundaries, however, thus set up, which consisted of loose stone walls, and were carried with immense labour over hill and dale, though they still remain, under the present unsettled government no longer distinguish property. The descendants of the owners to whom the several fields were formerly allotted, have either withdrawn their claims, or these are forgotten. At present, any one who chooses to take the trouble, collects the aloe-leaves, and nothing is levied on account of the Sultan." (Lieut. Wellsted, 'Memoir on the Island of Socotra,' in 'Journal of Royal Geogr. Society,' vol. v. p. 197.) In the language of the island the aloe is called Tayef; by the Arabs, Soobah. Though this island possesses plants sufficient to yield nearly all the aloes required in commerce, very little is now obtained from it; and what passes under the name of Socotorine aloes is almost entirely the best East Indian sort, as is rendered further evident by its being exported from Bombay. When one source of any article of commerce is dried up, it is the custom of the dealers to bestow the name of the sort in greatest repute on the best they possess; meaning, not that it is the produce of the place the name of which it bears, but that it possesses the qualities of the kind originally obtained from that part. Alterations in commerce, dependent on a variety of causes, are constantly rendering implicit reliance on names a very unsafe guide.

Attention to the mode of extracting the juice might render aloes, whencesoever procured, of excellent quality; but it will be seen presently how little the ordinary methods are calculated to ensure this end, quantity rather than quality being aimed at by the preparers. The aloe, like the hyacinth and many other liliaceous plants, contains a vast quantity of a mucilaginous matter (vegetable albumen?), more abundant towards the centre of the thick fleshy leaves than near the surface. The medicinal juice is altogether different from this, and is contained in a distinct set of vessels (Opangia, Link; Opophora, vasa lactifera), which are distributed chiefly under the thick cuticle of the leaves. Out of these vessels the juice sometimes exudes, either from turgescence or from the punctures of insects, and concretes into tears, forming that variety of aloes called *Aloe lucida*, seen occasionally as a curiosity, but not met with as a commercial article. (The term *A. lucida* is applied by Geiger and Theod. Martius to fine Cape aloes, but it is quite distinct from that now spoken of.) If transverse but not deep incisions were made at various points and at proper distances in the course of the leaves while yet attached to the stem, much fine aloes could be procured by scraping off the juice from time to time as it flows, or allowing it to become concrete and then picking it off. The general practice, however, is to cut off the leaves near the base, and put their open ends into a skin, into which the juice flows. This is afterwards inspissated, either by spontaneous evaporation in the sun, or promoted by a gentle heat. Pressure of the leaves is sometimes made to assist the flow, but by this means "large quantities of viscid mucilage are forced out, and mix with the proper bitter juice, which is proportionately deteriorated." (O'Shaughnessy.) Dipping the leaves into hot water, by which their vitality is lessened or destroyed, and their hygroscopicity diminished, is equally objectionable, as the viscid mucilage then flows out more freely. Worst of all is the plan now, but not formerly, pursued in Barbadoes. Barbadoes aloes of the present day is the extract of a decoction. "It is made by immersing for ten minutes in boiling water the chopped leaves previously enclosed in cloths or wicker baskets, increasing the strength of the decoction with repeated supplies of chopped leaves till the water is fully charged; then allowing the liquor to cool and the sediment to settle; and finally evaporating the clear liquor with caution till it is concentrated sufficiently to become solid on cooling. The hot liquor is allowed to concrete in large gourd-shells, in which it is always transported to Europe." (Christison.) From these different plans of collecting and inspissating the juice, results an article which differs considerably in appearance and greatly in value. Aloes is one of the few drugs in which adulteration is not extensively practised, further than by substituting the inferior and low-priced kinds for the superior. When carelessly prepared, sand and fragments of leaves and skins are frequently found in the samples.

A few of the most important sorts found in commerce may be noticed. The finest sort, to which the term Socotorine aloes is given, can scarcely be regarded as one of daily occurrence, and is noticed merely as a standard of excellence by which to judge of others according to the degrees in which they approximate it. "It consists of small angular fragments, possessing a deep garnet-red colour, altered somewhat by exposure to the air; a conchoidal fracture, a resinous lustre, much translucency in thin layers, a beautiful garnet-red hue by transmitted light, and a peculiarly fragrant odour. It is brittle, easily pulverisable, and of a fine golden-yellow tint when in powder. It is almost entirely soluble in spirit of the density of 950°, a very scanty light flocculent matter being left." (Christison.) As specimens decline from this unusually high standard, the lustre diminishes, the fracture is rougher, the odour less pleasant, the solubility less, they are not so readily pulverisable, the powder is of a deeper colour, inclining to brown, the residuum greater, and consisting of more of the flocculent matter, as well as incidental impurities. In regard to the amount of insoluble matter, Barbadoes aloes contains the most, varying from 5 to 12 per cent.; and it is much more difficult to reduce to powder, as the mode of obtaining it explains.

The chief varieties go by the name of—Socotorine; East Indian, called also frequently *hepatic;* and Cape aloes (*Aloe lucida* of Geiger and Theod. Martius), also called *A. Cabo.* Innumerable subvarieties of these are found. Caballine, or *horse* aloes, has nearly disappeared from commerce, refinement or fashion in veterinary medicine deeming it not fit for horses.

Barbadoes aloes comes to this country in the gourds and calabashes into which it is poured when prepared. Each of these weighs from sixty to even eighty pounds. When broken, the fracture is sometimes conchoidal, seldom lustrous, and having a more liver-like aspect, better entitling it to the designation of *hepatic*, by which it is frequently called, than any of the others.

The chief chemical constituents of aloes are *aloesin* (or the saponaceous principle); *resin*; *vegetable albumen*, absent from the best kinds; *gallic acid*, a trace according to Trommsdorff; *aloetic acid*, according to Pereira. Aloes is however of rather a more complex nature than appears from this view. Aloesin, or aloe-bitter, is entirely soluble in cold water, but not in absolute alcohol. When hot water is used, something is taken up, which is deposited as the water cools: to this the name of resin has been given, perhaps not with perfect propriety. The aloesin is looked upon as the cathartic principle of aloes, the resin rather as an irritant and objectionable ingredient. Hence in some of the 'Pharmacopœias' an extract is ordered to accomplish their separation; a proceeding altogether unnecessary, when aloes of the best quality can be obtained by giving a proper price for it. The formation of a decoction by heat is still more objectionable, as a much superior preparation is made by cold water alone, more grateful to the stomach and not less effective if given in rather larger dose.

Few more valuable drugs exist, as is proved by the numerous preparations made either of aloes alone, or with some other articles combined with it. These combinations have various objects in view, some to heighten its powers, others to modify, and some to get rid of certain well-founded objections to its effects. The chief of these are noticed here.

In large doses it is decidedly aperient, but is unlike many other cathartics in so far that increasing the dose beyond a certain point by no means increases the effect. This can be accomplished however by associating it with other cathartics, and still more decidedly by uniting it with tonics, such as iron or quinia. Aloes and quinia with antimonial powder, and aromatic powder to cover the unpleasant taste, form a combination of great utility in many gastric derangements, especially where the head is implicated. Thus, when persons are so fortunate as to be rallying from the stage of collapse in Asiatic cholera, this combination given frequently improves the secretions and abates the fever. In some fevers with numerous liquid motions it may also be given with striking benefit, the motions diminishing in frequency and increasing in solidity, as well as becoming of a more healthy appearance. In the congested state of the bowels and brain which precedes water in the brain, aloes, either in this combination or in some other form, is of great utility. (Yeats 'On Water on the Brain.') Persons predisposed to apoplexy are more benefited by aloes than by most other purgatives, especially if they have been previously subject to a hæmorrhoidal flux which has been suppressed.

The combination which increases the purgative power of aloes in the most remarkable degree is formed by adding one drop of strong (undiluted) sulphuric acid to four grains of the best aloes, and forming a pill, two of which, given every two, four, or six hours, will almost invariably relieve the most obstinate cases of constipation, such as occur in painters' cholic, ileus, and other diseases. It is even more efficacious than croton-oil, and not so apt to excite inflammation of the intestines. This augmentation of power seems to be in conformity with a general law, by which many vegetable principles have their properties heightened by adding an acid, either mineral or vegetable. Thus ammoniacum becomes a more powerful expectorant by adding dilute nitric acid to the mistura ammoniaci; and the fœtid gums, such as assafœtida, are rendered more potent by solution in vinegar. ('Acetum Antihystericum,' formula No. 1, in Copland's 'Dictionary of Medicine.')

Aloes, especially the compound decoction, is a most valuable emmenagogue, particularly when combined with tincture of ergot or preparations of iron. From its action on the lower part of the bowels it is deemed an improper purgative in pregnancy or during the menstrual flux. It is also considered improper for persons subject to piles. This objection has been attempted to be obviated by various means; but the best way is to combine it with other agents, as stated by Dr. Christison, as many persons can take the compound gamboge-pill, or compound extract of colocynth, who cannot take aloes alone. The best means of covering the unpleasant taste of aloes, when given in the liquid form, is the compound tincture of lavender.

ALOETIC ACID (HO, $C_{14}H_{2}(NO_{4})_{2}O$, Aq. ?), a resinoid acid, found by Schunck in the products of the action of nitric acid upon extract of aloes. It forms red salts.

ALÖIN. ($C_{34}H_{18}O_{14}$?) Stenhouse obtained this substance from the cold aqueous extract of Barbadoes aloes by evaporation in vacuo. It is deposited in coloured granular crystals, which after pressure between folds of bibulous paper, recrystallisation from water, drying at a temperature not exceeding 150°, and final recrystallisation from alcohol, present the appearance of groups of pale yellow needles. Aloïn is the active purgative principle of aloes. It is neutral to test papers, possesses an intensely bitter taste, and is rapidly changed at 212°. Caustic and carbonated alkalies dissolve it, forming orange-coloured solutions. Cape and Socotrine aloes also yield aloïn, but it is more difficult to purify when prepared from these varieties.

ALONSINE, or ALPHONSINE, TABLES, an astronomical work, which appeared in the year 1252, under the patronage of Alonzo X., in the first year of his reign. They contain the places of the fixed stars, and all the methods and tables then in use for the computation of the places of the planets; but they are not made from original observations, nor is there any material difference between the astronomy contained in them and that of Ptolemy, except in two points. The length of the year is supposed to be 365 days, 5 hours, 49 minutes, and 16 seconds; which is a more correct value than had been given before, being only 26 seconds over the best modern determinations. The mean precession of the equinoxes is stated at half its real amount; being such as would carry the equinoctial points round the circumference of the globe in 49,000 years. An inequality, however, is supposed, having a period of 7000 years, by which the mean precession is alternately augmented and retarded 18 degrees. It is difficult to say whence a theory so utterly at variance with the phenomena could be derived. The general opinion is, that these tables were constructed by Isaac Ben Said, a Jew, but others suppose that Al Cabit and Aben Ragel, the preceptors of Alonzo, were the real superintendents. The numbers above cited, in speaking of the precession, have been supposed from their connection with the number 7, and the difficulty of accounting for them otherwise, to have been the ideas of a Jew. These tables are constructed for the meridian of Toledo, and the epoch 1256. They were not held in much esteem by succeeding astronomers. Regiomontanus says, "beware lest you trust too much to blind calculation and Alphonsine dreams." And Tycho Brahé, who reports that 400,000 ducats had been spent upon them, laments that this sum had not been employed in actual observation of the heavens. A full account of their contents may be seen in Delambre, 'Hist. de l'Ast. du Moyen Age,' p. 248. Till the time of Copernicus and Tycho Brahé they continued in general use, being in truth, with some modifications, a body of Ptolemaean astronomy. They were first printed in 1483 by the celebrated Ratdolt of Venice. A copy of this *editio princeps* is in the Royal Library at Paris. There have been several subsequent editions.

ALPACA-WOOL. The natural history of the Alpaca, or Paco, has been treated under LLAMA, in the DIVISION OF NATURAL HISTORY; we here notice only the application of the wool to manufactures.

The introduction of this wool has attracted considerable attention; and the question of naturalising the alpaca in this country, in Germany, and in Australia, is also an object of much interest. The wool of the alpaca is superior to English wool in length, softness and pliability. The fleece averages from 10 to 12 lbs., while that of our sheep is seldom more than 8 lbs.; and while the staple of English wool does not often exceed six inches in length, that of the alpaca varies from eight to twelve inches. The lustrous appearance of the alpaca wool renders it applicable to many of the purposes for which silk is usually employed in textile fabrics; and it is found a useful substitute for Angora wool. The manufacture of plain and figured stuffs from the fleece of the alpaca was commenced at Bradford in Yorkshire, a number of years ago, and these fabrics have been much admired. The consumption of alpaca wool in this country in the seven years ending December, 1843, is estimated by Mr. Walton at 12,000,000 lbs.; it has since largely increased. Towards the close of 1844 five different articles were manufactured at Bradford for her Majesty, from the wool of an alpaca which had been kept at Windsor. The fleece weighed 16½ lbs., and when sorted and combed 10 lbs., including 1 lb. of white wool, the remainder being almost entirely jet black. One of the articles manufactured was an apron, in which the wool of the alpaca, without the admixture of any other wool, was used for the first time in this country; for though very large quantities have been woven at Bradford, it has usually been in fabrics where the warp was of cotton or some other material, and the weft only of alpaca. Three of the other articles manufactured for her Majesty were a striped and figured dress; the warp consisting of rose-coloured silk, and the weft of black alpaca with figures on alternate grounds of alpaca and silk. This dress, which measured 12 yards, required 2½ lbs. of alpaca. A plaid dress, measuring 15 yards, and containing 2¼ lbs. of alpaca, was woven with an intermixture of silk and worsted. Another article was a plain black alpaca lustre dress, the warp of fine cotton twist, and the weft of alpaca. This required 3½ lbs. of alpaca, and when taken from the loom it resembled silk from its lustrous quality, and was of course much softer.

The question of naturalising the alpaca has been taken up with great enthusiasm by a few persons; but very little progress has yet been made in convincing the country of its practicability. The alpaca inhabits the mountainous and inhospitable regions of Peru, and is remarkable for its abstemiousness. It thrives on coarse food. Those which have been brought to this country have been confined in parks and richly cultivated lands, and have been treated with too much care and tenderness. Mr. Walton asserts that they will live where our hardiest sheep would starve, and that the wildest parts of Great Britain are best suited to their habits. In the 'Transactions of the Highland and Agricultural Society,' 1844, there is an account, by Mr. Stirling, of the attempt at that time being made to introduce the alpaca into Scotland. During the severe winter of 1843-4, when sheep required to be regularly fed with turnips and hay, the alpacas perseveringly sought their own food, and did not experience a single day's illness. Mr. Stirling says that they were kept within enclosures better than sheep, and never attempted to leap a fence. In 1841 the Highland and Agricultural Society offered their gold medal for 'a satisfactory account, founded on actual observation and experiment, of the attempt to naturalise the alpaca in Scotland;' and in 1844 a prize was offered by the Society for the best pair of alpacas born and bred in Scotland, and the best two, male and female, imported. If, as Mr. Walton states, the alpaca may be pastured on lands which are now waste and unprofitable, and where the hardiest sheep would starve, the naturalisation of the animal would undoubtedly prove a great 'national benefit;' but if this is not the case, it is a question whether a constant demand for the wool as an article of import would not be quite as beneficial. The Peruvians would be induced to bestow greater care on the management of their flocks, and the possession of so valuable an export would bring them under influences of a civilising nature, which would render them better customers for our commodities. The expense of importing the alpaca is very great, and the long voyage kills more than two-thirds of the number shipped. Some of the Australian sheep-farmers are now (1859) making renewed attempts to naturalise the alpaca in that country.

Alpaca is now used to a remarkable extent in manufactures. Umbrellas, paletôts, and various articles and garments are made of it: as it presents a sort of compound of the qualities of silks and woollens. Mr. Titus Salt, of Bradford, has built one of the largest and most magnificent factories in the world, chiefly for the production of textile goods made wholly or partially of alpaca; nearly half a million sterling has been spent in the various buildings, dwellings, and machinery. The establishment almost constitutes a town in itself, and has been fancifully named *Saltaire*, by a combination of the name of the owner with that of the river, on the banks of which the factory stands.

The late Earl of Derby's ménagerie at Knowsley, sold by auction in October, 1851, contained eleven alpacas, which were born and bred on the estate.

ALPHABET is the name given to the series of letters used in different countries at different times. The term is borrowed from the Greek language, in which *alpha, beta*, are the first two letters; or if we go a step further back, we should derive the word from the Hebrew, which gives to the corresponding letters the names *aleph, beth.* Thus the formation of the word is precisely analogous to that of our familiar expression, the *A, B, C;* and some writers have found a similar origin for the Latin name given to the letters, namely, *elementa*, which it must be allowed, bears an extraordinary similarity in sound to the three liquids, *l, m, n;* but to make this derivation satisfactory, it should be proved that these letters were at one time the leaders of the alphabet, for otherwise it would be difficult to account for the selection of a name from them in preference to the rest.

Among the different causes which have promoted the civilisation of man, there is none, we might almost say, which has been so fruitful as the invention of the alphabet; and the very circumstance of the invention being essential to this effect, and therefore preceding it, has made it a task of some difficulty to point out the mode in which the discovery was made, for historical evidence upon such a point must be very imperfect. The present age however has nearly surmounted this difficulty, and we begin to see pretty clearly at least how the discovery *might* have been made, perhaps how it actually was made. Oral language itself, we might almost infer *a priori*, originated in an attempt to imitate, by the organs of the human voice, those different sounds which nature, in her animate and inanimate forms, is constantly presenting to our ears. By his powers of articulation man could imitate those sounds at pleasure, and thus recall to the minds of those around him the notion of absent objects and past actions with which the sounds were connected. Thus, in its various forms and combination the single principle of *sound* would afford a vast number of symbols which might be made to represent, at first, the material objects of nature, or the action of those objects upon one another. The transference of these signs from particular objects, that make an impression on the *ear*, to the expression of abstract qualities, would be governed by the same principles of association. That such must have been the origin of spoken language, reason would seem to point out, and the historical investigation of the subject strongly confirms the theory. On the other hand, the language which takes the *eye* for its channel of communication with the mind, would in its first steps be more direct and more simple. The objects of nature and many of the external relations between them were easily represented to the eye with more or less rudeness, by a stick upon sand, and by many other means of graphic imitation which even the savage may command. Yet when we compare these two modes of language with one another, we shall soon perceive that *sound* is a more convenient medium of ordinary communication, if it be only for the reason that the voice is ever with us, and that the ear is ready to receive impressions from every direction, above, below, and around us. A deaf and dumb savage who should wish to depict to a friend an object upon the sand must first catch the attention of his companion by the sense of touch, just as in modern manufactories where the speaking-pipe is used, a bell is attached to it, the ringing of which first directs the party who is to be addressed to apply his ear to the other extremity of the pipe. The result of a comparison then between these two forms of language may, perhaps, be fairly stated thus. The language of pictorial symbols is more easily invented and understood at first. The other, when once invented and understood, is better adapted for the ordinary uses of life. The difficulty of invention, however, is a difficulty that occurs but once; the difficulties in the after use of the language, such as they are, never cease. In the last place, sound travels without the aid of light. It is therefore natural to conceive that oral language would approach a comparatively perfect form with much greater rapidity than that which addresses itself to the eye. At the same time the two forms of language might well be used to some extent simultaneously, as indeed is even now not unfrequently the case—gesture being called in aid.

But the time would soon come when it would be desirable to record for a shorter or longer time the acts and thoughts and commands and duties of man; and here the language of the voice would utterly fail, while the other might ensure a continuance of existence, depending upon the nature of the material on which the representation might be made. In less than a second the sound of the human voice dies away, but the picture even on the sea-sand lasts until the next tide washes it away; the waxen tablet would preserve its characters long enough for the purposes of epistolary communication; the papyrus, the cloth of linen and cotton, the bark of trees, the harder woods, the skins of animals, would retain the impressions upon them for centuries; and lastly, bricks, and stone, and metal, under favourable circumstances, might convey their records to a posterity of many thousand years. Now, to represent visible actions and visible objects would, as we have already stated, be an easy affair, and the signs for abstract qualities might be obtained, as in sounds, upon the principle of association. But instead of forming a new series of associations, which would not easily become generally intelligible, it would no doubt be found more convenient occasionally to turn to account the already existing language of sound. A few examples may perhaps explain our meaning. Visible objects, in the first place, may be directly represented. No pictorial symbol of an *ox* can so readily convey that notion to the mind as the representation of the animal itself, or, in order to save time, that part of the animal which is most characteristic of it might, and would, be selected; in the present case we should propose the head of the animal with its horns. To signify a visible action, such as *fighting*, we should, perhaps, avail ourselves of the *fist*, as the natural organ for that purpose belonging to man, following therein the same direct principle of association which has formed the Latin word *pugnare*, to fight, from the element *pugnus*, or rather *pug*, a fist. In this way we should form a series of symbols altogether independent of the language of sound; but we repeat, it would often be more convenient to make the language of visible signs in part dependent upon the oral symbols. This may be most simply effected by what is in fact a species of punning: If, for instance, a symbol were required of an Englishman for the abstract notion of *friendship*, he might employ the two separate signs for a *friend* and a *ship*; the first of which we will suppose to be *two hands clasped*, the other, of course, *a hull with a mast* and enough *rigging* to distinguish it from other objects. We should thus have two pictorial symbols, which would separately excite in the mind first the *notions*, and then the oral names of *friend* and *ship*, and the combinations of these sounds would recall that new notion, for which the articulate sounds of the word *friendship* are already the conventional symbol. Books of amusement for children, as is well known, have been formed upon this principle; for example, such a sentence as—*I saw a boy swallow a gooseberry*, might be representented by uniting the pictures of an *eye*, a *saw*, a *boy*, a *swallow*, a *goose*, and a *berry*.

So far we have only considered what the origin of written language might have been. The records still existing of the Egyptians have enabled modern discoverers to deduce with an evidence closely approaching to certainty what it actually was. The hieroglyphic characters of Egypt bear upon the very face of them decided proof that they are in their origin pictorial emblems; and that they constitute a language, appears incontrovertibly from the triple Rosetta inscription, the Greek version of which expressly affirms, that the decree contained in the inscription was ordered to be written in three different characters; the sacred letters, the letters of the country, and the Greek. The second of these classes has been called the *enchorial*, from the Greek term (εγχωριος) signifying *of the country*, or else *demotic* (δημοτικος) that is, *of the people.* But although the hieroglyphic characters may be for the most part pictorial emblems used directly for the objects which they represent, or metaphorically for other associated ideas, it has been established by most satisfactory evidence, that they were also in some cases representatives of articulate sound, not, however, of the whole oral name belonging to their original object, but solely of the initial letter, or perhaps syllable. This use of the sacred pictorial characters as symbols of sound was perhaps originally confined to the expression of proper names. Such, for instance, is their use in the hieroglyphic division of the Rosetta inscription for the name of Ptolemy and in another inscription for that of Cleopatra. Thus the former name might be expressed hieroglyphically in our own language by the pictures of *a pig, a top, an owl, a lion*, and *a mouse*. It should be added, however, that when the sacred symbols are used with this phonetic or vocal power for royal names, they are included in an oval ring or cartouche. The enchorial character seems at first to bear little or no resemblance to the hieroglyphic; but a comparison of various manuscripts that have been found in mummies, containing parallel passages in the two characters, has led to the certain conclusion that the enchorial themselves have arisen from the degradation or corruption of the sacred pictorial characters. Dr. Young, in his excellent article on Egypt, in the Supplement to the 'Encyclopædia Britannica,' has given specimens which are perfectly sufficient to establish the connection. The subject, however, of Egyptian writing in its different forms requires an investigation of so many details, that we must refer our readers to HIEROGLYPHICS. We must here be satisfied with stating what appears to us to be a safe conclusion, that a language originally hieroglyphic, would naturally wear away until the characters lost nearly all trace of their original formation on the one hand, and became eventually the mere representatives of phonetic powers, first perhaps as syllables, afterwards as mere letters.

The Hebrew alphabet again affords double evidence of the same nature. The names of the letters, it is well known, are also the names of material objects, some of the very objects in fact, which would be well adapted to pictorial representation. A part of these names, it is true, are obsolete in the Hebrew language as at present known, that is, the authority for their meaning is solely traditional, as they are not found in the existing writings of the language; but this fact, while it affords evidence that the names are not the result of forgery, is precisely what must necessarily have occurred in those changes to which all language is exposed in the long course of ages. We have given a table with the Hebrew names of the letters, which it will be seen have been borrowed, with slight changes, for many other alphabets. But it will be objected that in fact the letters, whatever they may be called, bear no pictorial resemblance to the objects which it is pretended they represent. If the Hebrew characters alone be considered, this objection will not be unreasonable. But there is strong reason for believing that the present Hebrew characters are of comparatively modern date, and if so, there is nothing very violent in the supposition that they may have been derived by degradation from an earlier pictorial form, as the enchorial of the Egyptians, it is now established, arose from the corruption of their hieroglyphics. But not to rely too strongly upon theory, we may appeal to what are virtually *Hebrew* alphabets, though called Phenician and Samaritan. In Plate I. (col. 240) Nos. 2, 3, 4, 5, the reader will see specimens of these alphabets. The first two are taken from Boeckh's 'Inscriptions,' pp. 523, 527, and from the coins given by Mionnet. The Samaritan characters are taken solely from Mionnet. Now among these, we find a few at least, which, even to the sober minded, bear considerable resemblance to the natural objects. The first letter in these alphabets, *aleph*, it is well known means *an ox*; indeed, the terms ελεφας, *elephas, elephant*, of the Greek, Latin, and English languages, seem to be derived from this Hebrew name. If in Syria the name *aleph* was extended to the *elephant*, just as the Greeks applied their term *crocodile*, properly a *lizard*, to the monster of the Nile—when the word came to the Western nations in connection with the *elephant*, the original sense would be readily lost in the secondary. The Romans too called the same animal *Bos Lucas*, the *Lucanian Ox*. We have already stated that the most simple mode of representing an ox would be by a picture of its head and horns, and if any one will turn the engraving of our second Phenician character, so as to have the angular point downwards, he will see a very fair picture of an ox's head, with its two horns and ears into the bargain. Those who are determined to take nothing for a representative of an ox that has not a body, four legs and a tail, may be asked to account for the astronomical figure of *Taurus* in the zodiac.

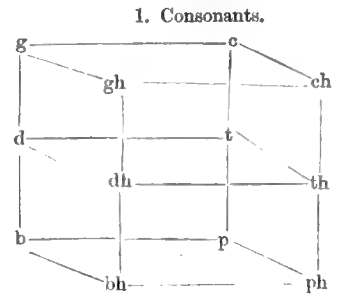
Again, the Hebrew name for the letter *m* was *mem*, and this also was the name for water. Now a very ordinary symbol for water is a zigzag line, which is no doubt intended to imitate undulation or rippling. We find this symbol for *Aquarius* in the zodiac, and we find it also in Greek manuscripts, both for θαλασσα the sea, and ὑδωρ water, the former word having the symbol inclosed in a large circle or *theta*, the latter having its aspirate duly placed above the waving line. Indeed every boy in his first attempt to draw water, represents it by a zigzag line. But before we point out in the written characters what we look upon as representing the wave, or (to be candid) as being the corrupted remains of what once was a wave, we must premise a few words on the characters of the older Western languages. We have already asserted our belief, that the Hebrew characters now used are of more recent form than those in the Phenician and Samaritan alphabets: we will now go one step farther, and express our opinion, that in many of the characters, the Greek alphabet and the Etruscan (which, notwithstanding its independent name, is a mere offset from the Greek) generally present a more accurate picture of the original letters than those of the three former alphabets. That all these alphabets are identical in their origin, we will presently show in more detail. It is enough here to rely upon the evidence of Herodotus (v. 58), who expressly affirms (and he speaks from his personal examination) that the Ionians received their characters from the Phenicians, and that they were actually called Phenician. Now, there is no doubt that the inscriptions from which we have taken the Greek characters of our plate are older, at least, than either the Phenician inscriptions given in Boeckh, or the coins which furnished Mionnet with his characters. Hence, we may naturally expect to find at times in the oldest Greek characters traces of a higher antiquity and purer forms than in those which pass under the more venerable names of Hebrew, Phenician, and Samaritan. The mere wave then, we contend, was probably the original form of the *mem:* the initial or concluding stroke of the wave becoming, by a kind of flourish, longer than the others, leads to the so-called Etruscan and Greek forms in columns 6, 9, 14, 15, 16, 18. This long descending stroke takes a bend in the Samaritan and Hebrew characters towards the left, as was not unnatural in a language where the words run in that direction. By a comparison of the *gimel, nun, ayin,* and *pe,* and perhaps *caph,* with the corresponding letters in the other alphabets, the reader will perhaps be induced to ascribe the bottom strokes, which in these letters also run to the left, to the same accidental origin. This supposition is strongly confirmed by the fact, that the *caph, nun, pe,* and *tsadi,* when they are the final letters of a word, omit this appendage, and in its place have the perpendicular stroke merely continued in the same direction downwards, a little beyond its usual length. Our last example shall be from *ayin,* which is at once the name of a letter and the word which signifies an *eye.* The eye happens moreover to be a hieroglyphic character of the Egyptians, and therefore we cannot be surprised to find it among the Hebrew symbols. Nay, if we may believe Champollion, the picture of an *eye* in the Egyptian hieroglyphics was actually used at times for an *o,* exactly as *ayin* by the Hebrews. Now, though an eye might be represented at first with tolerable precision, it would, in the inevitable course of degradation, soon become a mere oval, or rather circle (for the eyes of animals are generally circular), with a small dot in the centre to mark the pupil. Such a character is actually found in our Greek series of alphabets, Plate II., Column 21, &c. The form afterwards lost its inserted point, and at times was corrupted into a lozenge or even a triangle. In Dr. Young's successive plates of parallel passages from Egyptian MSS. ('Encycl. Brit. Supp.' Pl. 78. N.) the reader may see an emblem, consisting, like our own, of a circle with a point in it, gradually wearing down in MSS. less and less carefully written, until it becomes at first a mere circle, and then something more like a triangle. After what has been said, we need hardly repeat that the Hebrew form appears again in a very corrupted state. A tail has been added, upon the principle explained above, and the careless writer (as in the Greek letter, Plate II., Column 20) has failed to make his circle meet at the top, an accident which may be also traced in the Hebrew *theth.* Indeed, the letters *ayin* and *theth* may be compared in nearly all their forms. Those who examine the changes of letters, will not be surprised, that what was at first an accident, became at last a fixed rule in the formation. We shall soon see other instances of this fact.

But before we proceed to an examination of the alphabets given in our plates, it may be useful to consider the distribution of articulate sounds among the vowels, liquids, and consonants. Attempts have been made by some writers to determine the number of distinct sounds which the human voice is capable of producing. A little consideration would have shown them that they were attempting to limit that which was essentially infinite. The vowel sounds all run into one another in a continuous gradation. The same is true of those modifications of sound which we call consonants, and likewise of the liquids. At the same time it is of course necessary that a limited number of symbols should be employed. Of these, some nations will employ more, some less, but few have ever made use of so many as thirty, unless indeed we include those alphabets which consist of syllabic symbols, and then, of course, the consonantal syllables will be multiplied in the proportion of the simple vowels. The vowel sounds are usually placed in the order *a, e, i, o, u,* such being their succession in the various alphabets of Europe and Western Asia; but if we wish to place them in that order which marks their relation to one another, we should write *i, e, a, o, u,* or in the opposite order, *u, o, a, e, i.* Mr. Willis, in two papers in the 'Cambridge Philosophical Transactions,' vol. i., for Nov. 24, 1828, and March 16, 1829, has shown by experiment, that the different vowel sounds may be produced artificially, by throwing a current of air upon a reed in a pipe, and that, as the pipe is lengthened or shortened, the vowels are successively produced in the order above given. When a door creaks, or a cat mews, we have experiments of the same nature, at least as regards the result, for in both these cases we may often detect the due series of the vowels. Indeed, the word *mew* would be more expressively written *mieaou.* In all these remarks we speak of the vowels as possessing those sounds which are common on the Continent, not those which are peculiar to ourselves; namely, *i* like *ee, e* like *ay, a* as in *father, o* as in *bone, u* as *oo* in *fool.*

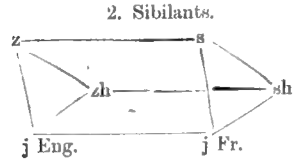
The liquids again should be written in the order *r, l, n, m,* beginning from the throat and advancing along the palate and teeth to the lips; or in the reverse order. For proof of this assertion, we need only ask the reader to sound the four letters, and at the same time note the parts of the mouth employed for each. The other letters have often been divided according to their organs: 1. The guttural and palatals, *g* (as before *a*), *k* (with *c, q*); *gh, ch* (as in the Scotch *loch*); *h,* with perhaps *ng, y,* and *wh.* 2. Dentals, *d, t; dh* (as *th* in *this*), *th* (as in *thing*); *z, s; zh* (like *ch* in *church*), *sh; j* (as in English), *j* (as in French). 3. Labials, *b, p; v, f,* and *w.* Perhaps the four last of those we have included among the dentals partake in an equal degree of the palatal character. In the above enumeration of the consonants, we have placed first in their respective series those commonly called the middle (or medial) letters *g, d, b;* then the *tenues,* or more delicate letters, *k, t, p;* and then the aspirates; but as each class presents two forms of the aspirate readily distinguished by the ear, and as these pairs of aspirates stand in the same relation to one another as the *medial* and *tenues,* we have throughout placed what we may perhaps call the middle aspirate before its delicate relative, namely, *gh* before *ch,* or χ; *dh* before *th; v* before *f.* Perhaps among the labials, *v, f, w* may be considered as aspirates; if so, they are still in their proper order. So among the six sibilants given after the dentals, it appears to us, that *z, ch,* and the English *j,* stand respectively to *s, sh,* and the French *j,* in the same relation of *medials* to *tenues,* and they are arranged accordingly. The letters *y* and *w* are *sui generis,* and are indeed intimately related to the vowels, having an affinity to the opposite extremities of the vocal series, *y, i, e, a, o, u, w;* and thus we may consider the commencement of the series as connected with the throat, and the termination with the lips. But although we have in the preceding enumeration appeared to limit the number of consonants, they are in fact, like the vowels, unlimited. Although an Englishman, for example, is satisfied with a single *t, l, f,* and *v,* he need not go far to find other nations whose wants are more extensive. An Arab has two modes of uttering a *t,* which to the ear of an ordinary European appear the same, and thus having what to him are two distinct results, he naturally employs two distinct symbols. A Pole, again, has two varieties of the letter *l.* So, also, in the comparison of different languages, it is well known that the sound of a German *w* approaches to, but is not identical with, an English *v;* and, in like manner, the Greek ϕ and Roman *f,* though treated by moderns as identical in power, are expressly distinguished by Quintilian. Nor can we stop at two varieties of the consonant. These are strictly, as we have said, infinite. In the production of a *t,* for example, the tongue may effect its contact with the palate either at the line adjoining the teeth or at a distance of an inch or more from this line. The two extremes give us those varieties of the consonant which, as just observed, are clearly distinguished by the ear of an Arab. But the contact might also be effected at any one of the intermediate points, and thus we have an imperceptible gradation from the palatal *t* to the dental *t.* Yet here again, as with the vowels, though the modifications of the consonant are without limit, it becomes a necessity to limit the symbols. We have a precisely parallel case in the colours produced by the prism, which pass by an imperceptible gradation from the one extreme to the other, and yet the names assigned to the colours are of necessity but few.

A tabular arrangement, in which the *medial, tenues,* and *aspirated* letters are placed in vertical columns, while those belonging to the same organ are collected in horizontal rows, affords a good view of them. But the parallelepipedon furnishes an arrangement superior to that of the square for the twelve related consonants given below; and for the sibilants, the angular points of the prism may be employed, while the vowels and liquids require nothing more than a simple line.

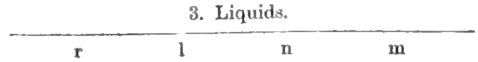
1. Consonants.



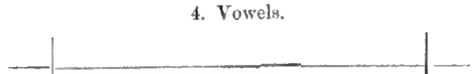
2. Sibilants.



3. Liquids.



4. Vowels.



In the preceding parallelepipedon, the three horizontal planes, beginning from above, represent the guttural or palatal, the dental, and the labial letters. The front vertical plane includes the aspirates; that at the back, the non-aspirates. The left vertical comprehends the medial letters; that on the right, the *tenues*. Every letter is, of course, at the intersection of three of these planes, and may be defined accordingly.

A distribution of the letters according to the actual nature of the sounds is of considerable use in the examination of those numerous euphonic and dialectic changes which occur not only in the polished language of Greece, but also in those languages which are inconsiderately called barbarous. But no single distribution will at once present to the view all the relations of the different letters. Not merely are the several letters in each of our horizontal, and to a certain extent also in the vertical divisions, interchangeable with their neighbours, but the twelve consonants arranged in No. 1 are in fact also related to the liquids, and even to the vowels. As these consonants extend from the throat to the lips, so do the liquids, and the vowels also, *y* and *i* being formed in the back of the mouth, *u* and *w* at the lips. In fact, the principle of lengthening the vocal pipe, which gave Mr. Willis the series of vowel sounds, is nothing more than what is done in the human mouth. To produce the first sound, we shorten the tube of the mouth; for the last, we extend it to its utmost length; and in intermediate degrees for the vowels, between the two extremes. In comparing therefore our ordinary consonants with the liquids and vowels, we find, as we might expect, *g* closely related to *y*, as our language in its older forms, and even its existing dialects, fully establishes. The intermediate *d* again has an affinity for *l*, *n*; and *b*, at the labial extremity of the consonants, is intimately related to *m*, *w*, and *u*, at the corresponding points of the other series. To make our views include the whole body of letters, it remains to be observed, in the first place, that had the nasal organ been considered, we should have had a series *m*, *n*, *ng* with their intermediate sounds depending partly upon the nose, and partly upon the lips, teeth, and palate respectively. In the Sanscrit alphabet, the series of guttural, palatal, lingual, dental, and labial consonants, have an *n* belonging to each class with a distinct symbol. That which belongs to the guttural series is a sound analogous to our *ng* in *ringing*. The nasal of the labial series is of course *m*. The other omission of our tabular view is the letter *h*, which, when pronounced at all, is a faint representative of the guttual aspirate *ch*. In the Hebrew alphabet, the names *cheth* and *heth* are given indifferently to the eighth letter, and the etymology of every language would supply examples of the connection.

Having endeavoured to arrange the letters of the alphabet upon some principle, we cannot pass over in silence the apparent confusion in the alphabets we have been speaking of, the Hebrew and the Greek. That the order observed in the latter is borrowed from the former, can scarcely admit of a question. For though the *vau* of the Hebrew has no corresponding character in the later Greek alphabet, it is yet well known that it once had such a correlative in the *digamma*, at least in power; and that the digamma was actually lost from the sixth place is proved from the gap at that point in the numerical use of the Greek alphabet, and the clumsy contrivance of filling it up by the symbol *ς*. The position of the letter F in the Roman alphabet is a proof in confirmation. The *tsadi* of the Hebrews can never have had a place in the Greek alphabet, but the following letter *koppa* most assuredly had, as is proved both by the existence of that letter in many of the older Greek inscriptions and the coins of Corinth, and no less decidedly by the insertion, as before, of a numerical substitute, which even retained the name of *koppa*. It may be observed, too, that the Latin *q*, of the same power and form, corresponds also in position; and the close connection between *koppa* and *q* is further confirmed by the fact, that as *q* is generally used solely before *u*, so *koppa* is rarely used except before *o*, as in the coins of Cos, Corinth, and Syracuse. The *schin* and *sin* of the Hebrew have in their own alphabet not merely an identity of form, except in the diritic points, but bear also the same numerical value, so that they must be considered as one in their origin. At *tau* the Hebrew series terminates, while the Greek adds first a *υ*, then a φ, a χ, a ψ, and an ω. That some of these did not belong to the early Greek alphabet is proved historically. The ω appears rarely before the year 403 B.C.; χ, ψ, and φ, were represented by ΦΣ, ΚΗ, ΠΗ, and *υ* or Υ appears to be only a variety of the *ayin*, to which it bears a strong resemblance in form. The letters *o* and *u* moreover in all languages are so closely related in power, that the one might almost supply the place of the other, as is actually the case in the Etruscan, which had a *u*, but no *o*. It is not therefore a very bold thing to assert that the early Greek alphabet terminated at the same point as the Hebrew. There is, however, a difficulty which should not be neglected. It has been a common assertion, that the old Greek alphabet consisted of only sixteen letters. But Pliny and Plutarch seem, in the first place, to be the sole authority for the statement; and the assertion of the former, that Palamedes, in the time of the Trojan war (!) added Θ, Ξ, Φ, Χ, and Simonides Ζ, Η, Ψ, Ω, is full of so many difficulties, that belief could not readily be given to him, even were there no counter authority. For upon what principle could the Greek letters have attained their present order, if they were introduced according to the chronological arrangement given by Pliny? But fortunately in the very passage of Pliny referred to (vii. 56, or 57), he gives another statement from Aristotle, differing from his own in several particulars, but it must be confessed not more satisfactory They mutually serve however to weaken the authority of each other In enumerating the sixteen letters, it may be observed that the long vowels Η Ω, the double letters Ζ, Ξ, Ψ, the aspirates Φ, Χ, Θ, are excluded by Pliny. In defence of Ω, Ψ, Χ, Φ we say nothing; but the character Η certainly did exist, not indeed as a long vowel, but as an aspirate. Thus with the *digamma*, the letter Η (*cheth*), and the *theta*, the old alphabet possessed a complete trio of aspirates: so erroneous is the notion that they should all be excluded. Lastly, as for Ζ and Ξ, the circumstance of their situation corresponding precisely to the *zain* and *samech* of the Hebrew would induce us to defend them, even at the risk of supposing (if such supposition be necessary) that, in their original power, they were not double letters. We do not however mean that the very characters existed, but that sibilants of some kind occupied their places. The precise correspondence of the Greek and Hebrew alphabets in the order and power and names of the letters, is an argument of much stronger weight than any testimony from such careless and late writers as Pliny and Plutarch.

But we are digressing too long from the question about the principle which governed the first arrangement of the Hebrew or old Greek Alphabet, if principle there be. Though we cannot satisfactorily account for the whole order throughout the twenty-two letters, there are certainly traces of some regularity in the arrangement We find first the simplest of the vowel sounds—simplest, because it requires neither retraction nor protrusion of the lips—followed by the three medials β, γ, δ, then another vowel, followed, with some irregularity indeed, by aspirates corresponding in order to the above consonants, *vau*, *cheth*, *theth*, no bad representatives of φ, χ, θ. Then again we have a vowel ι, followed soon after by three consonants related to each other, λ, μ, ν. Soon after we find a fourth vowel *o*, and after it, in a little disorder it must be allowed, *pi*, *koppa*, *tau*. It cannot well be a mere accident that the several classes of labials, palatals, and dentals occur so nearly together in the different parts of the series, and always in the same order. It will, perhaps, here be observed that in these remarks we are unintentionally confirming the assertion of Pliny and Plutarch about the sixteen letters, the more so as Plutarch (Symp. lib. ix. quaest. 3. § 2, Wyttenbach's ed. vol. iii. p. 1050) speaks of four quaternions. The chief objections to such an explanation of their statements consist in the difficulty of imagining a language to exist without a sibillant or *r*. But *th* approaches very nearly to the nature of a sibilant, and may have been used as one; while to many nations *r* and *l* admit of no distinction, so that one symbol is for them sufficient. Nay, the Latin had demonstrably at one time no *r*.

But we pause a moment to contribute a new item to the Curiosities of Literature. The theory here propounded, that the original Cadmeian alphabet consisted of four tetrads or quaternions symmetrically arranged, was originally given in the Penny Cyclopædia, in the year 1833 (Vol. I. p. 380, col. 2, &c.) In 1839 it appeared without acknowledgment in the 'New Cratylus,' pp. 99-101, with the one alteration, that in the second tetrad the vowel *i* was discarded in favour of a sibilant. The same writer again reproduced the theory in 1844, in his 'Varronianus' (pp. 188, 189); and when attention was called to this proceeding, he declared, on the word of a gentleman, that up to that moment he had not read the article, and indeed that on then referring to it, he found it to contain only a bungling approximation to his own theory. Lastly, in the second edition of his 'New Cratylus,' the same theory repeated in his text, p. 147, is accompanied by a note commencing:—"This organic arrangement of the alphabet has been more or less noticed by several philologers, of whom the earliest seems to have been the acute and learned Dr. Richard Lepsius, in his essay, 'über die Anordnung und Verwandschaft des Semitischen . . . . Alphabets.' (Zwei Abhandl. Berl. 1836.) Does the writer then mean to declare on the word of a gentleman that the year 1836 preceded the year 1833?

The accompanying plates require a few remarks in addition to what has been already said. The first plate contains alphabets running from the right to the left, a practice which seems to have been earlier than that which is now generally adopted. Herodotus tells us (ii. 36), that such, too, was the practice of the Egyptians, and his assertion is confirmed by a considerable number of the existing inscriptions, among which, however, some are found running in the opposite direction, and still more arranged vertically. The Etruscans, it is well known, turned their letters to the left, and there even exist specimens of Latin inscriptions with the same peculiarity. Among the Greeks, there were four modes of writing, one vertical (*κιονιδὸν* or *column wise*), and three horizontal, namely, one with the words running to the left; another, which soon prevailed over the rest, turned towards the right; and a third, in which the direction of the lines alternated, as in the course of a plough, from which idea, inscriptions of this kind are said to be written *βου-στροφη-δὸν*, or *ox-turning-wise*. This last method must have been much more convenient than our present broad sheet of letter-press, in which the eye, on arriving at the end of a line, requires a nice perception of a straight line to hit the commencing point again. The second and third plates give numerous specimens of the Greek alphabet, which are taken chiefly from Boeckh's great work, and the numbers written after the titles at the head of each column refer to the order of the inscriptions in that work.

The several inscriptions which have furnished these alphabets exist in the following forms:—

No. 14. In two flutings of a Doric column brought from the island of Melos, now in the Nanian Museum, but by some scholars much suspected.—No. 15. On a bronze tablet found in 1783 in Italy near Petilia, north of Policastro: it is in the Borgian Museum at Naples.—No. 16. On a vase discovered in a sepulchre near Corinth. (See Dodwell, ii. 196).—No. 17. On a votive helmet found in the Alpheius.—Nos. 18, 19. On a marble, now in the British Museum, No. 199.—No. 20. On a square marble base, near a temple of Apollo, in the island of Delos. (See Turnefort's 'Travels,' t. i. ep. vii. p. 360).—No. 21. On a bronze tablet dug up at Olympia and brought away by Gell in 1813.—No. 22. On a bronze helmet found in 1817, in the ruins of Olympia in the possession of Col. Ross.—Nos. 23, 24. Found at Delphi. (See Dodwell, ii. 509).—No. 25. On a small votive helmet found near

Coptic.

			Name.	Power.
1	Ⲁ	ⲁ	Alpha	a
2	Ⲃ	ⲃ	Bita or Vita	b v
3	Ⲅ	ⲅ	Gamma	g
4	Ⲇ	ⲇ	Dalda	d
5	Ⲉ	ⲉ	Ei	e
6	Ⲋ	ⲋ	So	s
7	Ⲍ	ⲍ	Zita	z
8	Ⲏ	ⲏ	Hita	i
9	Ⲑ	ⲑ	Thita	th
10	Ⲓ	ⲓ	Iauda	i
11	Ⲕ	ⲕ	Kappa	k
12	Ⲗ	ⲗ	Lauda	l
13	Ⲙ	ⲙ	Mi	m
14	Ⲛ	ⲛ	Ni	n
15	Ⲝ	ⲝ	Xi	x
16	Ⲟ	ⲟ	ŏ	o
17	Ⲡ	ⲡ	Pi	p
18	Ⲣ	ⲣ	Ro	r
19	Ⲥ	ⲥ	Sima	s
20	Ⲧ	ⲧ	Tau	t
21	Ⲩ	ⲩ	He	e
22	Ⲫ	ⲫ	Phi	f
23	Ⲭ	ⲭ	Chi	ch
24	Ⲯ	ⲯ	Psi	ps
25	Ⲱ	ⲱ	O	o
26	Ϣ	ϣ	Shei	sh
27	Ϥ	ϥ	Fei	f
28	Ϧ	ϧ	Khei	kh
29	Ϩ	ϩ	Hori	h
30	Ϫ	ϫ	Janja	j
31	Ϭ	ϭ	Shima	sh
32	Ϯ	ϯ	Dhei	dh

Ethiopian or Abyssinian.

		Name.	Power.
1	ሀ	Hoi	ha
2	ለ	Lawi	la
3	ሐ	Haut	ha
4	መ	Mai	ma
5	ሠ	Saut	sa
6	ረ	Res	ra
7	ሰ	Saat	sa
8	ቀ	Kof	ka
9	በ	Bet	ba
10	ተ	Tawi	ta
11	ኀ	Hharm	hha
12	ነ	Nahas	na
13	አ	Alph	a
14	ከ	Caf	ca
15	ወ	Wawe	wa
16	ዐ	Ain	a
17	ዘ	Zai	za
18	የ	Yaman	ya
19	ደ	Dent	da
20	ገ	Gheml	ga
21	ጠ	Tait	tha
22	ጰ	Ppait	ppa
23	ጸ	Tzadi	tza
24	ፀ	Zzappa	zza
25	ፈ	Af	fa
26	ፐ	Psa?*	pa?

Additional Amharic Letters

ሸ	sha
ቸ	tja
ኘ	nja
ኸ	kha
ዠ	ja
ጀ	dja
ጨ	tsha

* The name of the 26th letter, and also its power, seem open to doubt, as the use of the same character in the letters 31—36 appears to imply that it has the sound of *ja*, or something similar. The Ethiopic is a syllabic alphabet, and it has a system of additional marks or modifications of the letters, marking a change of vowel, not unlike the points of the Hebrew. We have not thought it necessary to insert these.—*See* Ludolf.

Moeso Gothic.

		Power.
1	𐌰	a
2	𐌱	b
3	𐌲	g
4	𐌳	d
5	𐌴	e
6	𐍆	f
7	𐌾	g or y
8	𐌷	h
9	𐌹	i
10	𐌺	k
11	𐌻	l
12	𐌼	m
13	𐌽	n
14	𐍉	o
15	𐍀	p
16	𐌵	q
17	𐍂	r
18	𐍃	s
19	𐍄	t
20	𐌸	th
21	𐌿	u
22	𐍈	ew or e
23	𐍅	w
24	𐍇	ch or x
25	𐌶	z

Russian.

	Antient.	Modern.	Name.	Power.
1	А	А	As	a
2	Б	Б	Booke	b
3	В	В	Vadi	v or f
4	Г	Г	Glaghol	gh
5	Д	Д	Dobro	d
6	Є	Е	Yest	e or ye
7	Ж	Ж	Sevetie	g
8	Ѕ	S	Zelo	z?
9	З	З	Zemla	z
10	И	И	Ische	i or e
11	І	і		i or e
12	К	К	Kako	k
13	Л	Л	Liudi	l
14	М	М	Missal	m
15	Н	Н	Nash	n
16	О	О	On	o
17	П	П	Pokoi	p
18	Р	Р	Rtse	r
19	С	С	Slovo	s
20	Т	Т	Twerdo	t
21	Ѵ	У	Eek	oo
22	Ф	Ф	Phert	f
23	Х	Х	Kher	kh
24	Ц	Ц	Tse	ts
25	Ч	Ч	Tscherv	tsch
26	Ш	Ш	Sha	sh
27	Щ	Щ	Stsha	stsh
28	Ъ	Ъ	Yer	
29	Ы	Ы	Yeri	ui
30	Ь	Ь	Yeer	e
31	Ѣ	Ѣ	Yat	ye
32	Є	Э	Kse?	x?
33	Ѯ	Ю	Kse	x
34	Ѱ	Я	Pse	ps
35	Ѳ	Ѳ	Thita	th
36	Ѵ	Ѵ	Ischitze	v

Olympia, in the possession of Col. Leake.—Nos. 27, 28. Part of a hymn to Bacchus inscribed on an altar, which contains also a representation of a procession in honour of the god, in the Pembroke Museum at Wilton.—No. 29. From an epitaph in elegiac verse on those who fell in the first battle before Potidaea, B.C. 432. (Thucydides, i. 62). It was found in the plain of the Academy near Athens, and is now in the British Museum, No. 290. No. 30. The alphabet here given is that which came generally into use at Athens after the archonship of Euclides, 403 B.C. Specimens may be seen in the Elgin marbles of the British Museum, for instance in No. 305, the date of which is said to be 398 B.C.

The column No. 26 is from Mazocchi's folio on the Heraclean tablet. The Codex Alexandrinus, No. 36, is in the British Museum. [ALEXANDRINE CODEX.] The fourth plate relates to the Roman alphabets, including, however, what are often called, but without good reason, Saxon alphabets. These last characters were undoubtedly employed in writing Saxon, but they were the ordinary characters used during the same period for Latin, and were, indeed, thence borrowed for the former language; their identity besides with the preceding Roman letters, is very evident. Such of the Saxon characters as were not common to the Latin are placed below plate 4. The other alphabets have their names affixed, and also the titles and powers of the letters. The Coptic, Russian, Servian, Mœsogothic are evidently derived, with some exceptions, from the Greek; and the same is perhaps true, in a great measure, of the Ethiopic, Illyrian, and Runic.

In passing the eye along the various forms which the several letters have assumed, we shall see a strong similarity running throughout—from the Phenician through the Greek and Etruscan to the Latin; and nearly all the differences which do exist admit of explanation, if a few points be taken into consideration. The form of a letter must, in the first place, depend much upon the nature of the material upon which it is written, and of the instrument employed. On hard substances where incisions are to be made, straight lines will naturally prevail. When the letter is merely painted or inscribed upon a very yielding material, two or more inclined lines are apt to degenerate into

Servian.

No.	Name.	Power.
1	Az	a
2	Buki	b
3	Vide	v
4	Glagole	gh
5	Dobro	d
6	Jest	e
7	Xiujate	x,ch
8	Jalo	—
9	Zemlia	z
10	Yi	i
11	Thita	th
12	Ixe	—
13	Yota	y
14	Kako	k
15	Liudi	l
16	Misljate	m
17	Nasc	n
18	Xi	x
19	On	o
20	Pokoi	p
21	Iscopita	—
22	Reczi	r
23	Slovo	s
24	Tuerdo	t
25	Ypsilcn	y
26	Uk	u
27	Fert	f
28	Hir	h
29	Psi	ps
30	Ot	o
31	Scta	ch
32	Czi	cz
33	Ceru	c
34	Sca	sc
35	Yer	—
36	Ye	ja
37	Ya	ya
38	Ye	ye
39	Yo	yo
40	Yu	you

Illyrian.

(Attributed to St. Jerome.)

No.	Name.	Power.
1	Az	a
2	Buki	b
3	Vide	v
4	Glagole	gh
5	Dobro	d
6	Est	e
7	Xivite	x
8	Zelo	
9	Zemlia	z
10	Ixe	
11	Ii	i
12	Ye	y
13	Kako	k
14	Liudi	l
15	Missile	m
16	Nasc	n
17	On	o
18	Pokoy	p
19	Reczi	r
20	Slovo	s
21	Tuerdo	t
22	Uk	u
23	Fert	f
24	Hir	h
25	Ot	
26	Cha	ch
27	Czi	cz
28	Ciseru	ci
29	Scia	sc
30	Yer	ye
31	Yad	ya
32	Yus	yu

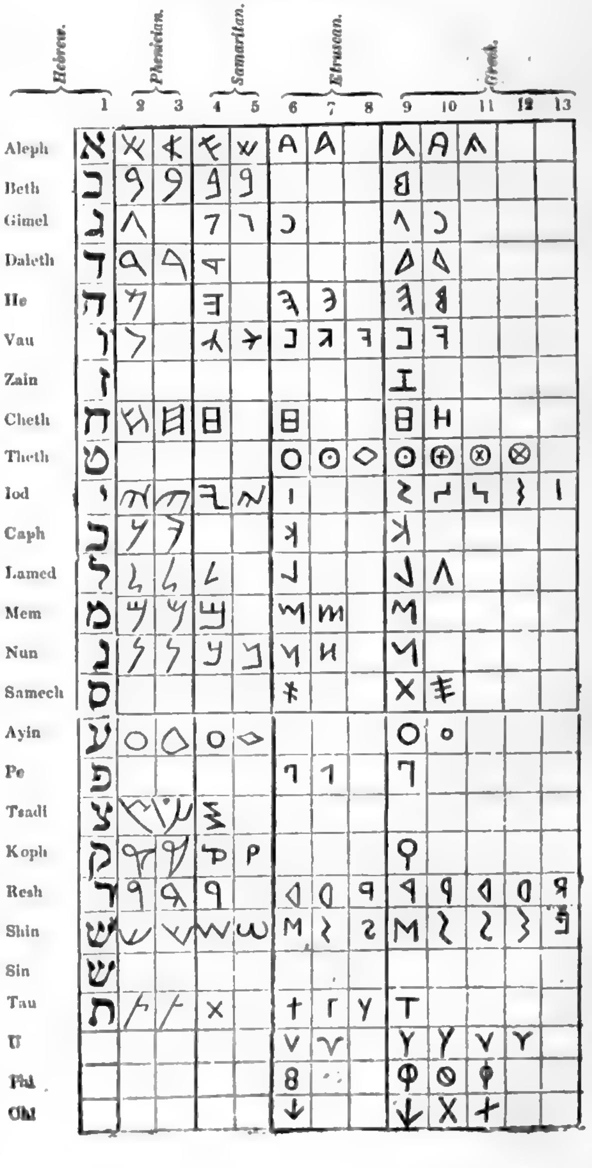
Runic.

No.	Name.	Power
1	Aar	a
2	Biarkan	b
3	Knesol	c
4	Duss	d
5	Stungen-iis	e
6	Fie	f
7	Stungen-kaun	g
8	Hagl	h
9	Iis	i
10	Kaun	k
11	Lagur	l
12	Madur	m
13	Naud	n
14	Oys	o
15	Stungen-birk	p
16		q
17	Ridh	r
18	Sol	s
19	Tyr	t
20	Ur	u
21	Stungen-fie	v,w
22		x
23	Stungen-ur	y
24	Stungen-duss	th

N.B. The names of these letters are also the names of material objects.

PLATE I.

Alphabets from right to left.



a single curve. Compare the forms of γ (the third letter) in columns 16 and 21; of δ (fourth letter) in 21, 23, and the Latin *D*; of ϵ (fifth letter) in 30, 33, and 34; of μ in 30 and 32; of π in 30, and the Roman *P* in 1, 2, 3, 4; of ρ in 20 and 21; of σ in 31, 32, and 33; of our own *u* and *v*, both derived from the same Latin character, &c. Again, in incisions the different lines which constitute a character will be generally of uniform thickness, but when a split reed or quill is employed, the strokes in one direction will be thick, in the other fine. Such has clearly been the origin of the existing Hebrew forms. A principle of corruption, not less powerful, is the desire of rapidity, which is most readily obtained by connecting the different parts of a letter together, so that the whole may be produced by one movement of the instrument, or, more strictly speaking, without raising the instrument from the surface. Thus the ϵ in 30 seems to be made by four separate strokes, such is certainly the case with the Roman letter in column 3; but that in 33 requires only two movements, and that in 34 but one. In the same way may be compared the forms of η in 36 and 37; of ξ in 30, 33, 35; of π in 37 and 38; of τ in 36 and 37, &c. But there may be several ways of effecting this object; a letter moreover may be commenced at different points, and hence arise double or more forms for the same letter, even at the same period: compare β in 37 and 38; ϵ in 34 with our own small running *e*, &c. This principle of rapidity carried a step farther leads to the connection of successive letters. In this way are formed what are called the cursive letters, which run on in continuous succession. Such modes of writing were no doubt common in very early times; and, as regards the Romans, we are not left to mere conjecture, as the British Museum contains an inscription of the kind on papyrus, which is referred to the second or third century. Lastly, a fanciful love of variety shows itself in all the works of man, and in none more than the arbitrary variations of letters, particularly those at the beginning and end of words. These several causes of change were more active, when nearly all writings were produced by the pens of individual writers. In modern times, the art of printing has tended strongly to create a unity of form, and will be the best protection against future change.

Having spoken thus generally of the alphabets given in the four plates, we will now remark upon each character in succession.

Of the letter A, one of the oldest forms, it appears to us, is in columns 10, 25, or 3. The greater part of the other forms arise from the different inclinations of the cross stroke, which in 7 runs from the extremity of one of the main strokes, and in 2, 4, and 11 is too much inclined even to meet the opposite side. No. 2 again is a mean between 4 and 1, and shows how the Hebrew form has originated. There was also an old Italian form of this vowel, which may be described as formed from the Π in 31, with a diagonal line running from the lower extremity on the right to the opposite angle; it was in fact the character in 14 or 16, with a square instead of a round or pointed top.—Of B it need only be remarked, that the Samaritan and Phenician

PLATE II.

Greek Alphabets.

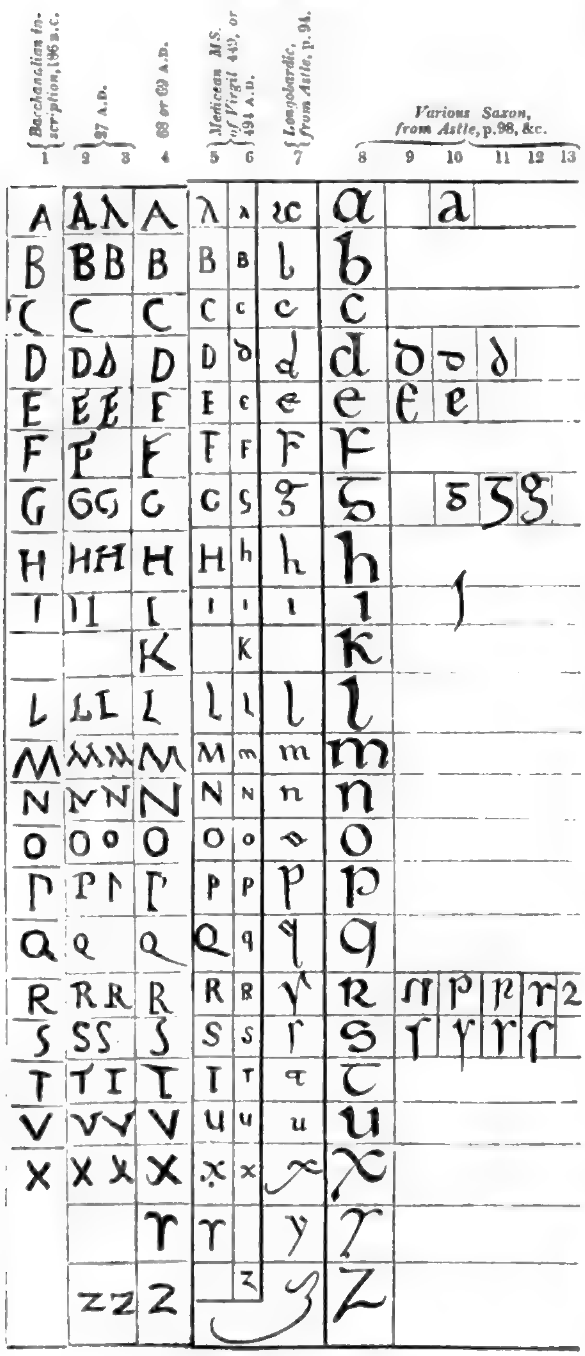
PLATE III.

Greek Alphabets continued.

forms show the progress of degradation between the Greek and the corrupted Hebrew. The forms of Γ are chiefly remarkable for the different positions of the angle which constitute the letter. The round form in 6, 10, and 16, is also found in the coins of the cities Gela, Agrigentum, and Regium. The third letter of the Latin alphabet has this form, and once possessed the same power. Hence, the oldest orthography of that language presents *macistratus*, *leciones*, for *magistratus*, *legiones*, and it is known that the common name *Caius* was pronounced *Gaius*, and indeed was so written by the Greeks. The form of the Hebrew *daleth* may be traced through the Samaritan from the Greek, in precisely the same way as the *beth*. The difference between the Samaritan or Phenician letters for *daleth* and those for

Plate IV.

Roman Letters.



Additional Saxon Letters.

ð dh; þ th; ƿ w.

beth consists solely in the lower stroke thrown out by the latter from the perpendicular, and the same is the case with the Hebrew letters; in both, the triangular or circular top has degenerated into a thick line.—The form of E in 10 is very anomalous and very rare. Of the other forms the Samaritan is again purer than the Hebrew. The next letter has been the subject of much controversy. The form in 8, 10, and 15, may perhaps be considered as the parent of all the rest; and again the Phenician has the advantage over the Hebrew, the form in 2 being intermediate between 4 and 1. The *zain* bears a faint resemblance to ζ of No. 9, which is the oldest form of that Greek letter, and from which the late forms are derived, upon the simple principle above mentioned, of completing a letter at one movement, and therefore substituting the diagonal stroke for the perpendicular.

The next letter has gone through violent changes, both in form and power. Its original power seems to have been a guttural *ch*, which would naturally wear away into an ordinary aspirate; or perhaps more correctly it may be stated, that its first power, as in the other letters, was syllabic, namely, *che*, which became *he*, and in the Greek language eventually only *e*. The two Hebrew names of the letters, *cheth*, *heth*, and the Greek form *eta*, all bear evidence in favour of such a supposition, and it would be difficult otherwise to account for the singular fact, that the same character H was at one time the Greek representative of an aspirate, afterwards of an initial *he*, and finally of a long *e*. In No. 26 of Plate II. H is the long vowel ē, and so in 30 of Plate III. and those which follow. In all the others which precede, it is an aspirated consonant. With regard to the various forms, the character in 3, 4, 6, 9, 22 being supposed to be the purest, No. 2 is half-way between the Hebrew on the one hand, and 18 on the other. But the Greek form did not stop here. When the letter H was appropriated as a vowel, the aspirate gradually lost its second pillar, until at last it appeared in the first of the two forms given in the Heraclean tablet, the second in that column being, as we have just stated, the representative of the long vowel. This form of the aspirate appears in many manuscripts above the initial letter of the word, but was eventually further corrupted into a mere comma, thus (ʽ). There exists, it should be stated, a story, that the Greeks derived their aspirate in a mode somewhat different from the above statement. The letter H, we are told, was cut into two parts, each consisting of a pillar and half the cross stroke; the first half being employed as an aspirate, the second as what they call a soft breathing, by which is meant simply the absence of an aspirate. A character to denote the absence of a sound is, it has been justly remarked, something new in alphabetic writing; and in fact it is now a common belief, that the soft breathing and its supposed representative are the mere creation of grammarians: at any rate, the supposed character for the soft breathing is found in no inscription whatever, and in no manuscript of any antiquity.—Of the next letter it need only be stated, that the Hebrew character is generally considered by modern Hebraists as a mere T, and it is often called *teth*.—Of the *iod* the Samaritan form seems even more perfect than the Greek in 9, 10, 11, 14, 15, 16, 17. The third of these, however, bears a close affinity to the Hebrew. The forms in 12 and 16 are gradually approaching the straight line, which afterwards prevailed.—The *kappa* in 21 is a mean between the more perfect in No. 9 and the Hebrew *caph*.—The next letter has a great uniformity throughout, the chief difference turning upon the different position of the angle as in the *gamma*; but it may be observed, that the forms in 27 and 28 closely approximate to the Phenician and Hebrew in 1, 2, 3.—Of μ and ν we have spoken before.—The *samech* and Greek ξ present many difficulties. Their forms, in the first place, have no similarity; the Greek letter is rarely met with in old inscriptions, as it was common to employ in its place the χ and σ, as may be seen in 23 and 29 (the $\kappa\sigma$ in the Nanian column is open to much suspicion.) The X given in 9, though found in Greek, is more common in Latin; yet even in this language the old inscriptions generally have XS, rather than X alone; so that it would seem that here, too, the X had originally the power of the Greek χ. The reason why the Greeks generally wrote XΣ rather than ΚΣ or ΓΣ, was most probably because the letter *sigma* has something of the nature of an aspirate, as Payne Knight contends. Upon the same principle they wrote ΦΣ for Ψ, not ΠΣ. (Column 29.)—The letter *ayin* is the subject of controversy, some calling it a nasal consonant, others a guttural, others a vowel *o*. The first and third assertions seem more at variance than they really are, for the close connection between the two sounds *n* and *o* is well marked in the Portuguese tongue in the pronunciation of such words as João, the representative of our John or Johann. The Romans, too, thought it enough to write Plato, where the Greeks wrote Platon. Lastly, if the vowel and liquid scales that have been given above be applied to one another, it will be found that the liquid *n* ought to have an affinity to the vowels *o* and *a*,* in the same way that the lip liquid *m* is related to *u* and *w*, and the palatal *l* (witness the *mouillé* sound of the French *ll*) to *y*, *i*, and *e*.—But, to proceed, the Hebrew *pe* has, it has already been observed, a stroke at the bottom which appears to have something of the nature of a flourish. Remove it, and the identity of the remainder with the Greek is self-apparent. The difference between the Greek Π and the Roman

* The connection between *a* and the final nasals is exhibited in the Ionic plurals of passive verbs, the double form of the accusatives of the third declension, and the Greek numerals δέκα, ἑπτα &c., compared with the Latin.

P is chiefly due to modern printers. The Greek had almost invariably its second leg much shorter than the first, and the Roman P very rarely had the circular bend completed so as to reach the main shaft. See the plates, and, above all, compare the Etruscan P in 7 with the Roman P in IV. 3.—The letter *tsadi* has no representative in the Greek alphabet, unless, indeed, it bear any relation to the Greek figure called *sanpi*, which, however, was never used, as far as it is known, for an alphabetic character; and secondly, even as a numeral, it does not occupy the place between π and *koppa*.—In the *koppa*, the Hebrew, or perhaps rather the Phenician, has a fuller and a more perfect form than the Greek; but be this as it may, the connection between them requires no comment.—If the ρ in 9 or 11 be the earliest form, the derivation of the rest is simple. The Hebrew has suffered the same injury as in *beth* and *daleth*, a comparison with which will remove all doubt. In 3, 13, and more fully in 22, 24, 27, we see the origin of the Roman *r*.—The original form of *shin* was perhaps as near the Hebrew as any of our characters; but, in fact, the difference between the *shin* in 1 and 4, and the Greek *sigma* in 9, 14, 15, 16, 17, 26, &c., or the Etruscan in 6, depends solely upon the altered position. The relative situation of the several strokes among each other is the same in both.—The next letter, *sin*, should perhaps have been omitted, as the difference between the power of *sin* and *shin* arises solely from the position of the point, which is near the right tooth in *shin*, near the left in *sin*. So completely are the two characters one in their origin, that they stand for the same number in the series of Hebrew letters.—The T in 6 would be a fit and proper parent for all the other forms. In the three characters, 1, 2, 3, 7, 8, the cross stroke has had an unfair preponderance to one side, as is the case again in our modern small character. In the Hebrew a little flourish has added to the difference.—The next letter, it has been already observed, seems to have grown out of the *ayin*. Its forms vary, but not unintelligibly. The modern *u* and *v* are, it has been already said, both derived from the Latin form, which had the double power of our consonant *w*, and our vowel *u*.—With regard to φ and χ, we find in 14 the double forms used before they were adopted; but unhappily the genuineness of this inscription is doubted.—Of the ψ, mention has been already made.—Ω brings us to the close; and it may be sufficient to observe, that among the forms given to this letter by Mionnet, in his work on ancient coins, one consists of an ordinary *o* lying upon a horizontal straight line. This has led to the notion that the letter was thus originally formed to mark a long ō, and, in confirmation of this notion, the letter H, as written in No. 9, was appealed to, which it was contended was formed in like manner from the letter E, with a perpendicular stroke on the right. The form of ω, in 32, would appear to be made up of the letter *ayin* or *o* repeated, precisely as our own *w* has its form as well as name from a repetition of *u* or *v*. The letter ω as well as η were not used in public documents at Athens until the year 403 B. C., when Euclid was Archon, but it must not be supposed that the letters were then invented, for, as Payne Knight has observed, the ω appears on the coins of Gelon, who died 478 B. C., and the η on very ancient coins of the Regians. Still in early times it was the ordinary practice to use *o* and ε for both long and short vowels.

In forming a table of the real Roman characters, there is some difficulty from the circumstance, that nearly all those who report ancient inscriptions take the liberty of using modern characters. Of those given in plate 4, the first is from the fac-simile of the Baccanalian inscription given by Drakenborch in the seventh volume of his 'Livy;' the date of which is fixed at 186 B. C., by the names of the consuls given in the decree. This inscription is in the Cæsarean Museum at Vienna. The second and third columns are from an inscription given by Maffei, in his 'Istoria Diplomatica,' p. 38, and here the date is fixed to the year 27 A. D., in the reign of Tiberius, by the names of the consuls, M. Crassus Frugi, L. Calpurnius Piso. Column 4 is from the same work of Maffei, p. 31, and belongs to the year 68 or 69, as is determined by the mention of the Emperor Galba. Both these inscriptions are of very coarse execution. Fac-similes of some very ancient inscriptions are also to be seen in the works on Herculaneum and in Muratori. The characters of the Medicean manuscript of Virgil, preserved at Florence, are taken from Burmann's engraved specimen, in the first volume of his edition of that author, p. xxxvi. of the preface. The remaining alphabets of that plate are from Astle's 'Origin of Writing.' The separate alphabets, beginning with the Coptic and ending with the Runic, are chiefly from the French 'Encyclopædia.'

The Roman alphabet requires but little comment. It has been seen how completely it agrees with the Greek. In the order of the letters the only violent difference consists in the insertion of the G after F, but what place could be better suited to it than the position of Z, a character which had no correlative in the Latin series? Our modern grammars, indeed, give both *y* and *z*, but Suetonius tells us indirectly that the Roman alphabet terminated at *x*, for the Emperor Augustus, he observes, employed a peculiar cypher in his papers. For the letter *a* he wrote *b*; for *b*, *c*; and so on, until for *x* he wrote *a* or *aa*. Some commentators, indeed, scandalised at the ignorance of Suetonius in not knowing his own A, B, C, have substituted *z* for *x* in the above passage. But, in fact, there is not a single Latin word that contains either *y* or *z*. Modern printers have further increased the Latin alphabet by giving in two instances double characters where the Romans had but one. The letter I of the Romans, besides its power as a vowel, represented also the closely-allied sound of our consonant Y, or the German J. When it is used with this consonantal power, modern printers have taken the liberty of substituting the character J, and modern readers have aggravated the error by giving it the sound of that English letter. Thus the Latin word IVGVM is now printed and pronounced *jugum*, instead of *iugum* or *yugum*, so as to destroy the close similarity of the word to the corresponding English term, *yoke*. Again, the Roman letter represented by *v* in inscriptions, and by *u* in the round form of manuscripts, has suffered the same fate. As a vowel, it has *u* for its character in modern books of Latin. But the Romans, as we have already stated, also employed it as a consonant, equivalent to our *w*. In this case the printer has preferred the sharp form *v*, which has again misled the modern reader as to the sound. When pronounced correctly, the Latin words *vespa, vastare, ventus*, bear a close analogy to our own terms *wasp*, to *waste, wind*. The letter K, though it became unnecessary when the third character was changed from a *gamma* to C, is a genuine member of the Roman alphabet, though often excluded from school grammars. What we have said leads to the result that the Roman alphabet had twenty-one letters, and this number agrees with the statement in Cicero ('Nat. Deor.' ii., 37 or 93).

It would be rather an amusing subject of inquiry, to trace to their source the remarkable differences in the magnitude of our modern small characters, some rising above, others descending below the general line. The first attempts of certain letters to shoot out into an undue extent may be seen in several parts of Plate IV., and we will leave the development to any reader who may be disposed to pursue it. It is but right to state further that the remarks we have made, and the alphabets we have given, are by no means sufficient to enable any one to read ancient manuscripts. Independently of the varying forms of letters, there are numberless contractions, which can only be learned by long practice.

ALPHONSINE TABLES. [ALONSINE.]

AL-SIRAT (that is, literally, 'The Path'), in the theology of some of the Mohammedans, is the name of a bridge extending over the abyss of hell, which must be passed by every one in order to enter paradise. It is described as being narrow, like the edge of a sword. Some, it is said, will pass it with the rapidity of lightning, others with the swiftness of a horse at full gallop, others like a horse at a slow pace, others still slower, on account of the weight of their sins, and some will fall down from it, and be precipitated into hell.

ALT, in music (from the Latin *altus*, high), that part of the scale beginning with F, the fifth line in the treble clef, and ending at E, the third leger, or additional, line above the same clef.

ALTA, in music (Italian 'high'), generally used in addition to the word ottava, as 'ottava alta,' an octave higher; 'più,' more, being by custom omitted.

ALTAR, an erection to offer sacrifice upon. The first altar mentioned is that set up by Noah, to offer sacrifice when he quitted the ark; and throughout the history of the Jewish patriarchs, altars are continually said to have been erected by them, in different places, as circumstances rendered it expedient. These seem to have been built of earth, or unhewn stone, like the altars which God commanded Moses to raise: *Exod.* xx. 24, 25. But when the Jewish law was given, the right of raising altars and offering sacrifice was no longer left common to all men; but one altar of burnt-offering, at which alone victims were slain, was made for the whole nation, and the priests, as ministers for the nation, offered sacrifice upon it for all. This in the first instance was constructed of wood, covered with brass, and always followed the ark, while the ark was migratory; but when Solomon built the temple, he placed a stone altar, with a brazen hearth, in the court before it. The Jews had two other altars, one solely appropriated to burning incense, called the altar of incense; the other called the altar of shew-bread, because loaves were placed upon it, and changed every Sabbath; which stood in the interior of the temple.

We constantly meet in the Bible with the expression of the 'horns of the altar.' Some suppose that these were really the horns of animals; others that they were merely projections at the corners. One use of them is obvious: victims might be conveniently bound to them. *Psalm* cxviii. 27. But horns were an emblem of power and authority throughout the east; and probably they were also meant to indicate the greatness of him to whom the altar was sacred. The altars of the Greeks and Romans had sometimes horns also, to which animals were fastened, and to which those who fled thither for protection used to cling. It was an act of impiety to force such persons away. This belief in the sanctity of places was adopted by the Roman Catholic Church, which, in the season of its temporal power, largely bestowed the privilege of sanctuary upon favourite churches and convents. [ASYLUM.]

A sort of natural religion seems to have pointed out the tops of hills and groves, as the fittest spots for altars. The pagan nations which surrounded the Jews were especially addicted to worshipping in high places; and it was hardly possible to prevent the Jews themselves from falling into this habit. "They also built them high places, and images, and groves, on every high hill, and under every green tree." 1 *Kings* xiv. 23. Passages of the same import occur continually in the Jewish Chronicles. The northern nations of ancient Europe worshipped in the thickest shade of their forests. The ancient Persians, as Herodotus tells us (I. 131), made no temples, nor statues, nor altars, but worshipped the deity on the tops of the mountains.

The altars of the Greeks were of three sorts: those dedicated to the heavenly gods (βωμὸς), were often structures of considerable height; those of demi-gods and heroes were low and near the ground (ἐσχάρα); and those of the infernal deities (if such may be called altars) were trenches sunk in the ground (βόθρος, λάκκος). They may again be divided into three classes, those for burnt-offerings (ἔμπυρος): those on which no fire was used, which were (ἄπυροι), meant for offerings of fruit, meal-cakes, &c.; and those on which fire might be used to consume vegetable productions, but no blood was spilled (ἀναίμακτοι), the altar: when dedicated to either of the latter classes, it was often nothing more than a raised hearth or step. Each temple usually had two altars, one in the open air before it, for burnt-offerings; another before the statue of the god to whom the building was sacred. Altars were often erected where there was no temple. The Greek altars were usually square, sometimes circular, or triangular. They were often made of marble, and elegantly sculptured.

The Roman altars and rites of worship much resemble the Greek. We must distinguish between *altare* and *ara*. The former, as is indicated by the syllable *alt*, signifying high, was an elevated structure, used only for burnt-offerings, and dedicated to none but the heavenly gods: the latter might belong either to the heavenly, or infernal gods, or to heroes. The Romans, however, like the Greeks, dug trenches (*scrobes*), into which they poured libations to the infernal gods. *Ara* seems to be the general term, and is used by Virgil as including *altare*;

En quatuor aras,
Ecce duo tibi Daphni, duoque altaria Phœbo.—*Ecl.* v. 65.

From *altare* comes the English word altar, which by the Roman Catholic church is used in its proper sense, to denote an erection on which sacrifice is offered, it being their doctrine that the mass is a sacrifice. Applied to the communion-table of an English Protestant church, the word is used metaphorically, or rather is misplaced; for the English church teaches the sacrament of the Lord's Supper to be no sacrifice, but merely a symbol. Altars were in England taken down, and wooden tables substituted, by royal command at the bishop's visitations in 1550; again set up at the commencement of the reign of Mary, and finally removed at the beginning of the reign of Elizabeth. Several of them, however, which escaped destruction, still remain in churches in various parts of England, and some of them are fine examples of the art of the period.

ALTAR-PIECE. We are accustomed in this country to give the name of Altar-piece only to paintings on sacred subjects placed over the altar at churches; but in earlier times the same name was given to small elaborately worked productions in gold and silver, and other metals, connected with the offices of religion. The exhibition of Mediæval Art at the rooms of the Society of Arts in 1850 contained many such specimens, in which much skill was often shown both by the artist and the artificer. One was an altar-piece of silver, partly gilt, enriched with scrolls and garlands, and enclosing enamels and gems.

ALTERATIVES, a word signifying 'things that produce a change.' Under this head are comprehended those medicines which do not produce any immediate or very perceptible effect, but which gradually bring the body from a diseased to a more healthy state. They seem to act in removing unhealthy conditions of the system, much in the same way that a drop of water hollows a stone, not by its violence, but by frequently falling. They are generally given in small and frequent doses, and, even when given in large doses, they are often repeated. The former mode of administering them is employed when they are powerful medicines, the latter when less active. Out of almost every class of medicines some one may be used as an alterative—its claim to be so regarded depending less upon its natural powers than upon the manner in which these are modified, so as to effect a particular purpose. Thus by diminishing the dose, or combining them with other medicines, some of the most powerful drugs we possess are capable of being employed as alteratives, and made to produce effects exactly opposite to what they do when given alone, or in large doses. Ten grains of ipecacuanha, for example, taken with some fluid into the stomach, will speedily cause a feeling of sickness, followed by vomiting—three or four grains will cause a feeling of sickness and loss of appetite, though not actual vomiting—while one-quarter or one-half a grain taken about an hour before each meal for several days in succession, will be found greatly to increase the appetite, and improve the digestion. Yet even ten grains of ipecacuanha, if taken along with two of opium, will not produce any obvious effect on the stomach, but, if the patient be kept warm in bed, will cause a profuse flow of perspiration.

Many of the forms or preparations of mercury, even the most active and poisonous, when given in very small doses, neither prove purgative nor destructive to life, but, on the contrary, often produce signal benefit, relieving the patient from many complaints which rendered his days miserable, or even threatened to shorten them. Nor is the most dreaded of the mineral poisons—arsenic itself—incapable of contributing to the restoration of health, since we see it now make the shivering ague cease, and at another time cause the agonising headache to depart.

Others which are less active may be given in very large doses, as sarsaparilla, and similar articles.

The variety of agents which may be used as alteratives must convince us that they cannot all act in the same way, and that their beneficial effects cannot be attributed to the same cause. Most of them appear to act upon the secretions and excretions—either by increasing their quantity or altering their quality. In many parts of the body, but particularly along the course of the alimentary canal, are situated glands, the duty of which is to elaborate from the blood certain fluids containing salts and other principles, which are primarily useful in keeping moist the surfaces over which they flow, and often secondarily useful in effecting changes in the matters with which they come in contact, as the saliva with the food, as soon as it is received into the mouth, and the bile with the chyle, upon its passage out of the stomach. These, then, are secretions. The kidneys and skin are organs by which fluids are separated from the blood, serving as vehicles for the removal from the system of salts and other principles no longer useful, the retention and accumulation of which would soon prove hurtful, and ultimately fatal. These are termed excretions:—that of the kidneys being of no primary or secondary use, while that of the skin keeps this covering moist and pliant,—states necessary for its answering the objects of its existence.

The preservation of a due proportion in the quality and quantity of these secretions and excretions is essential to the maintenance of that equilibrium, that fair and equal, or harmonising play of all the organs of the body, when, feeling no weight or oppression in any part, a man readily says he *is well*. The disturbance of this balance gives rise to various degrees of uneasiness and ill-health; states to which the French apply the expressive term—*malaise*.

The functions of secretion and excretion being rather vital than chemical processes, they are greatly dependent upon the state of the nervous system. This, again, is only perfect when the blood is of a proper quality; and this last is beholden for its excellence to the thorough performance of digestion, for which a due supply of nervous energy is required.

As all these functions act and re-act upon each other, it matters but little which of them is the first to fail in contributing its part to the general welfare, as all in time suffer; but the functions of secretion and excretion, perhaps, soonest show a falling off, and soonest attract the attention of the patient. He awakes with a dry tongue, and observes that the secretion from the kidneys is less in quantity and more highly coloured than natural, or excessive in quantity and pale, or he perceives that the skin is dry and harsh, or bloated.

To remedy these states, alteratives are often employed. Small doses of some mercurial, alone, at night, or with rhubarb and soda during the day, or small quantities of ipecacuanha, will often relieve the dryness of the mouth. A little common salt taken immediately on waking will also remove it. With this view a little bacon has often been recommended at breakfast—the benefit being due to the salt, not the bacon.

The removal of the depraved and unhealthy secretions from the intestinal canal, where they are apt to linger, causing uneasiness to the patient, and by the unpleasantness of his breath rendering his presence disagreeable to others, is best effected by a course of gentle purgatives. The frequent repetition of too powerful purgatives is to be reprobated, as often occasioning disease of the inner coats of the alimentary canal. After these, some strengthening medicine, as bark or iron, will generally be useful, especially if the nervous system be out of order, owing to much mental exertion, or protracted night-watching. At this stage of the treament, exercise and travelling, change of scene and pursuit, are of much service; or a visit to some watering-place; for the mineral springs, having the saline ingredients very minutely divided, may be considered as nature's alteratives.

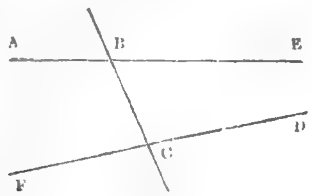
Where the skin is much affected, exercise of a regulated kind, such as that practised by trainers, may prove useful, as the diet is at the same time strictly attended to. Indeed, a partial or complete change of diet is often the most effectual alterative we can employ.

But neither medicines nor a strict plan of diet should be begun or continued without the advice of a competent judge. It is in such cases that persons are most apt to undertake the cure of their own complaints, and, either by using inefficient means, allow them to get rooted in the system—or, by employing the *nostrums* and secret, but often dangerous, combinations of *quacks*, become a prey, in their purses and persons, to ignorance and fraud.

The explanation of the functions of the system, and the action of remedies, already given and hereafter to be given in this work, are by no means intended to enable the patient to dispense with the assistance of his medical attendant, but to prepare him to receive the full benefit of that assistance, by enabling him to understand something of the principles on which his treatment is conducted, and thereby to teach him how he may co-operate with his physician in rendering it effectual.

ALTE'RNATE. In geometry, angles are said to be alternate which are made by two lines with a third, on opposite sides of it, as A B C and

B C D, or E B C and B C F. If two lines be parallel, the alternate angles made by a third line with them are equal.



In algebra, those terms of a proportion are said to be alternate which are separated from one another by another term; thus, in the proportion

2 is to 4 as 8 is to 16,

2 and 8 are alternate terms, as also 4 and 16. If alternate terms be rendered consecutive, and consecutive terms alternate, the proportion still continues; thus,

2 is to 8 as 4 is to 16.

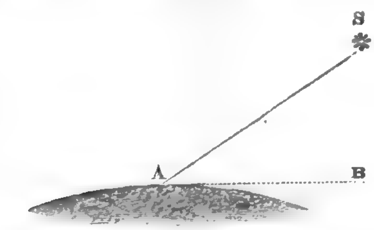
This proposition is the sixteenth of the fifth Book of Euclid, and is referred to by the Latin word *alternando*, or by the English words 'by alternation,' or 'alternately.'

ALTHIONIC ACID (HO, $C_4H_5S_2O_7$?) is produced when oil of vitriol in great excess is heated with alcohol until olefiant gas begins to be evolved. It has the same composition as sulphovinic acid, but its compounds differ in crystalline form. It is highly probable that the althionates are compounds of the sulphovinates and isethionates.

ALTIMETER is the name which the Rev. E. L. Berthon gave to a measuring instrument patented by him in 1850. It is a somewhat complicated contrivance, intended to measure the altitude of the sun, moon, or a star. There are two glass bulbs, one containing mercury and the other spirit, and placed in connexion with each other by vertical and horizontal tubes. A telescope is attached, through which the object is viewed. The vertical tubes are graduated; and the heights at which the two fluids adjust themselves in these tubes, when the telescope is directed obliquely upwards, is made to indicate the altitude or angle of elevation of the object viewed, by a particular arrangement of the several parts.

ALTISSIMO, in Music, is the scale which commences with F, the octave above the fifth line in the treble.

ALTITUDE, from the Latin *altus, high*, may be rendered by the English word *height*. This being the case, we should have referred it to the English word, if the term were not particularly reserved in astronomy to signify, not the *length*, but the *angle* of elevation. Thus, if A be the position of a spectator on the earth, and A B the line on the



horizon, which is drawn towards the point directly under the star S, the angle B A S is the altitude of the star. For other less common applications of the term, see HEIGHTS.

The altitude of the pole is the geographical latitude of the place of observation, and remains the same throughout the twenty-four hours: the altitudes of the stars and sun change with the diurnal motion; being nothing when they rise and set, and greatest when they are on the meridian.

The altitude of a star is directly observed at sea with the SEXTANT; and the uses which are made of such observations may be seen in the following mathematical propositions, into the proofs of which we cannot enter here.

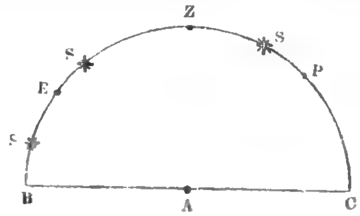
1. When the latitude of the place is known, the time of day may be found from one observation of the altitude of the sun or a star; or conversely, if the time of day be known, the latitude may be found from the observation.

2. When neither the time nor the latitude is known, both may be found by observing any two altitudes of the sun or a star, and noting the time which elapses between the observations; but it is most convenient to observe one altitude first, before a star comes to the meridian, and then wait for the time when the same star comes to the same altitude on the other side of the meridian. Or if the latitude be very nearly known, a more accurate approximation may be simply made by the above method.

3. If the star be one of those which never sets, the latitude of the place is the half sum of its greatest and least altitudes.

In all that precedes, it is supposed that the star is *known*,—that is, that its right ascension and declination are known; and certain corrections must be applied to the observed altitude, for which see DIP; PARALLAX; REFRACTION.

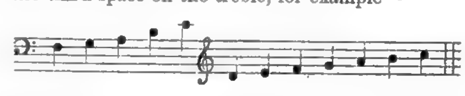
In fixed observatories on land, the altitude of stars, or rather their zenith distances, which are what the altitudes want of ninety degrees, are observed with the mural or the transit circle [CIRCLE, ASTRONOMICAL; TRANSIT]; but only when the stars are on the meridian. Let A be



the place of the observer, C and B the north and south points of his horizon, P the north pole, Z the zenith, C P Z B the meridian, arcs of which may be made to represent angles at A, and S the star on the meridian, whose altitude, B S, or C S, according as it is south or north of the zenith, or its *complement*, the zenith distance, Z S, has been observed. Then, E being a point in the equator, and P E being equal to Z C, both being ninety degrees, take away the common part Z P, and E Z is equal to P C, the latitude of the place. And E S, or the star's declination, is E Z diminished by Z S, if the star passes the meridian above E, or Z S diminished by E Z, if the star passes below E. If the star passes between the zenith and the pole, the declination E S is the sum of E Z and Z S. That is, the declination of a star is the difference between its observed zenith distance and the latitude of the place, if the star passes south of the zenith, or the sum of the same quantities, if it passes between the zenith and the pole. In the first case the declination is *north*, if the latitude be greater than the zenith distance; *south*, if the zenith distance be greater than the latitude: in the second case, it is always north.

In this way, with a number of minute precautions for the sake of accuracy, catalogues of the declinations of stars are formed, by observation of their altitudes, or, which amounts to the same thing, of their zenith distances.

ALTO, in Music, is the highest natural adult male voice, or countertenor, the usual compass of which is, from F the fourth line in the bass, to C the third space on the treble, for example—



Alto is also one name of the instrument called in England the tenor, and in Italy the viola.

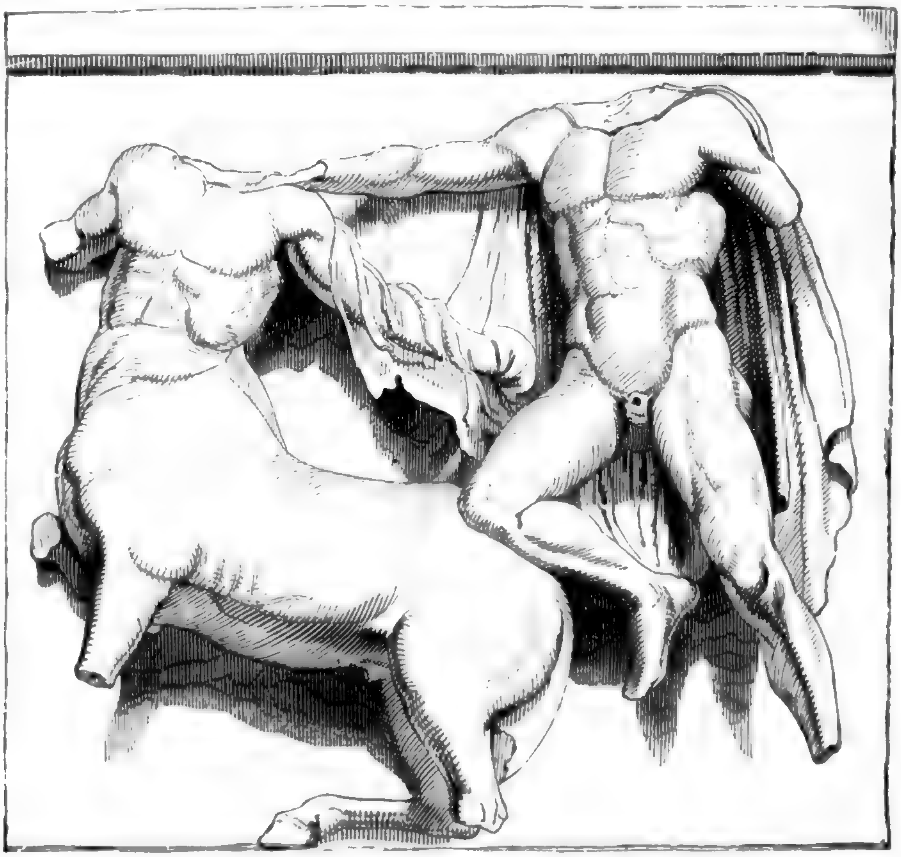
ALTO CLEF, in Music, a name of the C clef, when placed on the third line; more commonly, in England, called the countertenor clef. [CLEF.]

ALTO-RILIEVO, BASSO-RILIEVO, MEZZO-RILIEVO. The Italian term alto-rilievo is commonly applied to any work of sculpture connected more or less with a plane surface or back-ground, and in this general sense is opposed to insulated detached figures, or sculpture in the round. In its more particular meaning, alto-rilievo, or high relief, is usually appropriated to figures which are not only rounded to the full bulk, but have generally some portions of the figures quite detached. Basso-rilievo, low or flat relief, on the other hand, has only a very slight projection from the ground; and mezzo-rilievo (a style between the two), although sometimes rounded to a considerable bulk, has no part entirely unconnected with the plane surface or ground. A more accurate definition of the styles to which these designations refer will result from the explanations that follow. The terms used by the Greeks and Romans to distinguish these kinds of relief cannot perhaps be determined with complete accuracy; and it may be here remarked, that those writers are mistaken who suppose the word *Toreútike* (*τορευτική*) to have been applied by the Greeks exclusively to alto-rilievo, since Heyne, and indeed other writers before him, have proved that the term was appropriated to carving, and chiefly chasing in metal, in any kind of relief. The Latin word corresponding with it is *cælatura*. The Greeks seem to have employed the term *anaglypta* to denote works in relief in general; and the *ectypa sculptura* of Pliny (xxxvii. 10) also means work in relief. The term *glypta* (from *γλύφω, to cut into, to hollow out*), with other words formed from the same verb, appears to denote sculpture in the concave sense, intaglio. Herodotus, in a passage of his second book (cap. 138), where we have little doubt that he is speaking of the sunk Egyptian reliefs (which will be mentioned in another part of this article), couples a word formed from the verb (*γλύφω* with the word typus (*τύπος*): typus itself (perhaps) always means a work in relief properly so called. (See Herod. iii. 88; Cicero ad Atticum, i. 10.) Italian writers of the time of Vasari, it appears, used the term mezzo-rilievo for the highest relief, basso-rilievo for the less prominent, and *stiacciato* for the flattest or least raised. Whatever the origin of this kind of sculpture may have been, and there is no doubt of its being very ancient, an idea will be best formed of its style, as practised by the Greeks, by supposing it to be derived from the partial insertion of a statue in a perpendicular plane. Alto-rilievo is often literally nothing more than this. Applied however to a flat surface, the disposition of the limbs and the actions of the figure become necessarily more or less parallel with that surface, in order sufficiently to adhere to it. The attitude is thus, in a certain degree, adapted or selected. In inserting or embedding a figure in a flat ground, it is obvious, that although it may be buried *less* than half its thickness, as in alto-rilievo, it cannot be buried *more*, nor indeed (the structure of the figure strictly considered) quite so much, without ceasing to present the real boundary or profile of the form. In the less prominent kinds of rilievo it is therefore still required that the outline should present the real form, and this principle in its further application excludes, in a great measure, the *unreal* forms of perspective and foreshortening, which would suppose that the objects are no longer parallel with the surface on which they are displayed. Attempts at foreshortening must in most cases fail to satisfy the eye. The work can only be seen in front, and the appearance it presents is therefore required to be at once intelligible, for no uncertainty can be removed by an inspection from another point of view, as in walking round a statue. The bulk, or thickness, need not however be real, provided it appear so. The compression of the bulk, which constitutes the various degrees of mezzo- and basso-rilievo, thus follows the compression or flattening of the action, the characteristic of alto-rilievo. Lastly, the modifications of which this branch of sculpture was susceptible, were adopted, as we shall see, according to the varieties of light, situation, dimensions, and use.

The Greeks, as a general principle, considered the ground of figures in relief to be the real wall, or whatever the solid plane might be, and not to represent air as if it was a picture. The art with them was thus rather the union of sculpture with architecture than a union of sculpture with the conditions of painting. That this was founded on the most rational principles will be evident from a few simple considerations. The shadows thrown by figures on the surface from which they project at once betray the solidity of that surface. In the attempt to represent, together with actual projection, the apparent depth of a picture, or to imitate space, figures which are supposed to be remote are reduced in size; but although thus diminished in form, they cannot have the strength of their light and shade diminished, and if deprived of shadow by inconsiderable relief, they cease to be apparent at all when the work is seen from its proper point of view—that is, at a sufficient distance; having no distinctness whatever in the absence of colour, but by means of light and shade. In short, the art, thus practised, has no longer an independent style, and only betrays its inferiority by presenting defects which another mode of imitation can supply. A passage in Vitruvius proves that the ancients were not unacquainted with perspective; and the same author states that perspective scenic decorations were first employed by Agatharcus at Athens, in the time of Æschylus. However greatly the science may have been advanced by the moderns, this may be sufficient to prove that the absence of perspective in Greek bassi-rilievi was not from an absolute ignorance of its principles, but from a conviction that they would be misapplied in sculpture.

In carefully keeping within the limits, however narrow, which defined the style of rilievo, the great artists of antiquity failed not to condense into that style the utmost perfection compatible with it, while the various applications of the works suggested abundant variety in their treatment and execution. The British Museum contains unquestionably the finest existing specimens of this branch of sculpture in the rilievi which decorated the Parthenon, or Temple of Minerva, at Athens. We have here to consider the judicious adaptation of their styles for the situations they occupied; but in regard to their general excellence as works of imitation, it may also be well to remember that these sculptures were the admiration of the ancients themselves. Seven hundred years after they were produced, Plutarch spoke of them as "inimitable works."

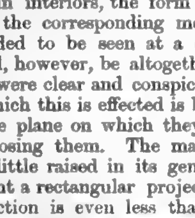
The figures which adorned the pediment are separate statues, although in their original situation, casting their shadows on the tympanum, they must have had the effect of bold alti-rilievi; the circumstance of their



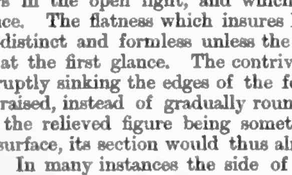
being thus completely detached must have given the greatest distinctness to their forms, and as they occupied the highest part of the building, their gigantic size and complete relief made them fully effective at a considerable distance. The sculptures which adorned the metopes, or spaces between the triglyphs, are in alto-rilievo. Those in the British Museum, representing combats with Centaurs, were taken from the south side of the building: the subjects were varied on the other sides, but they mostly related to the warlike exploits of the Athenians. It has been well observed, that the subjects of combats, usually chosen for the metopes in Doric temples, afforded opportunities of composing the figures so as to produce diagonal lines, which effectually distinguished the groups from the architecture, and at the same time had the effect of reconciling the vertical forms of the triglyphs with the horizontal lines of the epistylium and cornice. The compositions in question all fully occupy the space destined for them, and are calculated, from their treatment and relief, to produce the utmost possible effect. Those works which received the open light were thus boldly relieved from their ground to insure the masses of shadow which make them conspicuous: the principle, applicable to external architecture, that projection commands shade, was thus extended to external decorations; and care seems to have been taken to keep the light on the figures as unbroken as possible, especially as the whole series of metopes occupying the external frieze was more or less crossed by the shadow of the cornice. This precaution necessarily limits the attitudes, for many actions equally natural with those adopted would have projected shadows on the figure itself, thus tending to confuse the forms. A statue which can be seen from various points, and sometimes in various lights, might thus be unfit as to its composition for that intelligible display in one view and under a constant light which rilievo requires. On the principle that high relief is fittest for the open light, the rilievi of the temple of Phigaleia, which are also preserved in the British Museum, are bold in their projections. These works adorned the interior of the cella, but as the temple was hypæthral, or lighted from the open sky, the principles of external decoration were applicable. Had the temple been imperfectly lighted, a flatter kind of relief would have been preferable, and this leads us to consider the style of basso-rilievo, properly so called, the most perfect existing specimen of which is also in the British Museum. It adorned the external wall of the cella of the Parthenon, within the peristyle or colonnade, and was consequently always in shade: the strongest light it could ever receive would probably be the reflection from the pavement below when the sun was highest; but as reflected lights are uncertain, and may proceed from various points, the sculptures in question were calculated to be equally distinct in whatever direction the light was thrown. Their great elevation, and the peculiar angle at which they were seen, owing to the narrowness of the space between the exterior columns and the cella, may also be mentioned in considering the reasons which rendered projection unadvisable. That this confined view was not however the sole reason, may appear from the bold relief of the Phigaleian marbles, which, in the interior of the narrow cella of the temple they adorned, must have been seen on the side walls at a very inconsiderable distance compared with their height. The Phigaleian temple was built, according to Pausanias, by Ictinus, the chief architect of the Parthenon; and although the sculptures are inferior as works of art to the generality of Greek specimens, their style of relief is precisely the point where the architect may be supposed to have influenced their execution.

As projection commands shade, so flatness commands light, and the flattest relief is hence fittest for an invariably dark situation. The same principle is observable in architecture in the treatment of mouldings in interiors, the form and projection of which differ materially from the corresponding members in the open light, and which are intended to be seen at a distance. The flatness which insures light would, however, be altogether indistinct and formless unless the outlines were clear and conspicuous at the first glance. The contrivance by which this is effected is by abruptly sinking the edges of the forms to the plane on which they are raised, instead of gradually rounding and losing them. The mass of the relieved figure being sometimes very little raised in its general surface, its section would thus almost present a rectangular projection. In many instances the side of this projection is even less than rectangular; it is undercut, like some mouldings in architecture which require to be particularly distinct, and thus presents a deeper line of shade. But if the figure can thus command distinctness of outline, notwithstanding the inconsiderable light it may receive, it is obvious that its lowness or flatness of relief will in such a light greatly aid its distinctness: above all, this contrivance gives the work thus seen in an obscure situation the effect of rotundity. Indeed, it is a great mistake to suppose that the flat style of relief was intended to appear flat, and it is a great mistake to apply it in situations, as in the open air, where it must appear so, and be indistinct besides. The conventions of the arts are remedies, adopted in certain situations and under particular circumstances, and are supposed to be concealed in their results: their ultimate resemblance to nature, and their successful effect in those circumstances, are the test of their propriety and necessity. The absence of all convention in alto-rilievo (as opposed to the flat style), thus fits it for near situations, if not too near to expose it to accidents. The excellent sculptures which decorate the pronaos and posticum of the Temple of Theseus,

Lateral portico of the Parthenon.



End portico of the Temple of Theseus.

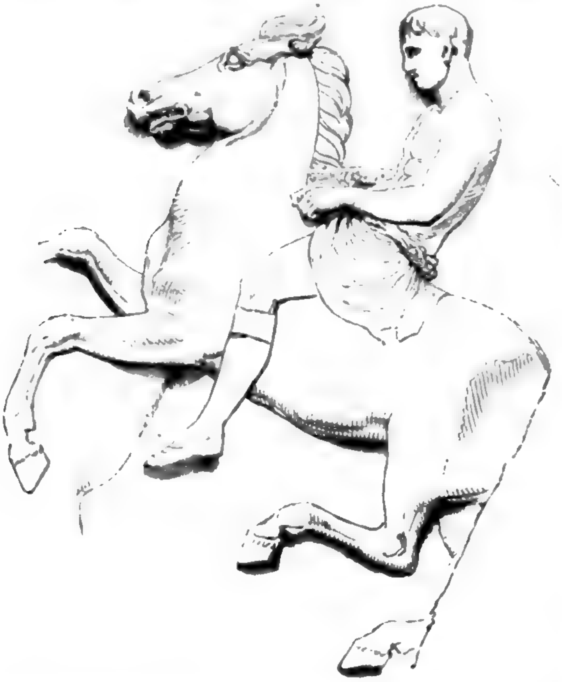


although under the portico, are in bold relief. They were not only nearer the eye, and seen at a more convenient angle than the flat rilievi of the cella of the Parthenon, but the reflected light which displayed them would necessarily be much stronger.

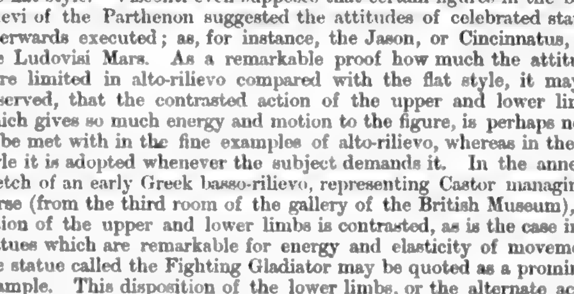
It is also to be remembered that only the end porticoes, where the sculpture could be more conveniently seen and was better lighted, were decorated with rilievi; the side walls of the cella were unornamented, and undoubtedly bold relief would have been less adapted for them. The Temple of Theseus was built about thirty years before the Parthenon; and it is not impossible that the satisfactory effect of the flat rilievi on the cella of the latter might have suggested a similar treatment, or some modification of it, in the Temple of Theseus, had it been erected later. It may be observed in general, that alto-rilievo can seldom be fit for interiors, not only from its liability to accident, but from the difficulty of displaying it by the full light which it requires. A superficial light, especially if in a lateral direction, necessarily throws the shadows of one figure on another. Instances of this occur in some of the palaces in Rome where works of sculpture have been injudiciously placed. A room, for example, lighted in the ordinary way, will have its walls (at right angles with that occupied by the windows) adorned with a frieze in considerable relief; the figures nearest the light consequently project their shadows so as to half conceal the next in order.

The conditions of proximity and distance, as well as the quantity and direction of light, were carefully attended to by the Greek sculptors, and suggested new varieties of relief. The end of the art, as far as relates to execution, is accomplished when the work is distinct and intelligible at the distance whence it is intended to be viewed. Hence the conventions which are intended to correct the defects of distance, of material, want of light, &c., are evidently unnecessary where the work admits of close inspection. The style of mezzo-rilievo, which in its boldest examples presents about half the thickness of the figure, is, on many accounts, least fit for a distant effect: the figure is nowhere detached from its ground; at a very little distance its shadowed side is lost in its cast shade, and its light side in the light of its ground; the outline, in short, soon becomes indistinct, but the semi-roundness of the forms is directly imitative, and thus again the absence of all conventional treatment fits the work for near situations. The style was preferred to alto-rilievo in such cases, as the latter would have been more liable to accidents, and would besides in some measure deform the outline or profile of any object which is circular in its plan. The figures which adorn sculptured vases are thus in mezzo-rilievo: these works probably ornamented interiors where any indistinctness in their distant effect or in an unfavourable light might be obviated by closer inspection. Two specimens may be seen in the second room of the Gallery of Antiquities in the British Museum. The celebrated Medicean and Borghesan vases, the finest known examples, are in like manner ornamented with mezzo-rilievo. The same consideration applies to all works, however unfit for a distant effect, which can, or in their original situation could, only be seen near. Even the mixed style of relief in the sculptures which occupy the internal sides of the Arch of Titus at Rome, would hardly be objected to, since the objects represented are distinctly seen, and can only be seen, at the distance of a few feet. The style of semi-relief (much purer than that of the Arch of Titus) adopted by Flaxman in front of Covent Garden Theatre, may be defended on the same principle, since the utmost width of the street is hardly a more distant point than a spectator would naturally retire to in order to see them conveniently. The still flatter style which has been introduced on the exterior of several buildings in London cannot, however, be defended on any grounds, and there can be no doubt, from the reasons adduced, that bold relief is generally fittest for the open light. The mezzi-rilievi on the miniature choragic monument of Lysicrates (casts from them are in the British Museum) may be admitted to have been fitly calculated for their situation because they must have been seen near; but there was in this case an additional consideration to be attended to; the building is circular, and alto-rilievo was avoided in order to preserve the architectural profile: on the other hand, the frieze of the small Temple of Victory, which was rectangular, was adorned with alti-rilievi; and in this case it appears that they did not even extend to the angles. The objections to sculpture on monumental columns will be obvious from these considerations; it has been observed, that in attempting to preserve the architectural profile, as in the Trajan column, and its modern rival in the Place Vendôme at Paris, the sculpture thus slightly relieved soon becomes indistinct, nor indeed would this indistinctness be obviated at a considerable height even by alto-rilievo, the figures being necessarily small, while the evil is only increased by substituting the dark material of bronze for marble.

We proceed to consider the varieties of style in this art as affecting composition. In rilievo, and in sculpture generally (a colourless material, or a material of only one colour being always supposed), it is evident that shadow is the essential and only source of meaning and effect. In works placed in the open air, and visible in one point only, as in the case of alto-rilievo, a certain open display of the figure is generally adopted; the shadows, or rather the forms which project them, are so disposed as to present at the first glance an intelligible and easily recognised appearance, and the impossibility of changing the point of view, or changing the light, as before observed, limits the attitudes more than in a statue, and, as will also appear, more than in a basso-rilievo. For in the latter, however distinct the outline is in which the chief impression and meaning of the figure reside, the shadows within the extreme outlines are in a great measure suppressed; it is, in fact, by their being so suppressed that the general form becomes so distinct. This is also the case when one form is relieved on another; it will be seen that the nearest object is very much reduced and flattened in order that its shadow may not interfere with the more important shadows of the outlines on the ground, and hence it may often happen that the nearest projection is least relieved. It will thus be evident that, owing to this power of suppressing the accidental shades and preventing them from rivalling or being confounded with the essential ones, the choice of attitudes becomes less limited, and



many a composition which in full relief would present a mass of confusion from its scattered and equally dark shades, may be quite admissible and agreeable in basso-rilievo. Accordingly the attitudes of statues, which are generally unfit for alto-rilievo, frequently occur in the flat style. Visconti even supposes that certain figures in the bassi-rilievi of the Parthenon suggested the attitudes of celebrated statues afterwards executed; as, for instance, the Jason, or Cincinnatus, and the Ludovisi Mars. As a remarkable proof how much the attitudes were limited in alto-rilievo compared with the flat style, it may be observed, that the contrasted action of the upper and lower limbs, which gives so much energy and motion to the figure, is perhaps never to be met with in the fine examples of alto-rilievo, whereas in the flat style it is adopted whenever the subject demands it. In the annexed sketch of an early Greek basso-rilievo, representing Castor managing a horse (from the third room of the gallery of the British Museum), the action of the upper and lower limbs is contrasted, as is the case in all statues which are remarkable for energy and elasticity of movement: the statue called the Fighting Gladiator may be quoted as a prominent example. This disposition of the lower limbs, or the alternate action in which one of the arms would cross the body, never occurs in alto-rilievo, because the shadow of the arm on the body or of one of the



lower limbs on the other could then no longer be suppressed, as it is in this case, but would rival the shadows of the whole figure on the ground. Among the metopes of the Parthenon, the Phigaleian marbles, and the alti-rilievi of the Temple of Theseus, there is not a single instance of the contrasted action alluded to; while in the two latter examples, the contrary position, or open display of the figure, repeatedly recurs, even to sameness. It must however be admitted, that this open display of the figure, although not presenting the most energetic action, is as beautiful as it is intelligible, and hence the finest exhibitions of form were quite compatible with the limited attitudes to which the sculptors thus wisely confined themselves. The objections which compelled this limitation being however entirely obviated in basso-rilievo, by the power of suppressing at pleasure the shadows within the contour, we find the fullest advantage taken of the latitude which was thus legitimately gained.

A better example cannot be referred to than the flat rilievi already mentioned from the cella of the Parthenon. (See the next Illustration.) The subject represents the Panathenaic procession, and although no perspective diminution is admitted, several equestrian figures are sometimes partly relieved one upon the other. The confusion which results from the number of similar forms in the repetition of the horses' limbs, as well as in the actions of the horsemen, must be admitted; but perhaps the subject is thus better expressed than by a simpler arrangement, and this treatment contrasts finely with the single figures. In a procession of horsemen moving two or three abreast, we are at once aware that the figures are similar, and the eye is satisfied, as it would be in nature, not in searching out each individual figure as if it had a separate principle of action, but in comprehending the movement and the mass, for one indicates the whole. Where the figures thus cross each other they are treated as a mass; the outline of the whole group is distinct and bold, being more or less abruptly sunk to the ground, but the outlines which come within the extreme outline are very slightly relieved. In short, the principle here applied is precisely the same as that observable in a single figure in the same style of relief: the outline of the whole form is distinct, or rather most distinct where it is most important, and the internal markings are seldom suffered to rival it, but are made subservient to this general effect. The relative importance of the objects is, indeed, the only consideration which is suffered to interfere with this principle: thus loose drapery is sometimes slightly relieved on the ground, while a significant form is now and then strongly relieved even on another figure. In comparing the slight varieties of treatment in these rilievi, it is to be remembered that the end porticoes were a little wider than the lateral colonnades. It is undoubtedly to this circumstance that the difference of treatment alluded to is to be referred; the figures in the end friezes are more separated from one another, and consequently somewhat more relieved than the compact processions on the side walls.

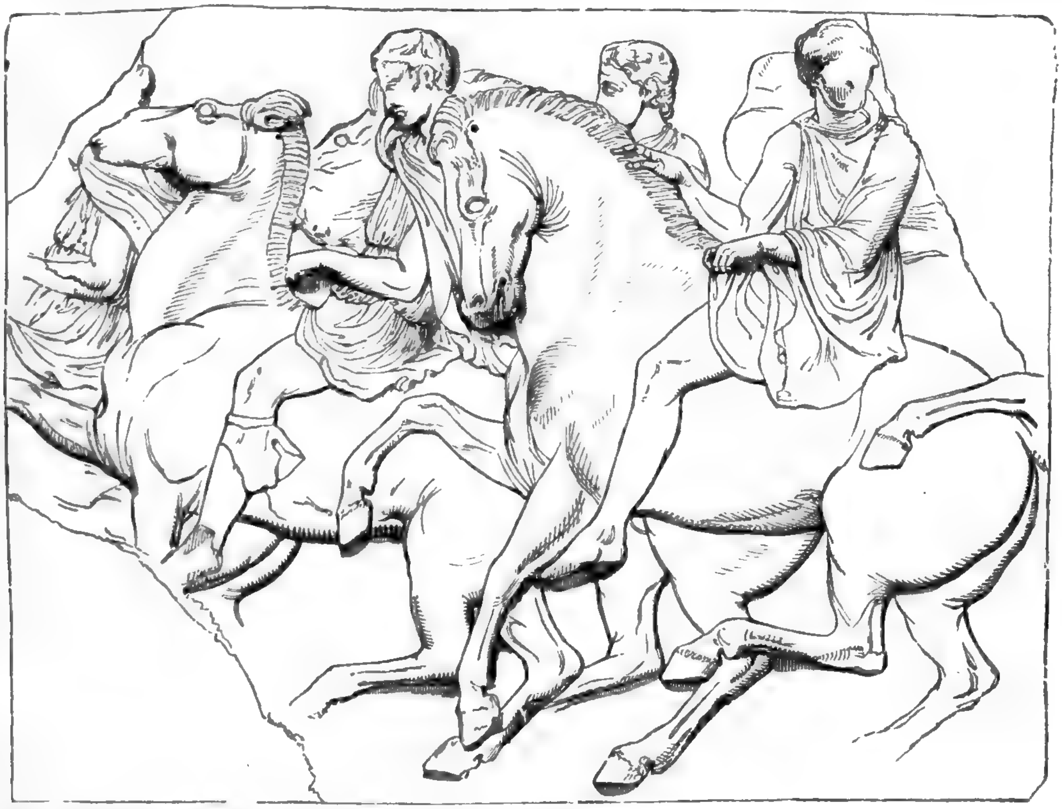
The fact that these bassi-rilievi, as well as most of the sculpture of the ancients, were partially painted, has been purposely left out of the account, because the very contrivances resorted to are calculated to supply the absence of colour. The custom in the best age of Grecian art of painting architecture and sculpture may be defended or excused elsewhere; it may be however here remarked, that while the ancient sculptors added colour after having employed every expedient which could supply its want, the moderns, in altogether rejecting it, often fail to make use of those very conventions which its absence demands.

It appears that the principle of suppressing the relief within the extreme contour which, with the strong marking of the outline itself, mainly constitutes the style of basso-rilievo, was employed by the ancients in works of considerable relief, in interiors, in particular lights, and probably at some distance or elevation. The real projection which works thus strictly belonging to the class of bassi-rilievi may sometimes present, points out the essential difference between basso and mezzo rilievo: a work, even if in very slight general relief, which has the parts that are nearest the most relieved, belongs to mezzo-rilievo; while a work which has the nearest parts least relieved, constitutes basso-rilievo, whatever its general projection may be. In the former, the outline is thus less apparent than the forms within it; in the latter, the outline is more apparent than the forms within it. The early Greek and Etruscan rilievi, which, however flat, have the nearest parts the fullest, while the outline is scarcely, if at all, rectangular in its section, have thus the principle of mezzo-rilievo. They are even fitted for near inspection, and cannot be said to present any unsatisfactory convention; for the bulk, however really thin, is proportionate in its relief, and is so far directly imitative; inasmuch as the eye consents to a diminished scale of bulk as easily as to a diminished scale of height, while the indistinctness of the outline has the effect of rounding the form. Such works are besides fitted for near examination, because they can scarcely command any shadow. Various specimens may be seen in the British Museum.

The antique vases of Arezzo were ornamented with figures in this kind of relief. Certain silver vases mentioned by Pliny were of the same description. The Egyptian intaglio, for so it may be called, rather than rilievo, belongs to the same style. The Egyptian artists, instead of cutting away the background from the figure, sunk the outline, and slightly rounded the figure, on the principle of mezzo-rilievo, within. Thus no part of the work projected beyond the general surface, and the architectural profile was preserved. There are, however, many very ancient examples at Thebes of figures slightly relieved from the ground, somewhat on the principle of basso-rilievo as practised by the Greeks,—that is, with the nearest parts least relieved, and with outlines rectangular in the section. Many of them, probably, in their original situations, and when the buildings were entire, ornamented interiors. Some Persian rilievi, in the British Museum, approach the same style. The Egyptian rilievi were painted in brilliant colours, and would have been ineffective in the open light without such an addition.

The distinctions of the three styles of relief, according to the Greek examples, may now be thus recapitulated. In the highest relief, however decided the shadows may and must of necessity be, on the plane to which the figure is attached, the light on the figure itself is kept as unbroken as possible, and this can only be effected by a selection of open attitudes; that is, such an arrangement of the limbs as shall not cast shadows on the figure itself. In basso-rilievo, the same general effect of the figure is given, but by very different means: the attitude is not selected to avoid shadows on the figure, because, while the extreme outline is strongly marked, the shadows within it may be in a great measure suppressed, so that the choice of attitudes is greater. Mezzo-rilievo differs from both: it has neither the limited attitudes of the first, nor the distinct outline and suppressed internal markings of the second: on the contrary, the outline is often less distinct than the forms within it, and hence it requires, and is fitted for, near inspection. Its imitation may thus be more absolute, and its execution more finished, than those of either of the other styles.

Most of the coins of antiquity are executed on the principle of mezzo-rilievo; and though often far bolder in this relief than modern works of the kind, are treated in a mode corresponding with their minute dimensions, which require close examination. The outline thus gradually rounds into the ground, and is never abruptly sunk, while the nearest parts are most relieved. Thus, conventional methods are always wanting in works that admit of close inspection, where the eye can be satisfied without such expedients. The comparatively strong relief of the heads on the ancient medals is again a contrivance for their preservation, and presents a new variety in the style of rilievo. Coins are exposed to friction, and the forms they bear are thus liable to be soon effaced. The earliest means adopted to prevent this was by sinking the representation in a concavity, in which it was thus protected. This plan was soon abandoned, for obvious reasons; and the method ultimately adopted was that of raising the least important parts most. Accordingly, the parts that are rubbed away in many fine antique coins are precisely those which can best be spared; the hair has generally a considerable projection, so that the face and profile are often perfectly preserved after 2000 years: a better specimen cannot



be adduced than the celebrated Syracusan coin representing the head of Arethusa or Proserpine. In addition to the propriety of its style, this head is remarkable for its beauty, and is classed by Winkelmann among the examples of the highest character of form.

The ordinary style of mezzo-rilievo was also used for gems, and indeed for all works in this branch of sculpture which required close inspection, and needed no conventional contrivance. A flat style of relief, which is sometimes observable in cameos, was adopted only for the sake of displaying a subject on a different coloured ground; the layers of colour in the stone employed, generally the sardonyx, being very thin. The difference of colour in the ground has, however, the effect of giving roundness to the figures relieved on it, as if, their whole effect becoming apparent, the internal markings disappeared. The figures on the Portland Vase are treated on this principle; and as it was intended to imitate a precious stone (for which indeed it was at first taken), the thinness of the outer layer of colour is also imitated. Such works, however, reduced to one colour in a cast or copy, are totally wanting in effect and style. The impressions from intagli, or engraved gems, which were used for seals, are never in the flat style of relief, but however slightly raised, are on the principle of mezzo-rilievo as above defined. The gems of Dioscorides, the finest of antiquity, are in mezzo-rilievo, and often of the fullest kind; as for instance, the heads of Demosthenes and Io, and the figures of Mercury and Perseus. The same may be observed of other celebrated gems, such as the Medusa of Solon, the Hercules of Cneius, &c. It is supposed that the same artists who engraved on gems, and who frequently inscribed their names, also executed the dies for coins. The latter are among the finest antique works of art; but of the many thousand existing specimens there is but one which bears the name of the artist, namely, the coin of Cydonia in Crete, the inscription on which proves it to be the work of Nevantus. It was observed, that in the antique coins, the least important parts are the most raised, and the reasons which dictated this practice limited the view of the head to the profile; but as the same reasons were no longer applicable in engraved gems, the impressions from which could be renewed at pleasure, the front, or nearly front view of the head was occasionally attempted, and seems to have been preferred by Dioscorides and his school. The head of Io before mentioned, considered with reference to this specific propriety of its style, as well as with regard to its general merits, is placed by Visconti in the first class of antique engraved gems. Thus the most skilful artists of antiquity seemed to consider the style of any one of the arts to consist chiefly in those points which were unattainable by its rivals. It may be here observed too, that they generally limited their representation to the most worthy object, namely, the human figure, when the dimensions on which they were employed were necessarily confined. Indeed, the principles of imitation itself were, as it were, condensed, and true character often exaggerated as the materials appeared less promising; so that the genius of ancient art is as conspicuous in minute engraved gems as in colossal sculpture.

Mezzo-rilievo of the fullest kind was also fitly employed (as well as alto-rilievo, when in situations not exposed to accidents) to ornament tombs and sarcophagi. These works, placed in the open air, decorated the approaches to cities, as the sepulchres were always without the walls. The Appian Way was the most magnificent of these streets of tombs in the neighbourhood of Rome, and must have exhibited, literally, thousands of sepulchral monuments. Though generally the work of Greek artists, and often interesting from being copies of better works now lost, the haste and inattention with which such prodigious numbers were executed, tended to degrade the style of their sculpture. In these rilievi, even in the better specimens, buildings and other objects are occasionally introduced behind the figures, thus approaching the spurious style of relief in which the effects of perspective are attempted to be expressed: a great variety, of various degrees of excellence, are to be seen in the British Museum. The greater part of what are called Roman bassi-rilievi are of this kind, and may be considered a middle style between the pure Greek rilievo and the modern Italian. It was from antique sarcophagi, fine in execution, but with these defects in style, that Niccola da Pisa, in the 13th century, first caught the spirit of ancient art. Many of the works from which he is believed to have studied are still preserved in Pisa. D'Agincourt gives a representation of one of the best. In imitating the simplicity of arrangement, and, in a remote degree, the purity of forms which these works exhibited, the artist was not likely to correct the defects alluded to, which had been already practised in Italy and elsewhere. Various degrees of relief, background figures and objects, and occasional attempts at perspective, are to be found in the works of the Pisani and their scholars, yet their works, which are to be regarded as the infancy of Italian art, and which undoubtedly are rude enough in workmanship and imitation, are purer in style than those of the succeeding Florentine masters, who attained so much general perfection in sculpture. The rilievi of Donatello are mostly in the style called by the Italians *stiacciato*, the flattest kind of mezzo-rilievo, according to the definition before given, which he probably adopted, as he worked in bronze, from the facility of casting; yet in such a style, commanding little distinctness from its inconsiderable projection, he introduced buildings, landscape, and the usual accessories of a picture. But this misapplication of ingenuity was carried still farther by Lorenzo Ghiberti, in the celebrated bronze doors of the baptistery, or church of San Giovanni, at Florence, which exhibited such skilful compositions, in which the stories are so well told, and in which the single figures are so full of appropriate action. In these works the figures gradually emerge from the *stiacciato* style to alto-rilievo. They are among the best specimens of that mixed style, or union of basso-rilievo with the principles of painting, which the sculptors of the fifteenth century and their imitators imagined to be an improvement on the well-considered simplicity of the ancients. In these and similar specimens, the unreal forms of perspective buildings, and diminished or foreshortened figures, which in pictures create illusion, when aided by appropriate light and shade and variety of hue, are unintelligible or distorted in a real material, where it is immediately evident that the objects are all on the same solid plane. Even Vasari, who wrote when this mixed style of rilievo was generally practised, remarks the absurdity of representing the plane on which the figures stand ascending towards the horizon, according to the laws of perspective; in consequence of which, "we often see," he says, "the point of the foot of a figure, standing with its back to the spectator, touching the middle of the leg," owing to the rapid ascent or foreshortening of the ground. Such errors, he adds, are to be seen "even in the doors of San Giovanni." Lorenzo Ghiberti, like other Florentine sculptors, first learnt the practice of his art from a goldsmith, and the designs of the artists who competed with him for the honour of executing the doors of San Giovanni were submitted to the judgment of goldsmiths and painters as well as sculptors.

The taste of the Florentines in basso-rilievo was thus greatly influenced by the prevalence of a style most applicable to the precious metals, in which a general sparkling effect is best insured by avoiding uniformly violent relief, which projects considerable shadows, and especially by avoiding unbroken flatness. The background is thus filled with slightly relieved distant objects, so as to produce everywhere a more or less roughened or undulating surface. The same end seems to have been attained in the antique silver vases, by the introduction of foliage. The style continued to be practised with occasionally greater absurdities than those before alluded to, and perhaps less redeeming excellence, till the close of the last century. The sculptor Falconet says of the antique bassi-rilievi, that "however noble their composition may be, it does not in any way tend to the illusion of a picture, and a basso-rilievo ought always to aim at this illusion." He leaves no doubt as to the literal meaning he intends by citing the Italian writers who applied the term *quadro* indiscriminately to picture and basso-rilievo. Sculpture in this country was indebted principally to Flaxman for the revival of a purer taste in the application of basso-rilievo to architecture. In works of decoration, intended to be executed in the precious metals, in which, as before observed, moderately embossed and general richness of surface is so desirable, in order to display the material as well as the work, he, however, united his own purity of taste and composition with an approach to the mixed style of relief practised by the Florentine masters, who, in this branch of sculpture, perhaps never equalled his shield of Achilles.

ALUM. ($KO, SO_3 + Al_2O_3, 3SO_3 + 24$ aq.) or ($NH_4O, SO_3 + Al_2O_3, 3SO_3 + 24$ aq.) Alum as met with in commerce is a double salt, one of the constituents of which is sulphate of alumina, and the other either sulphate of potash or sulphate of ammonia. These two descriptions of alum are distinguished respectively by the names *potash* alum, and *ammonia* alum. Potash alum is occasionally met with as a natural product in volcanic districts. It is there formed by the action of sulphuric acid upon lavas and trachytes containing potash and alumina. Under these circumstances it is found at Auvergne in the South of France, in Sicily and the adjoining volcanic islands, also in the neighbourhood of Naples, at the Grotto di Alume (Capo Miseno), and at Solfatara. The alum forms an encrustation on the surface of the volcanic rocks, and being dissolved in water, it is recrystallised after the mechanical impurities have been removed by subsidence. It is then sent into the market as *Roman* alum.

Such natural alum constitutes, however, but a very small proportion of that used in the arts. For several centuries alum has been made in this country, from deposits found at Whitby in Yorkshire, and at Hurlett and Campsie near Glasgow, and known as *Alum Schist* or *Alum Shale*. This material contains, amongst other ingredients, alumina, iron pyrites, and a bituminous or coaly matter. The following is the process employed for obtaining alum from this schist:—

1. A thin layer of brushwood is laid upon the ground, and on this alum schist is piled in a pyramidal form to the height of 90 or 100 feet. The brushwood is then ignited, and the combustion gradually communicates itself to the coaly matter of the schist, which is present in sufficient quantity to afford heat enough for the calcination of the whole mass. Great care is taken to cause the combustion to proceed very slowly, otherwise the mass would become partially fused, and the objects of the operation be defeated. From one to two years are therefore required for the burning of one of these heaps. During the calcination the bisulphide of iron (iron pyrites) is decomposed, and converted at the expense of atmospheric oxygen into protosulphate of iron and free sulphuric acid, the latter uniting immediately with the alumina of the shale to form sulphate of alumina. These chemical changes may be thus expressed:—

$$\underbrace{3FeS_2}_{\text{Iron pyrites.}} + O_{21} + \underbrace{Al_2O_3}_{\text{Alumina.}} = \underbrace{Al_2O_3, 3SO_3}_{\text{Sulphate of alumina.}} + \underbrace{3FeOSO_3}_{\text{Protosulphate of iron.}}.$$

2. When the whole mass has been exposed to the necessary temperature, and has again become nearly cold, it is sprinkled with water from time to time, so as to moisten it thoroughly without interrupting the circulation of air through its interstices; the object being to oxidise the protosulphate of iron and to convert it as far as possible into insoluble basic persulphate. A certain portion of the iron, however, still remains as neutral persulphate, but this probably suffers double decomposition with the silicate of alumina in the shale, producing soluble sulphate of alumina and insoluble silicate of iron. The mass is now lixivated with water in stone cisterns, when sulphate of alumina nearly free from persulphate of iron dissolves out.

3. The aluminous liquor thus obtained is now concentrated by evaporation until it attains a density of about 1·4. This operation is performed in brickwork cisterns lined with lead, thirty-six feet long, six feet wide, and two or three feet deep, heated by the reverberatory flame from a furnace placed at one end and fed with highly bituminous coal. Much soot is deposited in the pans, but it subsides, leaving the liquor above it clear. The latter is then run off into tanks and allowed to cool.

4. The cool concentrated liquor is now ready for conversion into alum, which is effected by adding to it a sufficient quantity of a saturated solution of sulphate of potash or sulphate of ammonia; in the former case potash alum is produced, whilst in the latter ammonia alum is the result. As sulphate of ammonia is now, in almost all localities, a more abundant and consequently cheaper salt than sulphate of potash, it has almost entirely superseded the last-named salt in the alum manufacture, nearly all the alum now met with in commerce being ammonia alum. As alum is far less soluble in cold water than sulphate of alumina, it is precipitated in the form of a granular crystalline powder, termed "alum-meal," when either of the sulphates just mentioned is added to the concentrated solution of sulphate of alumina. Thus the alum at the moment of its production becomes separated from a number of other salts, such as the sulphates of iron, lime, magnesia, &c., which remain in solution, and the remaining operations have for their object the rendering of this separation more complete by removing the impure liquor from the interstices of the alum-meal, which is effected by washing the latter twice with small quantities of cold water and then recrystallising it from a boiling saturated solution. The latter operation is performed in vessels termed *roaching casks*, which consist of a sufficient number of staves, six feet long, lined with lead, and fitting tightly around a circular flagstone, four to five feet in diameter, which thus forms the bottom of a cask or vat; the staves are held together by strong iron hoops, which can be tightened or relaxed at pleasure by screws joining their extremities, thus permitting the casks to be put together or taken to pieces with great facility. Into these casks the boiling saturated solution of alum is run; and as it cools most rapidly where it is in contact with the staves, a thick crystalline encrustation of alum soon attaches to the sides of the cask, and in three or four days becomes strong enough to retain the interior liquor without the assistance of the staves, which are accordingly removed to facilitate the

refrigeratory process. It takes from eight to fourteen days for the liquor to cool and deposit its crystals; the mother liquor remaining in the centre is then run off through a hole bored in the side of the crystalline mass, which is then broken up into irregular square blocks and sent into the market.

By the use of a purer raw material than the alum shale above mentioned, the processes may be much simplified, so far at least as regards the production of the sulphate of alumina. Thus, in some manufactories, pipe-clay or china-clay containing little else than silicate of alumina, contaminated with only a small quantity of oxide of iron, is gently roasted in a reverberatory furnace, and then decomposed by hot sulphuric acid which combines with the alumina, expelling the silicic acid chiefly in the insoluble form. The mass thus obtained is now lixiviated with water, and there is thus obtained a concentrated solution of sulphate of alumina, which is subsequently converted either into potash or ammonia alum in the manner already described.

A large quantity of alum is now made by Spence's process, which is peculiarly fitted for coal districts, inasmuch as the whole of the materials employed are derived from coal and the coal strata. Thus the iron pyrites so frequently met with amongst coal in lenticular masses or distinct strata, furnishes sulphuric acid [SULPHURIC ACID] which, when heated in large shallow leaden pans with roasted coal shale (a material very similar in composition to alum shale), yields sulphate of alumina, containing an excess of sulphuric acid. A quantity of the ammoniacal liquor of gasworks [GAS] is now boiled in a close vessel, and the vapours of carbonate of ammonia and sulphide of ammonium arising therefrom are conducted into the hot acid solution of sulphate of alumina, where they are converted into sulphate of ammonia, which immediately forms ammonia alum with the sulphate of alumina present, whilst carbonic acid and sulphuretted hydrogen gases escape. On cooling, the solution deposits a copious crop of alum crystals, which are purified by washing and recrystallisation, in the manner already described.

Properties.—Alum presents the appearance of colourless, tolerably transparent octohedral crystals, which possess a sweetish astringent taste, and are soluble in about 18 parts of cold water and less than their own weight of boiling water. These crystals contain 24 equivalents of water, which they lose on exposure to a heat of about 400°, and are converted into a light, porous, white, insoluble mass termed *burnt alum*. At a bright red heat ammonia alum is totally decomposed; ammonia and sulphuric acid are volatilised, whilst pure and anhydrous alumina is left behind. For the chemical relations of alum, see ALUMS.

Uses.—Alum is largely employed in dyeing and calico-printing, and in the manufacture of paper; it is also used in the production of pigments called *lakes*, and is sometimes mixed with the flour used for bread. A minute quantity of alum thus employed renders the bread, especially if made from the inferior kinds of flour, lighter, whiter, and probably more digestible; it also enables the bread to retain a larger amount of water after baking. It is easy to perceive that these properties may, on the one hand, be made fraudulently subservient to the production of bread apparently of the best quality from inferior flour; and on the other, may be legitimately used as means whereby such flour, when it must be employed as food, may be converted into a more palateable and wholesome bread. The amount of alum (about $\frac{1}{1000}$ of the weight of the flour) required to produce this effect, is too minute to exercise any deleterious effect upon the consumer of such bread.

In all these applications it is immaterial whether potash alum or ammonia alum be employed; weight for weight, however, ammonia alum is rather more valuable than potash alum, since it contains 11·90 per cent. of the active ingredient, alumina, whilst potash alum contains only 10·82 per cent.

About 20,000 tons of alum are now annually manufactured in the United Kingdom.

ALUMINA (Al_2O_3). The oxide of aluminium; it constitutes a large proportion of all clays, which in a great measure owe to it their plastic property. The name of alumina is derived from *alumen*, the Latin for alum, the salt from which it is generally obtained in a pure state, by means which will presently be mentioned. Alumina is widely diffused in nature; the adamantine spar or corundum, the ruby, and sapphire, are alumina nearly pure and crystallised, and are among the hardest substances in nature. The diaspore is a crystallised mineral, which consists almosts entirely of alumina and water; and in North America another hydrate of alumina has been found, and called gibbsite. Emery, likewise remarkable for its hardness, and hence much used for grinding and polishing, is also alumina coloured with the oxides of iron and manganese.

The following is the process recommended by Berzelius ('Traité de Chimie,' ii. 369) for procuring pure alumina: Dissolve and crystallise alum repeatedly, to deprive it of the peroxide of iron which it usually contains; when thus rendered pure, a portion of the alum dissolved in water, and added to a solution of potash in excess, gives a precipitate at first, which is afterwards completely redissolved. To a boiling solution of the purified alum, add one of carbonate of potash, as long as precipitation takes place; then a slight excess of the carbonate being used, digest with a gentle heat to decompose the subsulphate of alumina formed. Wash this carefully on a filter, and redissolve it in hydrochloric acid; precipitate the clear solution with ammonia or carbonate of ammonia, and wash the precipitate, which, when dried with a gentle heat, is hydrate of alumina, and when heated to redness becomes pure alumina, by losing its water.

If intended for the purpose of solution in acids, it is better to keep the alumina in the state of hydrate; for when once rendered anhydrous, acids act upon it slowly and with great difficulty. Pure anhydrous alumina may also be obtained by heating ammonia alum to redness.

Hydrate of alumina, when recently precipitated, presents the appearance of a white, bulky, semi-transparent, gelatinous substance; on drying it contracts greatly and forms a white powder, which adheres to the tongue strongly. Hydrate of alumina readily combines with acids, except carbonic acid, forming salts which are generally soluble and uncrystallisable. They all possess an acid reaction. If the acid be volatile, a portion of it is generally expelled on boiling a solution of the salt, and a basic compound is precipitated. With acetate of alumina this takes place at ordinary temperatures; as, for instance, in the *ageing* of calico, which has been mordanted with acetate of alumina, acetic acid passes off during the ageing process, and a basic and insoluble acetate becomes fixed in the fibre, forming what is termed the *mordant*. Hydrate of alumina, as usually prepared, is insoluble in water; but Walter Crum has described a curious modification of it, which dissolves in large quantity in water containing a minute amount of acetic acid. Hydrate of alumina is readily soluble in solutions of the fixed alkalies, but insoluble in ammonia. If its solution in caustic potash or soda be exposed to the air, carbonic acid is gradually absorbed, and terhydrate of alumina (Al_2O_3, 3 HO) deposited in small but well-defined crystals.

When strongly heated, hydrate of alumina becomes suddenly incandescent, contracts greatly, and loses its water of hydration. It is then nearly insoluble in acids, but may be fused before the oxyhydrogen blowpipe, yielding an exceedingly hard vitreous mass, resembling corundum.

Alumina is an important substance, whether regarded as the ore of the metal aluminium, as a constituent of soils, or with respect to its extensive employment in the operations of the dyer, calico-printer, and colour-maker. It is also a necessary ingredient in all kinds of porcelain, earthenware, bricks, and tiles.

ALUMINA, SULPHATE OF. (Al_2O_3, $3SO_3 + 18aq.$) A salt formed by dissolving hydrate of alumina in dilute sulphuric acid, and then evaporating the solution. It crystallises in colourless flexible scales, containing eighteen atoms of water. They are soluble in twice their weight of cold water. Sulphate of alumina has an astringent and acid taste; it is permanent in the air, and is nearly insoluble in alcohol. It is used in dyeing and calico-printing, in the place of alum, for the production of mordants; and, as a general rule, it may be employed for all the purposes to which alum is applicable. For these applications sulphate of alumina is manufactured on a large scale by treating the white previously calcined clays of Devonshire and Dorsetshire with their own weight of dilute sulphuric acid, specific gravity 1·200 at the temperature of boiling water; and then, after separating the insoluble silica, precipitating the small amount of peroxide of iron, which is dissolved as sulphate, with ferrocyanide of potassium. The Prussian blue thus formed is allowed to subside, and the supernatant liquor is concentrated by evaporation, until it solidifies on cooling into a white mass, which is nearly pure sulphate of alumina, containing from 13 to 14 per cent. of alumina. The commercial salt thus manufactured is sometimes called *patent alum*.

A less pure, but almost equally efficacious, sulphate of alumina is made by a still more simple process, and is sold under the name of *aluminous cake* [ALUMINOUS CAKE].

ALUMINIUM, the metal contained in alumina. Aluminium was first obtained in a state approaching to purity by Wöhler, in 1827, by decomposing chloride of aluminium by means of potassium. Its preparation has since been simplified and rendered practicable on the large scale by Bunsen and by Deville. The former chemist prepares it by the electrolytic decomposition of the double chloride of aluminium and sodium ($Al_2Cl_3 + NaCl$). The melted salt is maintained at a temperature of about 400°; and as the metal separates at the negative pole, which consists of a plate of gas-carbon, it sinks to the bottom of the crucible containing the melted salt, and is thus protected from oxidation. On subsequently raising the temperature, the particles of aluminium coalesce into a large globule.

M. Deville, to whom we are indebted for a process capable of preparing the metal on a manufacturing scale, obtains aluminium by decomposing its chloride with sodium. The chloride of aluminium he prepares as follows:—anhydrous alumina is mixed with charcoal, made into a paste with oil or tar, and ignited in a covered crucible. When cold, the mass, which now consists of alumina and carbon, is broken into fragments and placed in an earthenware retort, with the short neck of which a glass receiver is connected. The retort and its contents being heated to dull redness, a current of dry chlorine gas is introduced through the tubulare, and solid chloride of aluminium immediately begins to condense in the receiver. The following is the reaction:—

$$\underbrace{Al_2O_3}_{\text{Alumina.}} + \underbrace{3C}_{\text{Carbon.}} + \underbrace{Cl_3}_{\text{Chlorine.}} = \underbrace{Al_2Cl_3}_{\text{Chloride of aluminium.}} + \underbrace{3CO.}_{\text{Carbonic oxide.}}$$

If, however, the chloride is to be at once employed for the preparation of the metal, it is better to conduct the vapour from the neck of the retort over ignited chloride of sodium, by which the double chloride of aluminium and sodium is produced. For the preparation of aluminium, 400 parts of this double salt are mixed with 200 parts of chloride of sodium and 200 parts of fluor spar (fluoride of calcium), all perfectly dry and in fine powder. This mixture is then placed in a crucible, interstratified with 75 to 80 parts of sodium; the whole being covered with a layer of powdered chloride of sodium. The crucible is heated at first gently, until the sodium begins to act, and afterwards to the melting point of the materials, which are to be stirred about with a porcelain rod and then poured out into a convenient mould. The cooled mass will contain a regulus of about 20 parts of aluminium, and a further quantity of about 5 parts in small globules. The reduction of chloride of aluminium by sodium may be thus expressed:—

$$\underbrace{Al_2Cl_3}_{\text{Chloride of aluminium.}} + \underbrace{3Na}_{\text{Sodium.}} = \underbrace{Al_2}_{\text{Aluminium.}} + \underbrace{3NaCl.}_{\text{Chloride of sodium.}}$$

Earthenware crucibles lined with a mixture of lime and alumina are used for the reduction.

Cryolyte, a native double fluoride of sodium and aluminium ($3NaF + Al_2F_3$), has been also used in a similar manner by Percy and Rose for the preparation of aluminium.

Aluminium thus prepared is a blueish-white metal, of a lustre inferior to silver. When cast, it is as soft as pure silver, and has a specific gravity of 2·56, about equal to the lightest descriptions of glass. By hammering and rolling, it becomes nearly as hard as iron, and has then a specific gravity of 2·67. Its melting point lies between those of zinc and silver. It is slightly magnetic, and conducts electricity eight times better than iron. Exposed to the air it does not oxidise, even at a red heat, and may be placed in contact with boiling water for any length of time without undergoing change. Dilute or concentrated nitric acid do not act upon it in the cold, and even concentrated boiling nitric acid dissolves it only with extreme slowness. On the other hand, dilute hydrochloric acid and solutions of fixed alkalies readily act upon and dissolve it, with the evolution of hydrogen. It is not tarnished like silver by sulphuretted hydrogen, and does not amalgamate with mercury by simple contact. It can be wrought with about the same ease as silver, and has already been used to a considerable extent by the silversmith and jeweller. In beauty of surface it is inferior to silver, but its extraordinary lightness and permanency in the air will probably lead to its employment for articles in which these qualities are a desideratum.

ALUMINIUM, CHLORIDE OF. [ALUMINIUM.]

ALUMINOUS CAKE, an impure sulphate of alumina, recently patented by Mr. Pochin, and which is now employed to a considerable extent as a substitute for alum in the preparation of mordants and in the manufacture of paper. It is prepared by gently calcining china clay, selected as free from iron as possible, and then when cold mixing it with concentrated sulphuric acid in a leaden vat. A coil of leaden pipe is placed at the bottom of the vat, and steam passed through the former until the sulphuric acid begins to act upon the clay. The hot mixture is then run into a shallow flag vat with moveable sides; here the action becomes every moment more violent, torrents of steam are evolved from innumerable little craters, and finally, the mixture solidifies to a hard, honey-combed, grayish-white mass, which consists almost entirely of silica and sulphate of alumina. When this mass is treated with water, the sulphate of alumina dissolves, whilst the silica remains behind in an insoluble condition. The following analysis shows the composition of aluminous cake:—

Alumina (as soluble sulphate)	13·44
Peroxide of iron (as soluble sulphate)	·26
Insoluble basic sulphate of alumina	2·99
Soluble silicic acid	·01
Insoluble silicic acid	18·70
Insoluble alumina (as silicate)	3·38
Sulphuric acid (in soluble sulphates)	32·81
Sulphates of soda and potash	·87
Lime	·50
Magnesia	trace
Water	27·04
	100·00

As the sulphate of alumina is the only ingredient in alum which is made use of in nearly all the processes to which the latter salt is applied, it follows that aluminous cake may be effectively substituted for alum, whilst, being considerably cheaper and containing a larger proportion of alumina, its use is more economical.

ALUMS. A name applied by chemists to an important class of salts, to which commercial ammonia alum and potash alum belong. The alums are essentially double salts, consisting of an alkaline sulphate combined with the sulphate of a sesquioxide base, and crystallising generally in octohedrons with twenty-four atoms of water.

The following are the principal salts belonging to this class:—

Potash alum	$KO, SO_3 + Al_2O_3, 3SO_3 + 24$ aq.
Ammonia alum	$(NH_4)O, SO_3 + Al_2O_3, 3SO_3 + 24$ aq.
Soda alum	$NaO, SO_3 + Al_2O_3, 3SO_3 + 24$ aq.
Iron alum	$KO, SO_3 + Fe_2O_3, 3SO_3 + 24$ aq.
Manganese alum	$KO, SO_3 + Mn_2O_3, 3SO_3 + 24$ aq.
Chrome alum	$KO, SO_3 + Cr_2O_3, 3SO_3 + 24$ aq.

AMALEKITES, a nation who dwelt S.W. of Palestine, between Edom and Egypt. (Gen. xiv. 7; Exod. xvii. 8—16; 1 Sam. xv. 7.) According to Josephus ('Antiquities,' iii. 2), those who dwelt in Gobolitis and Petra were called Amalekites, and were the most warlike among the surrounding nations. He calls their country Amalekitis, and describes it as a part of Idumæa. ('Antiq.' ii. 1.) Josephus also calls the country of Midian Amalekitis, and says that it was situated between Pelusium, on the borders of Egypt, and the Red Sea. ('Antiq.' vi. 7; s. 3, and ch. 8.) It appears also that they occupied several places in Palestine among the Canaanites, and in the land of Ephraim we find a mountain of the Amalekites where Abdon, the son of Hillel, was buried in Pirathon.

The Amalekites were the first who opposed the Israelites on their march from Egypt. (Exod. xvii. 8—13; Jos. 'Antiq.' iii. 2.) They suffered great loss, but were afterwards assisted by the Canaanites, and obtained a great victory. (Num. xiv. 39—45.) During the time of the Judges, the Israelites were frequently oppressed by the Amalekites, Ammonites, and Midianites. (Judges iii. 13; vi. 3; Joseph. v. 7.) Saul fought with the Amalekites, and took their king Agag alive, who was cut to pieces by the prophet Samuel. (1 Sam. xv.; Jos. 'Antiq.' vi. 8.) David warred against them (1 Sam. xxvii. 8); and therefore the Amalekites plundered the town of Ziklag, and set it on fire, but David overtook them in the wilderness and recovered all that they had carried away. (1 Sam. xxx. 18; 'Antiq.' vi. 15.) The Amalekites were finally extirpated by the Simeonites, who occupied their country during the reign of Hezekiah (1 Chron. iv. 43), and this is the last notice of them. Thus, according to the direction of Moses, the remembrance of Amalek was blotted out from under heaven, because they slew the hindmost of the Israelites who fainted in the wilderness. (Deut. xxv. 17, 19.) Josephus says that Haman, called in the book of Esther an Agazite, was an Amalekite. Le Clerc, Hengstenberg, and others, assert that there was more than one tribe of Amalekites, an opinion founded chiefly on the difference of their localities: but the Bible narrative makes no distinction, and their national character, that of a warlike and pastoral race, will account for their dispersion.

AMALGAM, a compound of two or more metals, of which one is always mercury; and this circumstance distinguishes an *amalgam* from a mere *alloy*. Nature presents us with only one amalgam, which is of silver, and is termed by mineralogists *native amalgam*: it occurs in Hungary, Sweden, &c., and is met with either semi-fluid, massive, or crystallised in rhombic dodecahedrons. Klaproth found it to consist of 64 parts of mercury and 36 of silver in 100 parts. Most metals may be amalgamated with mercury, and the combination appears to depend on chemical affinity. When the cohesion of a metal is slight, as in the cases of potassium and sodium, or when its affinity for mercury is considerable, as in the instances of gold and silver, amalgamation takes place readily by mere contact. When, on the other hand, the cohesion of a metal is strong, or its affinity for mercury is weak, heat, or intermediate action, or both, are requisite to effect amalgamation.

There are several circumstances which show that amalgamation is the result of chemical affinity; the crystalline form of the native amalgam is strongly indicative of it, and it is confirmed by analysis; for if the quantities of mercury and silver were 64 of the former and 34·56 of the latter metal, instead of 36, as above mentioned, they would be in the proportions of 200 to 108, or 1 atom of each.

The phenomena also which accompany the action of mercury upon other metals evince its chemical nature: if 44 parts of mercury be mixed with 1 part of potassium, combination occurs with the evolution of much heat, and when the resulting amalgam is cold, it is hard, and has the appearance of silver. When the quantity of mercury exceeds 100 parts to 1 part of potassium, the compound is liquid; and an amalgam containing only 1·5 per cent. of potassium is susceptible of crystallising. The density of an amalgam exceeds that of the mean of the metals.

There are some metals, it has been already observed, which require heat in order to amalgamate them; of these antimony offers an example. In order to effect combination it must be melted, and while liquid mixed with hot mercury. Mere heat, however, causes no action between iron and mercury. It has been stated, however, that they may be amalgamated by mixing the filings of the metal with powdered alum, and rubbing them together in a mortar with a little water: after trituration the alum may be washed out; but an amalgam of iron may best be formed by rubbing the latter metal with an amalgam of sodium. By the intervention of tin or zinc, iron may be combined with mercurcy, and a double amalgam is formed. Platinum also unites with mercury by the intervention of the amalgam of potassium or sodium, but not by direct action. Many metals otherwise difficult to amalgamate, such as iron, platinum, and aluminium, may be combined with mercury when placed in contact with the latter metal in acidulated water, and made the negative pole of a voltaic circuit. The nascent hydrogen is here supposed to induce the amalgamation.

Having stated some examples of the different modes in which amalgams may be formed, we shall notice their general properties. Amalgams are either liquid, soft, or hard; their form being dependent, in some cases, upon the quantity of mercury employed; and, in others, upon the nature of the metal amalgamated: thus an amalgam consisting of 80 parts of mercury and 1 part of sodium is solid, whilst a compound of 15 parts of mercury and 1 part of tin is liquid. The liquid amalgams resemble mercury in appearance, except that the greater part of them flow less readily. Solid amalgams are brittle. In general, amalgams are white; they are all crystallisable, and then form compounds in definite proportions. To prove this, it is only requisite to dissolve a proper quantity of a metal in mercury with heat, and to allow the amalgam to cool; it then separates into two portions, one of which is liquid, and the other is solid and crystallised; the fluid portion may, however, be regarded as a solution of the definite compound in the excess of mercury. The amalgams of the more oxidable metals, as of potassium and sodium, are decomposed by exposure to the air and absorption of oxygen, and they decompose water with the evolution of hydrogen gas. The double amalgam of iron and zinc does not rapidly undergo any change. All amalgams are decomposed by a red heat, the mercury being volatilised, and the more fixed metals remaining. The processes of amalgamation and decomposition are employed to separate gold and silver from their ores; the mercury obtained by distilling the amalgams is repeatedly used for the same purpose, with comparatively little loss. The amalgams of gold and silver are employed in the processes of gilding and plating. The amalgam of tin is largely used in what is termed silvering mirrors, and various amalgams of tin and zinc are employed for exciting electricity in the machine. These compounds, as well as other amalgams, will be treated of under each particular metal. Some curious effects result from the action of amalgams upon each other: if mercury be added to the liquid amalgam of potassium and sodium, an instant solidification ensues, and heat enough to inflame the latter metals is evolved. When, on the other hand, a solid amalgam of bismuth is put in contact with one of lead, they become fluid, and the thermometer sinks during their action. There is a curious compound called an amalgam of ammonium, the real nature of which has not been satisfactorily explained. When mercury is made the negative pole in a solution of ammonia; or an amalgam of mercury and potassium is placed in solution of chloride of ammonium, the metal increases in volume twenty fold, and becomes of the consistence of butter; this phenomenon appears to be owing to the combination of *ammonium* with mercury. When thrown into water it effervesces copiously, hydrogen gas is given off, and ammonia remains in solution. Ammonium amalgam, when left to itself, spontaneously decomposes into liquid mercury and a mixture of two volumes of ammoniacal gas with one volume of hydrogen.

AMALGAMATION. The process of combining any metal with mercury. Technically it is applied to the metallurgic process by which gold and silver are separated from their ores. [AMALGAM; GOLD; SILVER.]

AMALGAMATOR. Shortly after the discovery of gold in Australia, many varieties of machines were invented for crushing the quartz ore, amalgamating the powder with mercury, and separating the pure gold by this means. The machines were in some instances called 'Crushers,' some 'Amalgamators,' and some 'Separators;' such as 'Tyzard's Quartz Crusher and Separator,' 'Wright's Quartz Crusher and Amalgamator,' 'Baggs's Gold and Silver Ore Amalgamator and Separator,' &c. All that need be described on this subject will be found under AMALGAM; GOLD.

AMALIC ACID ($C_{12}H_7N_2O_8$). One of the products obtained from the action of chlorine upon caffeine. When a current of chlorine is transmitted through a thick magma of crystals of caffeine suspended in water until nearly the whole of the alkaloid is decomposed, the liquid yields on evaporation colourless granular crystals of amalic acid, which stain the skin pink and assume a violet colour when moistened with baryta water. When exposed to the vapour of ammonia amalic acid forms a magnificent purple-colored body, homologous with murexid, and termed caffeomurexid ($C_{36}H_{24}N_{10}O_{16}$).

These reactions attach amalic acid to the uric series, and, in fact, it may be regarded as dimethyl-alloxantin, that is, alloxantin in which two atoms of hydrogen are replaced by methyl ($C_8(C_2H_3)_2N_2O_7$). [URIC SERIES.]

AMANDINE. The vegetable casein found in sweet and bitter almonds.

AMARINE ($C_{42}H_{18}N_2$). An organic base produced by the action of ammonia upon the essential oil of bitter almonds (hydride of benzöyl). An alcoholic solution of oil of bitter almonds is saturated with ammoniacal gas and then allowed to stand for one or two days, at the end of which time it solidifies to a crystalline mass. This is boiled with water until most of the alcohol has been driven off, and whilst the liquor is still hot it is saturated with hydrochloric acid. An oily matter, sometimes mixed with crystals of *benzimic acid*, now separates, and the clear liquid, which must be decanted from the oil whilst still hot, contains the hydrochlorate of amarine in solution; on the addition of ammonia, crystals of amarine gradually precipitate and may be purified by recrystallisation from alcohol.

Amarine may also be obtained by the action of potash upon hydrobenzamide, and by the distillation of a mixture of hydrate of lime and sulphite of benzöyl-ammonia.

Amarine crystallises in needles, possessing a very slightly bitter taste. It is insoluble in water, but tolerably soluble in boiling alcohol, and also in ether. It possesses a slight but decided alkaline reaction, is fusible by heat, and volatilises at a higher temperature, undergoing at the same time decomposition. A boiling solution of bichromate of potash in dilute sulphuric acid, rapidly oxidises it, producing a large quantity of benzoic acid. Submitted to destructive distillation it yields, amongst other products, an organic base—*lophine* ($C_{42}H_{17}N_2$).

The salts of amarine possess an intensely bitter taste, and, with the exception of the acetate, are very sparingly soluble in water.

AMARYTHRIN. A bitter semifluid body of uncertain composition, produced by exposing to the air for a few days a hot aqueous solution of orsellic ether.

AMASATINE. [INDIGO.]

AMAURO'SIS, from ἀμαυρόω (to darken or to make obscure), dimness of sight, blindness. [GUTTA SERENA.]

AMAZONS, a fabulous nation of female warriors. Wild and almost impossible as the stories relating to them for the most part are, the historians and geographers of antiquity bear testimony to the general belief that such a nation existed. All appear to agree in assigning them a Scythian origin. Two Scythian princes, according to Justin, wandering from their own country, reached the river Thermodon in Cappadocia with their followers, and settled there. The new comers in time provoked the anger of their neighbours, and, in a war which ensued, their male population was almost exterminated. The women then took up arms, and with so much better success, that in future they resolved to live without men, and put the remaining males to death. They elected two queens, who in turn commanded their armies in the field, and kept order at home. They are said to have extended their conquests far and near, and to have founded many cities in Asia Minor, as Ephesus, Smyrna, Cumæ, and others; and indeed they are placed by different authors in so many different parts of Asia Minor, that nothing certain can be made out respecting them. Their chief seat, however, was Themiscyra, on the river Thermodon, near the southern coast of the Euxine Sea. Diodorus places a tribe of Amazons in Lybia; far more ancient, he says, than those settled on the Thermodon. The Amazons are said to have been warred on by Heracles (Hercules) and by Dionysus (Bacchus); to have invaded Attica in the time of Theseus, under the command of Hippolyta; and the battle between the Amazons and Athenians was painted at Athens in the celebrated portico called Poikile (the painted). The Amazons came to the assistance of the Trojans against the Greeks under the command of Penthesilea, who was slain by Achilles. (Virgil, 'Æn.' i. 494.) They did not neglect the care of continuing their race, but only brought up female children, whom they educated in all the arts of war, searing the right breast, that it might not interfere with the free use of the arm. They are usually figured, in medallic and other representations, with a short mantle reaching to the knee, the left breast bare. By the orator Lysias they are said to have been the first who fought on horseback, and to have had iron weapons which were not in use among their neighbours. This may, perhaps, have arisen from the geographical position assigned to them, near the country of the Chalybes, or workers in iron. Their weapons were a semicircular or crescent-shaped shield, bows and arrows, and the double-edged battle-axe, which was their peculiar and distinguishing weapon. Even in times of ascertained and credible history, we still find rumours concerning these singular beings; for it is asserted by Diodorus and Curtius, although the story is exploded by Arrian, that Thalestris, Queen of the Amazons, paid a visit to Alexander in Hyrcania; and by Plutarch, that certain Amazons fought with the Albanians against Pompeius. Of their name various derivations are given: for example, that they are so called from ἅμα ζώσας, 'females living together;' or from ἄνευ μάζου, 'without a breast.' A more recent opinion is that the name is derived from the Tscherkessischen, *maza*, the moon, and applies to a people in Upper Asia, whose chief deity was that planet. The notion of such a race has been ascribed to embellished rumours of the modes of life peculiar to the women of some Caucasian districts, and of remarkable instances of female bravery, which, in the same regions, are not unknown even in modern times.

The story of a race of Amazons is not confined to Asia. Alvarez, who visited Abyssinia in 1520, speaks of a race of Amazons south of Damot, who were warlike, and fought with bows and arrows, mounted on bullocks. They destroyed the left breast when young. They lived with their husbands, but were governed only by a queen: the men had nothing to do with war. Orellana, also, on his descent of the river Amazonas, in 1542, met with a tale of a nation of women, which of course vanished on investigation; though the fiction gave its name to one of the mightiest rivers of the newly-discovered continent, and which it has ever since retained. (Pierre Petit, 'Traité Historique sur les Amazons;' Herod. iv. 110-116; Strabo; Diodorus; Justin.)

In Greek art the Amazons were very frequently represented; and usually with an Asiatic character in contour and costume. Statues of Amazons in marble and bronze, and representations of them on sarcophagi, vases, gems, coins, &c., are extant in most public and many private collections. The combats of the Greeks and Amazons are represented on two very important series of bassi-rilievi in the British

Museum: 1. On twelve slabs from the temple of Apollo Epicurius (the Deliverer) on Mount Cotylion, near Phigalia, in Arcadia; and 2. On several slabs forming part of the frieze of the famous tomb erected at Halicarnassus, in honour of King Mausolus, by his wife Artemisia. Figures of the Amazons occur as wall paintings at Pompeii.

(Rasche, *Lexic. Rei Num.*; Müller, *Handb. der Archäol.* §§ 365, 412, 417, &c.)

AMBASSADOR is the term most commonly used by writers on public law to designate every kind of diplomatic minister or agent, and may, in this sense, be defined to be a person sent by one sovereign power to another to treat upon affairs of state.

Among the ordinary functions of an ambassador, the following are the most important: First, to conduct negociations on behalf of his country. The extent of his authority in this respect is limited by the power which he has received; he has, however, by the modern law of nations, no authority to conclude any engagement definitively, the treaty which he has negociated having no binding power till it has been formally ratified by his government. Secondly, to watch over the accomplishment of all existing engagements; and, Thirdly, to take care generally that nothing is done within the territories of the state, nor any treaty entered into with other powers, by which the honour or interests of his country can be affected, without informing his government of such measures.

Besides these more public functions, an ambassador has certain duties to perform towards private individuals of his own nation: such as to provide them with passports; to present them at court, if they produce the requisite testimonials; to protect them from violence and injustice; if any manifest wrong has been done, or if justice has been refused them, to obtain redress, and to secure for them the full benefit of the laws; and, lastly, to assist them in maintaining their rights in courts of justice, as well by certifying what is the law of his country upon the point in dispute, as by the authentication of private documents, which is usually confined in practice to such as have been previously authenticated at the foreign-office of his own government, and thence transmitted to him.

The right which exists in every sovereign power, of communicating by means of ambassadors, implies on the part of the state to which such communications are made, certain corresponding duties. (Grotius, ii. c. 18.)

The first of these duties is that of receiving the ambassadors sent to it. This is a duty, however, which exists only between nations at peace with each other; for, in time of war, a hostile power cannot claim to have its ambassadors received, unless they are provided with a safe-conduct or passport; and the granting of these is merely a matter of discretion. And in order to claim the performance of this duty, it is, in all cases, requisite that the ambassador should be provided with the proofs of his authority; these are contained in an instrument called his Letters of Credence, or Credentials, delivered to him by his own government, and addressed to that of the state to which he is sent. [CREDENTIALS.] A refusal to receive an ambassador properly accredited, if made without sufficient cause, is considered a gross insult to the power that he represents. But if one of several competitors for the sovereign power in any country, or if a province which has revolted and asserts its independence, claims to send an ambassador, a government, so far from being bound to receive the person so sent, cannot do so without thereby taking upon itself the responsibility of recognising the competitor in the one case to be actually the sovereign, and the revolted province in the other to be actually independent. Though this may be the general principle, the practice is somewat different. In such cases, consuls are generally first sent; and when a *de facto* power has been established for some time, governments think themselves justified in following up these consuls by ministers, even though the mother country, to which the revolted states belong, may not have recognised their independence. This was done by the British government and others in the case of the South American States.

The next great duty of a state, with respect to ambassadors sent to it, is to protect them from everything which may in any degree interfere with the due performance of their functions. This duty commences even before the ambassador has delivered his credentials, as soon as his appointment has been notified to the court. This is the principle on which are founded what may be called the essential privileges of an ambassador.

The first of these privileges is that of perfect security; for as he is necessarily placed among those who have always the power, and, from the nature of his duties, not unfrequently the will to molest him, it is requisite that he should be in the fullest manner protected from every kind of violence whatever, either to his person or his property. The breach of this privilege has, from the earliest ages been considered a high offence against the rights of nations, whether proceeding from the sovereign power itself, or from the unauthorised acts of individuals.

The second essential privilege of an ambassador is, that no legal process can affect him, in his person or his property; at least so much of his property as is connected with his official character, such as his furniture, equipages, &c. Ambassadors are therefore deemed not to be amenable for their conduct before any *civil* tribunal of the country they reside in.

No claim can be enforced against an ambassador by any compulsory process whatever. It is a matter of dispute how far an ambassador is privileged in matters in their nature *criminal*. (Blackst. 'Comm.' Mr. Kerr's ed. vol. i. p. 247.)

These privileges are not confined to the ambassador alone, but are extended to all his suite—his companions as they are sometimes called,—including not only the persons employed by him in diplomatic services, but his wife, chaplain, household, &c. The law of nations in this respect is fully recognised by the law of England. By the statute of 7 Ann. c. 12, all legal process against the person or goods of an ambassador, or of his domestic, or domestic servants, is declared to be void. (Blackst. 'Comm.' *supra.*)

The third essential privilege of an ambassador is, that his residence enjoys a security similar to that of his person and property: it is not only protected from open outrage, but is likewise exempted from being searched or visited, whether by the police, by revenue officers, or under colour of legal process of any description whatever.

The salaries and pensions for diplomatic services are paid out of the consolidated fund, and are regulated by 2 & 3 Wm. IV. c. 116.

For further information on the subject of ambassadors, the reader may consult Wicquetort, 'De l'Ambassadeur;' 'Les Causes Célèbres du Droit des Gens,' by C. De Martens; and the writers on the law of nations, particularly Vattel and G. F. Martens; and likewise the 'Cours de Droit Public,' par Pinheiro-Ferreira.

The functions of permanent ambassadors appear to have originated in modern times. The ambassadors (πρέσβεις) sent by the Greek states, and those sent by the Romans (legáti) or received by them, were limited to extraordinary occasions. Among the Romans, ambassadors were often sent by foreign nations to them, and sent by the Romans to foreign states, and the law with respect to them (Jus Legationis; Livy, vi. 17)b ecame in course of time well settled. Ambassadors to Rome were under the protection of the state, whether they came from a hostile or a friendly nation. They were received by the Roman senate and transacted their business with that body. The senate appointed the ambassadors who were sent from Rome to foreign states. The expenses of such ambassadors were paid by the Roman state, but the ambassadors were also entitled to make certain demands from the provincials in their progress through a Roman province.

The word 'legatus' is a participle from the verb 'lego,' and signifies a person who is commissioned or empowered to do certain things.

AMBER. A resinoid body, either exuded from certain plants of the coal epoch or produced during the formation of coal and lignite. It is found most abundantly on the shores of the Baltic, where it is often washed upon the beach during the autumnal storms. It has also, though rarely, been found on the Scandinavian coast, in Greenland, England, Italy, Spain, Sicily, Siberia, China, and the United States. Its colour varies from light yellow to brownish yellow, orange-red, and brownish black. It is generally translucent, but sometimes milk-white and opaque, has a resinous conchoidal fracture, and bears a good polish, hence its employment in jewellery. When rubbed it becomes strongly electric. Heated to 550° it fuses, gives off an agreeable aromatic odour, and burns with a clear flame. Its specific gravity is 1·065 to 1·070. It is inodorous and tasteless, entirely insoluble in water, but soluble in spirit of turpentine by the aid of heat.

Amber contains a volatile oil (oil of amber), succinic acid, and two resins soluble in alcohol and ether; its chief constituent, however, is a peculiar substance—*amber bitumen*, insoluble in alcohol and ether. Amber, when freed from everything soluble in ether, has the same composition as laurel camphor, which may be expressed by the formula $C_{20}H_{16}O_2$.

AMBERGRISE. An organic substance of uncertain origin, said to be a diseased secretion of the Spermaceti Whale, and to be found floating on the sea near the coasts of Madagascar, Coromandel, Japan, and the Moluccas; it is of a greyish colour with darker streaks running through it. In the hand it softens like wax, and exhales an agreeable odour. Its specific gravity is about 0·91. It contains a volatile oil, and benzoic acid, but its chief constituent is Ambrein, of which it contains about 85 per cent.

AMBREIC ACID. [AMBREIN.]

AMBREIN ($C_{33}H_{32}O$). A fatty body analogous to cholesterin found in ambergris. From boiling alcohol it crystallises in fine colourless needles, tasteless, but possessing an agreeable odour. Ambrein fuses between 86° and 104°, or may be distilled without alteration. It is very soluble in ether, and in fixed and volatile oils, but is not saponifiable. Nitric acid converts it into ambreic acid.

AMBROSIAN LIBRARY at Milan. The Ambrosian Library owes its existence to the munificence of Cardinal Frederick Borromeo, archbishop of Milan. He laid the foundation of it in 1602, and it was opened to the public in 1609. Its name was given in memory of St. Ambrose, archbishop and patron-saint of Milan. Frederick Borromeo not only placed his own collection of books in this library, but sent his librarian, Anthony Oggiati, into different countries to purchase additions. Montfauçon assures us that numerous manuscripts were obtained for it from Thessaly, Chios, Corcyra, and Magna Græcia: the founder added to these some very valuable accessions from the monastery of Bobbio (anciently Bobium), in the northernmost Apennines, together with a considerable assemblage of manuscripts from the Pinelli collection; the latter cost no less than three thousand four hundred ducats. It was the founder's original intention to join to the endowment of his library a college of sixteen learned men; but the want of funds reduced the number to four: of these, one translated Greek, a second taught Hebrew, a third Arabic, and a fourth was to make collections of whatever was valuable in authors. The Ambrosian Library now contains above sixty thousand printed volumes, with rather more than fifteen thousand manuscripts; and annexed to it is a gallery of pictures, statues, antiques of various kinds, and medals, and containing numerous articles of rarity and reputation. Many of its curiosities of every description were carried to France during Bonaparte's campaign in Italy, and with them a manuscript collection of the works of Leonardo da Vinci, accompanied with drawings and designs, which a citizen of Milan, of the name of Galeas Arconati, refusing every lucrative offer from private persons, had given to the Ambrosian Library. One volume of this collection was returned to the library after the Peace of Paris in 1814, but the remaining volumes, having been sent to the library of the Institute and not to the Bibliothèque du Roi, it was not at the time of the reclamation known where they were, and they are yet retained in Paris. Another rarity belonging to the Ambrosian collection is a manuscript of Virgil, the margins of which are interspersed with notes in the hand-writing of Petrarch: the 'Palimpsesti,' or rescript manuscripts, edited between 1814 and 1816 by Angelo Mai, were discovered in the Bobian portion of the Ambrosian collection. Oggiati, Muratori, and Mai, have been the three most eminent librarians of this library. Mai became afterwards the librarian of the Vatican. The hall is well proportioned, though not so large as might be expected for a collection of books and manuscripts so considerable. The ceiling is adorned with paintings, and the space between the book-cases and the cornice filled up by the portraits of the most eminent authors whose writings are deposited below.

(For further information on the Ambrosian Library we refer to Boscha *De Origine et Statu Bibliothecæ Ambrosianæ Hemidecas*, 4to. Milan, 1672; Saxius *De Studiis Literariis Mediolanensium Prodromus*, 8vo. Milan, 1729, p. 147; and Montfaucon's *Diarium Italicum*.)

AMBRY, or ALMERY, in Gothic churches a locker or closet used for keeping the sacramental elements, the ecclesiastical plate, vestments, documents, &c. Ambrys were usually formed in the thickness of the wall, enclosed with a door, and secured with a lock. In every church there was an ambry by the altar to contain the utensils belonging to it; but in large churches and cathedrals there were usually several in various parts of the building, and some of them of large size. Generally they were made to contribute to the architectural effect of the edifice by means of a traceried arch or a crocketed canopy: the doors were also sometimes considerably enriched. Few in this country at least retain their original fittings. In some of the French churches excellent examples of the mediæval ambry still remain.

AMBULANCE, a French word derived from the Latin *ambulare*, to walk or march, applied to the moving hospitals which are attached to and accompany every army, or division of an army, in the field; also to the means of transport for sick and wounded soldiers. As medical science increased, the necessity was felt for some organization of this kind to render immediate surgical and medical aid to sick and wounded soldiers. But the credit of the first introduction and organisation of an ambulance train on the present footing is due to the celebrated French surgeon Baron Percy, who, when head of the medical staff of Napoleon's army in Spain, formed the first battalion of the Ambulance Corps, having previously, when under Moreau, organised a *Corps Mobile de Chirurgie Militaire*. Since his time great improvements have been introduced, especially by the well-known Larrey, in this most important department, and have been adopted in the various armies of Europe. The ambulance trains usually consist of covered spring-waggons, with litters inside for the sick and wounded men, containing also surgical apparatus and medical comforts, though, of course, the patterns of these vary much in the different armies.

One of these, which may be more particularly mentioned as employed in the French army, and from it adopted in the English army during the Crimean war, consists of two stretchers hung one on each side of the pack-saddle of a mule or pony. The stretchers, made with an iron framework and canvass bottom, are so contrived as to fold up and make an arm-chair, or, being extended, to form a sloping bed.

These can accompany troops over more difficult ground than the waggons, and afford assistance to exhausted men who would otherwise be neglected and left on the line of march; or attending close to the scene of action, receive the wounded men who are carried to the rear on stretchers, and remove them with the utmost promptitude to the ambulance hospitals, which are placed out of reach of the enemy's fire.

(*Biographie Universelle*, Suppl. 76; also Larrey, *Mem. de Ch. Milit.* vol. i.)

AMBULATORY (from the Latin *ambulo*, to walk) is, in a substantive sense, a place to walk in. With reference to buildings, this term may be applied to the space enclosed by a colonnade or an arcade. In the peripteral temple of the Greeks, the lateral or flanking porticos are properly termed ambulatories; the cloister of a monastery is surrounded by an ambulatory or ambulatories. Of the external colonnaded ambulatory, the porticos of the *Bourse* or Exchange at Paris afford a good modern exemplification; and of an internal arcaded ambulatory, a good instance is afforded by the Royal Exchange in London. The aisles of the ancient Basilica, and those of its representative in later architectural works, the cathedral, or other large church, are sometimes called ambulatories.

In an adjective sense, ambulatory may be applied to anything, the functions of which require it to move from place to place. Formerly the Parliament and the Court of King's Bench in this country were termed ambulatory courts, because they were held sometimes in one place, and sometimes in another: indeed, wherever the king happened to be.

AMBUSCADE. A military term derived from the Italian *imboscare*, *imboscata*, to lie in bushes or concealed, *in* and *bosco*, *bosque*, a wood; Eng. *bush*. It is the same as the original English word ambush. It signifies the lying in wait, or concealed, to attack an enemy unprepared, and therefore at a disadvantage. In ancient times before the introduction of fire-arms, when armies were not encumbered with long trains of material, &c., this mode of attack was more common and more frequently successful than at present, when it can only be adopted with small and detached parties. And in fact we only hear of such things in wars against barbarous or semi-civilised peoples, or in a war of outposts. A case occurred in the late Indian mutinies where the party sent to relieve the fortified post of Arrah, then besieged by the mutinous Sepoys, while marching through a wood after nightfall, fell into an ambuscade, were surrounded, and nearly cut to pieces.

We do not include in this word an attack which, though unexpected and sudden, is made while the other party is aware of an enemy somewhere in the neighbourhood; or an unexpected attack made upon an enemy in position, which is called a surprise.

AMEN, a Hebrew word, properly signifying 'firmness,' and hence 'truth,' which has been adopted without alteration in various languages.

Its most frequent use is at the conclusion of prayers, thanksgivings, and denunciations, where it is understood to express belief, assent, and concurrence in what has been expressed. Examples of its use in all these cases are numerous in the Bible. When the priest has declared to the woman suspected of adultery the effect of the water of jealousy, "the woman shall answer, Amen, amen."—Numb. v. 22. When curses are pronounced against the wicked in Deut. xxvii. 15, all the people are ordered to repeat amen.

The word amen concludes all the gospels, and almost all the epistles; it is repeated at the end of four of the five sections of the Psalms according to the division of the Jews; namely, the 41st, the 72nd, the 89th, and the 106th Psalms; in this last Psalm it is followed by hallelujah, which word concludes the last section.

In many churches in England, the word amen is pronounced aloud by the people: this was the ancient practice of the Christian world, and St. Jerome relates, that when the congregated people at Rome pronounced amen, the sound was like that of a clap of thunder. They possibly attributed great efficacy to the loudness of their voices, after the example of the Jews, who imagined that this word, shouted forth with great force, had power to open the gates of heaven.

Amen is often used by our Saviour at the beginning of a discourse, as an impressive particle, which in our version is rendered 'verily.' In the Gospel of St. John the word is always repeated.

In one instance this word is used as an adjective, meaning certain, fixed. "For all the promises of God in him are yea, and in him Amen," 2 Cor. i. 20. In one other instance the word denotes our Saviour. "These things saith the Amen," Rev. iii. 14.

AMENDE HONORABLE. Amende in French is a penalty, so called from being regarded as a compensation for, or rectification and amendment of, the offence. According to the old laws of France, persons guilty of crimes coming under the head of public scandals, such as sedition, sacrilege, fraudulent bankruptcy, &c., used sometimes to be condemned to make a public confession of their guilt. This was called making the *amende honorable*, which was either simple, or *in figuris*, in which last case the culprit was conducted by the public executioner into open court in his shirt, with a rope about his neck, and a lighted torch in his hand, and in that state made his confession on his knees. The amende honorable was accounted an infamous punishment, and appears to have been so called as consisting altogether in the disgrace, and not in any fine or other actual suffering. The courts, however, were also sometimes wont to order a person by whom the reputation or honour of another had been injured to make a public acknowledgment of the wrong; and such a sentence carried no infamy with it. It is from this latter custom that the modern and popular use of the expression has been borrowed, according to which we say that a person makes the amende honorable when he publicly admits any wrong which he feels that he has done to another person.

AMENDMENT, in Law, signifies the correction of mistakes in the records of judicial proceedings. In the early period of our English law, the pleadings between the parties were conducted *ore tenus*, as it was called, at the bar of the court by their respective advocates. If any mistake occurred in the pleading of either party, it was corrected at once upon a suggestion made to the court. Subsequently, when oral pleading became superseded by the present practice of delivering written pleadings between the parties, the same indulgence as to amendments continued. Hence the courts upon application by either party, will amend the interlocutory proceedings in a cause; and at the present day will amend mistakes in the pleadings, whilst they continue in paper, upon proper terms. But anciently, after the proceedings were once entered on record, the judges considered that they had no authority to alter them in any respect; either for the purpose of correcting false Latin, of supplying a word, syllable, or letter accidentally omitted, or of removing any other clerical error. The consequence was, that after a suit had been decided in favour of one party, it frequently happened that his adversary discovered some blunder made by the officer of the court on making up the record and by bringing a writ of error, deprived the successful party of all the benefit of the judgment he had obtained. This inconvenient rule arose out of a rigid observance of an ordinance of Edward I., which directs the judges to record the pleas pleaded before them, but forbids them "to make their records a warrant for their own misdoings, or to erase or *amend* them, or to record anything against their previous enrolments." These words obviously imply nothing more than a reasonable restriction upon the alteration of the records of the court clandestinely or for sinister purposes, and certainly do not justify the strict interpretation afterwards applied to them. To the rule thus established there were several exceptions:—1. All errors in records might be amended during the same term in which they were made, because in contemplation of law the record is in the breast of the judges during the term, and not on the roll. 2. In an essoign, or excuse by a defendant for not appearing in proper time, if the plaintiff's name were mistaken, the mistake might be amended, because it was inconsistent with the writ, and, if enrolled in its erroneous form, it would be a record against a previous enrolment, and for that reason a breach of the ordinance. 3. For the same reason, a continuance, which is an entry on the record showing the continuation of a cause from one term to another, might be amended so as to make it correspond to the proceedings previously recorded.

It is plain that these ingenious exceptions would afford little relief from the strictness of the rule; and in cases which did not fall directly within them, the judges held that they were bound by the ordinance of Edward I., and refused to rectify the most palpable errors after the expiration of the term to which the record belonged. It is possible that the judges adhered thus closely to their interpretation from a reasonable regard to their own safety; for in the seventeenth year of Edward I. (1289), we find that king instituting a prosecution of enormous severity against the judges, and imposing fines amounting altogether to 70,000*l.* for imputed offences, connected, for the most part, with the erasure and alteration of the records. With this before their eyes (and it was an expedient very convenient for a monarch engaged in expensive wars to repeat for the purpose of replenishing his coffers), the judges were perfectly justified in erring on the side of caution, by adhering to the strict letter of the ordinance.

But this rigid abstinence from all alteration of the record was necessarily a great inconvenience in the administration of justice, and led in course of time to a series of legislative enactments, called Statutes of Amendment and Statutes of Jeofails (from the Norman-French, *j'ai faillé*), by the former of which, authority was given to amend certain specified errors; by the latter, the judges were empowered to proceed to judgment notwithstanding such errors. The first Statute of Amendment (14 Edw. III., c. 6, 1340) enacted that no process should be annulled by a clerical mistake in "writing one syllable or letter too much or too little; but that as soon as the thing was perceived by the objection of the party, or in other manner, it should be amended in due form, without giving any advantage to the party who objected to the mistake." The judges exhibited great reluctance to depart from the letter of the statute, and much discussion arose whether the statute, though it authorised the amendment of a letter or syllable, extended to the case of a total omission of a word. In a case in which this point was raised some years after the statute had been passed, the judges resolved to incur no personal danger by deciding it, but formally consulted the law-makers upon the meaning of the Act. "I went," says Chief Justice Thorpe, who describes this conference in a case in the 'Year Book' (40 Edw. III. c. 34), "together with Sir Hugh Green, to the Parliament, and there were twenty-four of the bishops and earls; and we demanded of them who made the statute, if the record might be amended; and the archbishop or metropolitan said, that it was a nice demand, and a vain question of them, if it might be amended or not; for he said that it might as well be amended in this case as if it were but one letter, for if a letter or a syllable fail in a word, it is no word; wherefore, if all the word fail, it may be amended as well as if it failed but of a letter or a syllable; for there is no more difference in the one case than in the other." Upon this advice of the archbishop, the judges admitted the amendment of a word.

In consequence of the indisposition of the judges to give this statute a liberal interpretation, it proved in a great measure ineffectual; for though its terms appear to extend to every part of civil or criminal proceedings, the judges construed the word 'process' strictly, and confined amendments to civil suits, and in them to errors in the process for the defendant's appearance, and for summoning the jury. If therefore a mistake of a word, syllable, or even a letter, was made by the clerk in drawing up the roll or body of the record, the whole proceedings might be annulled by a writ of error. To remove this, and to enlarge the power of judges in amendments, the statutes 8 Henry VI. c. 12 and c. 15 (1430) were made, by which the judges were authorised, "in any record, process, word, plea, warrant of attorney, writ, panel, or return, to amend all that which to them seemed to be the misprision of the clerk;" and also the "misprisions of sheriffs, coroners, bailiffs of franchises, or other officers, in their returns."

But these latter enactments, which were, properly speaking, the only statutes of amendment in ancient times (those which followed being statutes of Jeofails), though they considerably enlarged the power of the judges in making amendments, proved an insufficient relief to suitors. They extended only to the amendment of the misprision of the clerks, and upon this point subtle doubts and nice distinctions were suggested by the acuteness of legal criticism, and multiplied to an enormous extent in the course of the ensuing century; in consequence of which, judgments were continually overthrown by formal objections, founded on errors which the courts did not consider to be strictly clerical misprisions.

The next legislative provision was a Statute of Jeofails, passed in 1540 (32 Henry VIII. c. 30), by which it is enacted, that "where the jury have given their verdict for either party in any court of record, and a jeofail or mistake is afterwards discovered, the judgment of the court shall stand according to the verdict without reversal." This was followed by the statute 18 Eliz. c. 14 (1572), which declares, "that after verdict given in any court of record, judgment shall not be stayed or reversed for false Latin or other faults in form, in original and judicial writs, counts, &c., or for want of any writ, or by reason of the imperfect return of any sheriff, or for want of any warrant of attorney." The 21st Jac. I. c. 13 (1623) specifies several other formal defects not mentioned in the previous statutes, and declares, that on account of such defects, when discovered after verdict, no judgment shall be stayed or reversed. The next Statute of Jeofails, in chronological order, was the 16 & 17 Charles II. c. 8 (1665), called by Mr. Justice Twisden "the Omnipotent Act," which was intended to remove doubts arising upon former laws as to the distinction between matters of form and matters of substance, and also specified a great variety of minute technical defects, which after verdict were not to arrest or stay the judgment of the court. These statutes were calculated to aid imperfections in form after the verdict of a jury had passed upon the facts. This limitation was extremely unreasonable and prejudicial, as it enabled a party who made no defence, and had no substantial defence to make, to defeat a just action, by taking formal objections to the record, in arrest of judgment, or upon a writ of error, of which he could not have availed himself after a verdict. To remedy this inconsistency, the statute introduced by Lord Somers, after his retirement from the office of chancellor in 1705 (4 Anne, c. 16) extended the operation of the Statutes of Jeofails to all cases of judgment by confession or default.

From this summary view of the statutes, it appears that since the time of Henry VI. the legislature discontinued the direct and convenient mode of obviating the evil by allowing the judges to amend formal errors in their records where justice required it, and adopted a circuitous and uncertain course, by specifically enumerating certain errors and mistakes which were not to deprive the successful party of his judgment. Perhaps the caution of the judges in former times, in adhering rigidly to the letter of the power delegated to them, may have suggested this course to the legislature. However this may have been, there can be no doubt that the authority to amend under certain restrictions was the more efficient remedy. The Statutes of Jeofails have always given very imperfect relief to suitors; for professional ingenuity has never failed to discover new errors not specified in them, and to draw subtle distinctions in cases where the words of the statutes were to a common understanding distinctly applicable.

In modern times a disposition has been manifested to proceed upon the ancient course, by increasing the authority of the judges to make amendments. A most important improvement at the time was introduced by the statute of 9 Geo. IV. c. 15, which enabled "any court of record in civil actions, any judge at Nisi Prius, and any court of Oyer and Terminer and gaol delivery, if such court or judge should see fit so to do, to amend the record upon the appearance of a variance between any matter in writing or in print produced in evidence, and the recital thereof upon the record."

Further improvements, both in the pleading and practice of the courts, were effected by the 3 & 4 Will. IV. c. 42, §§ 23 & 24. But all former powers of amendment vested in the judges have been swallowed up, as it were, in the sweeping powers lately conferred on the courts by the Common Law Procedure Acts of 1852 and 1854, which not only enable amendments to be made in nearly all matters of merely technical detail, but require the judge at all times to make all such amendments as shall be necessary, so that the real question in issue betwixt the parties shall be tried in the existing suit. This statute also sweeps away several niceties in the practice of special pleading, which have for centuries been a fertile source of delay and expense, as well as caused frequently a positive defeat of justice; and it is somewhat curious, that practically the statute will to some extent cause a return to the ancient system of pleading *ore tenus*, for defective and erroneous pleadings are not to be objected to by special demurrers, which are abolished, but to be summarily amended by a judge at chambers, at the instance of the party objecting, and on such terms as to costs, answering the amended pleading, &c., as the judge shall determine.

In one of the early Statutes of Amendment (8 Henry VI. c. 12) indictments and criminal prosecutions are excepted from its operation;

and though there is no such exception in the other Statutes of Amendment, or in the Statutes of Jeofails, it was established by the current of authorities, that notwithstanding those statutes, criminal pleadings stood upon the same principles with respect to amendment as those to which all pleadings were subject at common law. With respect to indictments, it was considered that, as they are found upon the oath of a jury, there would be a manifest impropriety in making any alteration without their consent; hence it became a common practice to ask the grand jury, at the time of their returning their bills into court, whether they consented that the court should amend matters of form in the bills they had found, altering no matter of substance without their privity. Instances of such amendments are unknown in modern practice. Criminal informations, which do not depend upon the oath of a jury, may be amended by the court at any time before trial; though this was considered, as late as the time of Lord Holt, to be a questionable point. A frequent failure of justice by means of minute objections was the consequence of this exclusion of criminal cases from the beneficial operation of the statutes. An attempt to remove this evil was made in 1826, by the statute 7 Geo. IV. c. 64, in order, as the preamble states, "that the punishment of offenders might be less frequently intercepted in consequence of technical niceties." It provides that no judgment upon any indictment or information, for any felony or misdemeanour, whether after verdict of outlawry, or by confession, default, or otherwise, shall be stayed or reversed for want of the averment of any matter unnecessary to be proved; then proceeds to specify a variety of defects, and enacts that an objection founded on the appearance of such defects upon the record shall not have the effect of staying or reversing the judgment of the court.

But the whole mass of legal subtleties in indictable cases were swept away by the 14 & 15 Vict. c. 100, so that now criminal trials will be upon the merits, and on the merits only.

It would be out of place here to attempt to enumerate the various statutes passed to remedy defects in the administration of criminal justice. These can only be stated under the heads of the respective subjects to which they refer.

AMENDMENT, in Parliamentary Proceedings, is an alteration proposed to be made in the draught of any bill, or in the terms of any motion under discussion. Although no member (except when the House is in committee) is allowed to speak more than once upon the same question, he may speak again upon the amendment, which is considered so far a new question. Sometimes an amendment is moved, the effect of which is entirely to reverse the sense of the original motion; but when this is the object, it is more usual to move a negative. It not unfrequently happens, however, that the amendment proposes to leave out all the words of the original motion except the word "That," with which it commences, and to substitute others in their place. When a motion for the amendment of the House is made, it is always in the words, "That the House do now adjourn." If carried, the House adjourns to the next sitting day, unless a resolution shall have been come to previously, that at its rising it will adjourn to some other day. It is not competent, therefore, upon a motion for adjournment to move an amendment, specifying any day to which the House shall adjourn. It was long disputed whether, when an amendment was proposed to a motion after the previous question had been also proposed, it was necessary to withdraw the previous question before the amendment could be put; it was decided in the House of Commons on the 16th March, 1778, that it was necessary first to withdraw the motion for the previous question. An amendment may be proposed upon an amendment. It is commonly said that the rule is, when an amendment has been proposed, that the amendment is first put to the vote, and then the main question; but this is not exactly the practice of Parliament. There the general rule is, that the motion which has been first put and seconded, shall always be the first put from the chair; and, accordingly, when an amendment has been proposed, instead of the question that it shall be adopted being directly put, a vote is taken upon the question, "That the words proposed to be left out stand part of the question." If this motion is carried in the affirmative, the main question, which is really the same thing, is next put, and, of course, agreed to. But if the motion, "That the words proposed to be left out stand part of the question," is negatived, the words that were proposed in the amendment are substituted, as of course, and the main question thus altered is then put. So that, in point of fact, the amendment separately is never put at all.

When amendments are made in either House upon a bill which has passed the other, the bill, as amended, must be sent back to the other House. The rules of proceeding between the Houses, in the case of such amendments, are as follows:—"1st, Either House disagreeing to amendments made by the other should assign reasons, and all reasons must be delivered at a conference; 2ndly, If the reasons for disagreeing are held to be sufficient by the other House, that House answers by message that they do not insist; 3rdly, If held insufficient, the House at a conference say, that they insist, or adhere, and give reasons for so doing." It may be added, that the almost uniform practice in both Houses, when it is intended not to insist upon the amendments, has been to move affirmatively "to insist," and then to negative that question. As to the practice in passing bills in Parliament, see May's 'Treatise on the Laws, Usages, &c., of Parliament,' and 'The Standing Orders of both Houses,' published annually.

AMERCEMENT. Where courts of justice impose a pecuniary punishment, the sum ordered to be paid is termed a *fine*, or an *amercement*, according to the nature of the offence and the authority of the court. The difference between these is not merely nominal, though at the present day of no practical importance. The remedy for the recovery of an amercement is by action, or by distress; for a fine, the law has provided a process for securing payment, by arrest of the person.

Where the offence amounts to a breach of the peace, or to a contempt of court, a fine is the ordinary punishment, the amount of which is in the sole discretion of the judge: where the offence is of a lighter character, the party is punished by being amerced; and is said to be *in misericordiâ*, or 'at the mercy' of the court. In the latter case, the court has no further authority than to adjudge that *some* amercement shall be inflicted on the party; the *amount* of it the law leaves to be assessed (or, in technical language, *affeered*) by persons whose character is analogous to that of a jury.

Thus the sum ordered to be paid by way of penalty for the commission of any criminal acts, of which an offender has been found guilty, is a *fine*, and is sometimes also called a *ransom*, because it is imposed in lieu of corporal punishment.

So, anciently, where the defendant in a civil action had a verdict against him for the commission of a trespass, or any other civil injury accompanied by force or violence, the court awarded that he should pay a fine to the crown over and above the damages which he was liable to pay to the injured party. (Hence the origin of the former, and now abolished, proceedings called 'Levying a Fine,' to bar an estate tail.) Where there was a verdict in an action against the defendant for a breach of contract, or other similar injury wholly independent of any imaginable force or breach of the peace, the court awarded that he should be *amerced* (in addition to the usual judgment of damages, &c., payable to the plaintiff), and the proper person to assess the amount was the coroner of the county in which venue in the action had been laid. In actions in which the plaintiff failed in establishing his right, a similar amercement was imposed on him *pro falso clamore suo;* and this is in addition to the costs which he had to pay to the successful party.

Although the records of legal proceedings till quite recently carried on their face the formal evidence of these ancient usages, and the defeated plaintiff was nominally amerced for his false claim, and the unsuccessful defendant made liable in many instances to be amerced for his resistance to the plaintiff's just demand, yet in civil actions, neither fine nor amercement were ever in fact levied. In some cases the legislature had abolished the practice; in others it had been abrogated by desuetude, and therefore when new forms of proceedings were framed, after the passing of the Common Law Procedure act of 1852, the nominal amercement of the unsuccessful litigant was done away with. Scarcely any other fines or amercements are now known, except those which are imposed in the execution of criminal justice.

The subject of amercements was formerly of sufficient importance to obtain a place in the provisions of the 'Great Charter,' which enacts that they shall be equitably proportioned to the magnitude of the offence, and shall in no case be so excessive as to deprive the offender of the means of livelihood. It is by analogy to the case of amercement that fines, although not expressly named in 'Magna Charta,' are deemed to be constitutionally within its spirit, so as to restrain within moderate and reasonable limits the discretion of the judges in imposing them.

(*Bill of Rights*, 1 William and Mary; Bacon's *Abridgment*, tit. *Fines and Amercements;* Blackst. *Comm.* iii. p. 429.)

AMERICANISM, a term used to express some peculiarity in the written or spoken language of the inhabitants of the United States of North America. Of all the colonies of Great Britain, in which her language has been planted, the United States are yet the only parts that have been separated from the mother-country, and have attained political independence. In consequence of the rapid increase of their population, the diffusion of education, and the springing up of a numerous body of native writers, we see a new phenomenon in the history of the world, of two great nations separated by a wide ocean using the same language. To preserve this language in its purity, as far as its essential character is concerned,—to introduce no new words but such as experience shows to be necessary,—to form them on true principles of analogy, and to give to them precise and definite meanings—these are objects of equal importance to the two nations; for the preservation of a common language is a bond of unity, and one of the great elements of civilisation. The mother-country may yet claim—and perhaps her claim will be allowed by some Americans—the privilege of a very rigid examination of American importations, before she allows them to be current coin of the realm; but to attempt to reject all new words that America produces, would be both absurd and ineffectual. New wants and new circumstances are the parents of new terms, which increase quicker in a new than in an old country. The main differences between the spoken and written English language, as it exists in America and Great Britain, may be comprised under the following heads:—Pronunciation; the use of words now obsolete in England, or used in different senses; the use of words in various parts of America, as they are still used in various provinces of England; and new words.

As to the use of words now obsolete in England, they are mainly confined to conversation, for every one is aware that there is very little in the style of a good American writer, except perhaps a greater degree of ornament, by which we can distinguish it from that of a good English writer. But as the Americans write a great deal in public journals, and are the most prolific people in the world in producing inaugural speeches, orations, and all the various modes of addressing an audience, we should look at that part of their language in order to form a complete judgment of its whole condition, as well as at those specimens of composition which are of a less showy but more valuable and permanent nature.

The number of words now used in a different sense from that which they have in England is but small among writers of good authority; the list of those used in conversation would be somewhat larger. We have heard the word *shew* used as the past tense of the verb *to show;* the form is now obsolete in England, but may be found in our older writers. In some parts (for we are aware that in so extensive a country scarcely any remark of this kind can be general), the word *balance* in the spoken language is employed to express the *remainder*, or *the rest:* thus people speak of the "balance of the professors," meaning "the rest of the professors." The word *mutton* is sometimes used, as it once was in England, to signify a sheep. Dr. Webster remarks, that this sense is obsolete or ludicrous: it is not either obsolete or ludicrous in the spoken language of some districts. The word *bug* is used (see Webster) in its original sense of a *fly;* and the old verb *prògress*, which the Americans use very often, and pronounce *progréss*, is now beginning to be again adopted in its native country, though we think we could very well do without it. In judging how far words used in America in different significations from what they have in England have been sanctioned by authority, and established in the written language, we cannot perhaps take a better guide than Dr. Webster's 'Dictionary,' and we shall find the number by no means small. Cooper, in his 'Mohicans,' speaks of a "lake having *flowed* its usual banks." Webster sanctions this usage under a transitive sense of the word *flow*, which he makes equivalent to *overflow*. (See Webster's 'Dictionary,' under *flow;* and the example.) Against this usage we take the liberty of protesting. In the 'National Intelligencer,' March 2, 1826, we find—"for providing a jurisdiction *convenient* to the scene of almost all the shipwrecks;" this English-provincial and Irish use of *convenient* in the sense of *near* is properly omitted by Webster. The verb *rent* has the double meaning in Webster of *granting on lease*, as a proprietor does, and *taking on lease*, as a tenant does. *Nullification* is not in Webster, but has been defended on the ground of analogy, and by a reference to the use of *nullify* in Flavel. The usage of the word *locate* is familiar to all who read American papers or public documents: we say "that a man has *located* (that is, has selected, surveyed, and marked out) a hundred acres in Alabama." The word *expect* is often used in a strange sense in some parts of America, but certainly nearly altogether in conversation, as in the following instance given by Webster: "I *expect* it was." The American lexicographer justly condemns this usage, which is of provincial English origin. The word *guess* in the sense of *believe* is another conversational expression. The word *lengthy* some critics object to as being of American origin: we rather doubt if it be. Still it is a good word, well made, and well adapted to express the wearisomeness of listening to a long speech or discourse of any kind: we presume that in this, as in some other instances, the Americans did not call the word into use till they felt the absolute necessity of it. For other American usages which are somewhat peculiar, the reader may refer to the following words in Webster:—*wagon* (*waggon*); *stud-horse; subserve; clever* (Webster's account of the English use of this word is incomplete); *notify; graduated*, &c. The American uses of *creek, girdle, section*, &c., may be seen in Webster. *Firebar*, in Webster, for *five-barrel*, is a mere vulgarism. Mr. Pickering, in a work published at Boston in 1816, has traced a great number of words and phrases, which have been considered as Americanisms, to the counties of the mother-country. We recollect one word at present, which we can only trace to Holland. In Virginia, *waffel-cakes* are often made; a similar cake, with the same name, *waffel*, is very common in Holland.

There are some words of which the use is exclusively American, and are little understood in England. We select two of the most common. 1. *Bunkum*, the origin of which is thus described:—A member of the lower House of Congress, from a district which included the county of Buncombe (in which county he resided), whose style of speaking produced a very common effect of driving the members from the hall, was one day addressing the House, when, as usual, the coughing and sneezing commenced, and the members began to leave. He paused awhile, and assured the House that there need be no uneasiness on their part, and that for himself it mattered not how many left, for he was not speaking to the House, but to *Bunkum*. It is now understood to mean the constituent body, as distinguished from Congress. 2. *Caucus* is thus explained:—On the 2nd of March 1770, a quarrel took place at the premises of John Gray, a rope-maker, between a soldier and a man in the employ of Gray, and the former was severely beaten. Two affrays in consequence took place, in which the soldiers fired upon the people of the town, three of whom were killed and five wounded. These occurrences induced the rope-makers and calkers, whose occupations brought them in contact, to form a society, and at its meetings the most violent resolutions were passed against the British government and its agents in America. The tories, in derision, denominated these assemblies of the members of this society *calker* meetings; and the word in time became corrupted to *caucus*, which is the term still used in Boston to denote a general meeting of a party.

As to new words, the number used in the written language is not great. The word *bindery*, meaning "a place where books are bound," is in Webster. We believe it is a new, but it certainly is not a bad word. In American advertisements we observe the word *book* is generally prefixed: thus we might say, a *book-bindery*. *Sparse* is, for anything we know, a new word, and well applied; the Americans say a *sparse* instead of a *scattered* population, and we think the term has a more precise meaning than scattered, and is the proper correlative of *dense*. The danger of new words is, that the ignorant will use them without knowing their meaning, as we may observe in some of the inferior American newspapers. The number of new words that may be gradually creeping into the American spoken language, we suspect, is not inconsiderable. This arises in some measure from intermixture with foreigners, and must produce some effect, though it may not be much. We have heard the German word *plunder* vulgarly applied to baggage or heavy commodities. The term *cookie* also, used for a species of tea-cake, is evidently derived from the German *kuchen;* and filibuster is from the French, through the German, embodied entirely from flibuster, a buccaneer or pirate.

We suspect that many words of a moral import are beginning to vary considerably as to the signification attached to them in England and America. *Highminded*, a word not much used in Great Britain, rather implies something elevated or noble in *enduring:* in the conversation language, at least, of some parts of America, it is applied as a term of praise to *action* often impetuous, and sometimes unjust. *Lady* and *Gentleman* are terms that come under the same predicament, as to difference of import.

The orthography of the English language is liable to more change in America than in England: the Americans, as a general rule, do not observe orthography so strictly as the English, of which any reader of American papers may convince himself. We refer to American newspapers, because they are, more than in England, used as a common medium for addressing the public on all subjects, and form a large part of the reading of the community.

AMHA'RIC LANGUAGE has its name from Amhara, in Abyssinia, where it is or was spoken in its greatest purity. Inferior dialects of the Amharic are spoken in the provinces of Gojam, Angot, Efat, Shoa, Bagemder, Samen, &c. The Amharic is supposed to be meant by Agatharchides when he speaks of a language called Kámara. (Hudson, 'Geogr. Min.' t. i. p. 46.) The Amharic began to prevail in Abyssinia over the Geez language when Icon Amlak, about the year 1300, having overcome the Zagæan dynasty, ascended the throne of his ancestors, and removed the residence of the royal court from Axum to Shoa, where he had lived in exile. A knowledge of the Amharic enables a traveller to make himself understood in nearly every part of Abyssinia, although there are numerous dialects, of which no complete classification has yet been accomplished; of these the Tigré resembles much more the ancient ecclesiastical Ethiopic or the Geez language, than the Amharic. The Arabian writer, Makrizi, counts 50 dialects. It will be probably quite as difficult to define the exact number of Ethiopian, as of Arabic, modern Greek, and English dialects, or the number of languages in general. The king of Abyssinia, his councillors, ecclesiastics, monks, and every well-educated Abyssinian, know the Geez language, in which documents and letters are usually composed. Therefore the Geez is called *lesana matzhaf*, or *metzhafena*, that is, the language of letters or books.

The British and Foreign Bible Society have published a 'Psalterium Davidis Amharice,' London, 1833, large 18mo; and 'Novum Testamentum in Linguam Amharicam, vertit Abu Rumi Habessinus, edidit Thomas Pell Platt,' London, 1829, foolscap 4to. The New Testament and the Psalms have been circulated by Mr. Gobat and other missionaries in Abyssinia, and have been sometimes transcribed by the natives who could not be provided with printed copies. The French consul at Cairo, Asselin de Cherville, caused Abu Rumi, an old Abyssinian, who had been the instructor of Bruce and Sir William Jones, to translate the whole Bible into Amharic. This is the translation which is in the possession of the British and Foreign Bible Society. The circumstances under which they obtained it are detailed in their reports, and in the 'Christian Researches in the Mediterranean from 1815 to 1820,' by the Rev. W. Jowett, pp. 197—213.

The Amharic is said to be a degenerated Semitic dialect, the grammatical structure of which has preserved its character, though its lexicographical contents are mingled with African words. It is likely that the Amharic and other dialects of the Ethiopic are derived from the old Arabic of the Himyarites in Yemen. The Amharic adds to the twenty-six characters of the Geez seven others, which are mere modifications in order to express some characteristic sounds. The vowels are expressed by variations in the shape of the letters, so that each character or letter is in fact a syllable, being a consonant followed by a vowel, thus: *lă, lū, lī, lā, lē, lĕ, lo*. The Amharic, with other Ethiopic dialects, is written from the left to the right hand, like the European languages.

AMIDES. A class of chemical compounds derived from ammonia, by the replacement of one of its atoms of hydrogen by another body, either simple or compound:—thus, amide of potassium, or potassium amide, and acetamide may serve to illustrate this class of substances, and their relations to ammonia may be seen from the following comparison of their formulæ.

$$\underset{\text{Ammonia.}}{N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.}\qquad\underset{\text{Potassiumamide.}}{N\left\{\begin{matrix}K\\H\\H\end{matrix}\right.}\qquad\underset{\text{Acetamide.}}{N\left\{\begin{matrix}C_4H_3O_2\\H\\H\end{matrix}\right.}$$

The inorganic amides, like potassium amide, are not numerous, but amongst organic compounds there is a large and important family of amides, of which acetamide (othylamide) may be regarded as a type. To these latter, Gerhardt has recently added two other classes of bodies, in which respectively two and three equivalents of hydrogen are replaced by a negative organic radical like othyl. These three descriptions of amides he terms primary, secondary and tertiary amides. Their relations to each other may be seen by the following formulæ:

$$\underset{\text{Acetamide.}}{\overset{\text{Primary Amide.}}{N\left\{\begin{matrix}C_4H_3O_2\\H\\H\end{matrix}\right.}}\qquad\underset{\text{Diacetamide.}}{\overset{\text{Secondary Amide.}}{N\left\{\begin{matrix}C_4H_3O_2\\C_4H_3O_2\\H\end{matrix}\right.}}}\qquad\underset{\text{Triacetamide.}}{\overset{\text{Tertiary Amide.}}{N\left\{\begin{matrix}C_4H_3O_2\\C_4H_3O_2\\C_4H_3O_2\end{matrix}\right.}}}$$

In the above amides, each single equivalent of hydrogen is replaced by a single equivalent of a *uniatomic* negative radical, but sometimes two equivalents of hydrogen in a double equivalent of ammonia are replaced by a *biatomic* radical, giving rise to what is termed a *diamide*. Thus oxamide is a compound of this description:

$$\text{Oxamide}\;\ldots\;N_2\left\{\begin{matrix}C_4O_4{}''\\H_2\\H_2\end{matrix}\right.$$

A *triamide* is formed when a *triatomic* radical replaces three equivalents of hydrogen in a triple molecule of ammonia. Thus citramide is a triamide, and has the formula

$$N_3\left\{\begin{matrix}C_{12}H_5O_8{}'''\\H_3\\H_3\end{matrix}\right.$$

The diamides and triamides have also representatives amongst the secondary and tertiary amides, but for a complete description of these and more complex amides the reader is referred to 'Traité de Chimie Organique, par M. Gerhardt.'

Sometimes one of the remaining equivalents of hydrogen in a primary amide, is replaced by a positive radical, forming an *alcalamide*. The *acetanilide* for instance is an alcalamide:

$$N\left\{\begin{matrix}C_{12}H_5\\C_4H_3O_2\\H\end{matrix}\right.$$

The most important group of amides is that consisting of the primary organic amides. They are produced: 1st, by the abstraction of a double equivalent of water from the ammonia salts of the monobasic organic acids; thus,

$$\underbrace{\left.\begin{matrix}C_4H_3O_2\\NH_4\end{matrix}\right\}O_2}_{\text{Acetate of Ammonia.}}=\underset{\text{Acetamide.}}{N\left\{\begin{matrix}C_4H_3O_2\\H\\H\end{matrix}\right.}+\underset{\text{Water.}}{\left.\begin{matrix}H\\H\end{matrix}\right\}O_2}$$

2nd. By the action of the chlorides of the negative radicals upon ammonia:

$$\underset{\text{Chloride of Othyl or Acetyl.}}{\left.\begin{matrix}C_4H_3O_2\\Cl\end{matrix}\right\}}+\underset{\text{Ammonia.}}{N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.}=\underset{\text{Acetamide.}}{N\left\{\begin{matrix}C_4H_3O_2\\H\\H\end{matrix}\right.}+\underset{\text{Hydrochloric Acid.}}{\left.\begin{matrix}H\\Cl\end{matrix}\right\}}$$

3rd. By the action of ammonia upon the ethereal salts of the monobasic organic acids; for example,

$$\underset{\text{Acetic Ether.}}{\left.\begin{matrix}C_4H_3O_2\\C_4H_5\end{matrix}\right\}O_2}+\underset{\text{Ammonia.}}{N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.}=\underset{\text{Acetamide.}}{N\left\{\begin{matrix}C_4H_3O_2\\H\\H\end{matrix}\right.}+\underset{\text{Alcohol.}}{\left.\begin{matrix}C_4H_5\\H\end{matrix}\right\}O_2}$$

The primary amides are, with few exceptions, either sparingly soluble, or insoluble in water, and generally volatile without decomposition. By ebullition with water, most of them re-assume its elements, and become converted into ammonia salts, by the converse of the first reaction given above for their formation. This decomposition is greatly facilitated by the presence of free acid or alkali. The primary amides possess neither acid nor alkaline qualities, the secondary amides generally redden litmus paper, and frequently form salts.

The following is a list of some of the most important amides with their formulæ:

PRIMARY AMIDES.

Acetamide	$N(C_4H_3O_2)H_2$
Propionylamide	$N(C_6H_5O_2)H_2$
Butyramide	$N(C_8H_7O_2)H_2$
Valeramide	$N(C_{10}H_9O_2)H_2$
Benzamide	$N(C_{14}H_5O_2)H_2$
Salicylamide	$N(C_{14}H_5O_4)H_2$
Acetanilide, or Phenylacetamide	$N(C_4H_3O_2)\,(C_{12}H_5)H$

PRIMARY DIAMIDES.

Oxamide	$N_2(C_4O_4)''H_4$
Succinamide	$N_2(C_8H_4O_4)''H_4$
Suberamide	$N_2(C_{16}H_{12}O_4)''H_4$
Asparagin	$N_2(C_8H_4O_6)''H_4$
Fumaramide	$N_2(C_8H_2O_4)''H_4$
Tartramide	$N_2(C_8H_4O_8)''H_4$

For the modes of producing the inorganic amides, see POTASSIUM-AMIDE, and ZINCAMIDE.

AMIENS, TREATY OF. [TREATIES, CHRONOLOGICAL TABLE OF.]

AMINES. [ORGANIC BASES.]

AMISATINE ($C_{96}H_{39}N_{11}O_{18}$), a crystalline body of no interest, obtained from indigo.

AMMELIDE ($C_6N_4H_4O_4 = NCyH_2, 2CyHO_2$), a chemical compound obtained by the action of concentrated sulphuric or nitric acid upon ammeline or melam.

$$\underbrace{2NCyH_2,\ CyHO_2}_{\text{Ammeline.}}+2HO=\underbrace{NCyH_2,\ 2CyHO_2}_{\text{Ammelide.}}+\underbrace{NH_3}_{\text{Ammonia.}}$$

$$\underbrace{3NCyH_2}_{\text{Melam.}}+4HO=\underbrace{NCyH_2,\ 2CyHO_2}_{\text{Ammelide.}}+\underbrace{2NH_3}_{\text{Ammonia.}}$$

Ammelide is a white powder, insoluble in water, alcohol, ether, and acetic acid, but soluble in warm solution of ammonia. It is also soluble in sulphuric, nitric, and hydrochloric acids, and when these latter solutions are boiled, the ammelide is transformed into cyanuric acid and ammonia. Ammelide possesses neither acid nor alkaline properties in a marked degree, nevertheless it forms a compound with silver, which has the formula $C_6N_4H_3AgO_4$.

AMMELINE ($C_6H_5N_5O_2 = 2NCyH_2, CyHO_2$), a body produced by the action of acids or alkalies upon melam or melamine: The following is the reaction:—

$$\underbrace{3NCyH_2}_{\text{Melam or Melamine.}}+2HO=\underbrace{2NCyH_2,\ CyHO_2}_{\text{Ammeline.}}+NH_3.$$

It is a brilliant white crystalline body, insoluble in water, alcohol, and ether, but soluble in several acids and in solutions of the caustic alkalies. It possesses feeble alkaline properties, uniting with most acids and forming crystallisable salts, which are, however, partially decomposed by water.

AMMON, or AMUN, or AMN RA, the name of an Egyptian deity, whom the Greeks considered as synonymous with their Zeus (Jupiter). He is often represented on the monuments of Egypt and in other works of Egyptian art with a ram's head and a human body; about which Herodotus (ii., 42) tells the following odd story, picked up during his travels in Egypt:—"Hercules was exceedingly anxious to have a sight of Zeus, but Zeus did not feel inclined to show himself. At last, when Hercules was very importunate, Zeus hit on the following contrivance: he flayed a ram, and cutting off the head put it before his face; he then got into the skin, and in this guise showed himself to Hercules. From this circumstance the Egyptians represent the image of Zeus with a ram's head."

The god Ammon appears in the human form with a tesher, or tall red cylindrical cap on his head, surmounted with two plumes. Also, under the figure of a crio-sphinx or ram-sphinx, which is an animal with a ram's head and the body of a beast of prey of the feline species. ('Egyptian Antiquities,' vol. i., in the 'Library of Entertaining Knowledge,' and the drawings in the French work on Egypt, 'Antiquities,' tom. iii., pl. 32.)

The word *Ammon*, or *Amun*, is probably connected with the Coptic word signifying 'to feed' sheep. ('Coptic Testament,' John xxi. 15; &c.) Ammon would thus be the god of a nomadic race, and originally a pastoral deity. Several other derivations, with the traditions on which they rest, agree in representing Ammon as a guide and protector, bearing the same relation to mankind as a ram to the flock.

The worship of Ammon seems to have been specially of Ethiopian origin, and its chief place to have been Meröe. Its introduction into Egypt was annually celebrated for twelve days at Thebes, when the image was carried across the Nile, and after an interval brought back, as if it had returned from Ethiopia. What power was worshipped under this form is yet doubtful, some contend that it was the sun,

others that it was the zodiacal sign Aries. The number twelve is further held to point to the astronomical character of Ammon and his place in the Zodiac; while he has also been described as the spirit of the universe and the author of all life. Sir J. G. Wilkinson's theory is, that the Egyptians had the idea of an abstract and supreme deity, "worshipped in silence," according to Jamblichus, but that the attributes of this deity were soon divided amongst a variety of gods, of whom they gave bodily representations. Ammon was the "divine mind in operation, the bringer to light of the secrets of its hidden will." Women of high rank are represented on Egyptian monuments as ministering in the temple of Ammon. The two chief Ammonian temples which now exist are that at Carnak, on the east side of the Nile, forming part of the extensive ruins of Thebes, and that of the oasis of Siwah, in the Libyan Desert, known to the Greeks by the name of Ammonium; this last has been described by Mr. Bayle St. John in his 'Adventures in the Libyan Desert,' 1851.

The Greeks adopted the worship of Ammon at an early period. There was a temple and statue, the gift of Pindar, erected to him at Thebes; Pindar also celebrates him in an ode. Other places where he is known to have been worshipped were Sparta, Aphylis, Megalopolis, and Cyrenaica. Alexander's visit to the Ammonium at Siwah is well known.

We find in Jeremiah xlvi. 25, and Ezekiel xxx. 15, the expression Amon-No; and in Nahum iii. 8, that of No-Amon, given as No only in the authorised translation. The former is supposed to refer to the Greek Diospolis, or 'City of Jupiter,' now forming part of the ruins of Thebes. The No of Nahum is more probably the Diospolis of the Delta.

The name Amon forms a part of the proper name of several Egyptian kings and persons, such as Amenotph and Ptamon; and is also often used in the title or qualifying term applied to the name of a king; thus we find on the monuments prefixed to the name of Ramses, the title *Amn-mai*, 'beloved by Ammon.'

[Jablonsky's *Pantheon*; J. C. Prichard's *Egyptian Mythology*; J. F. Champollion, *Panthéon Egyptien*; Ideler, *Handbuch der Chronologie*; Sir J. G. Wilkinson's *Ancient Egyptians*.]

AMMONIA (NH_3)—*Spirit of Hartshorn*—*Volatile Alkali*. This highly important compound was first procured in a pure state by Priestley, who termed it *alkaline air*; he obtained it from sal-ammoniac (chloride of ammonium), and hence the present name of the compound. Ammonia exists in the atmosphere to the extent of about one volume in 28,000,000 volumes of air; it occurs also in rain, river, and sea water, and is a product of volcanic action and of the putrefaction and decay of organic matters containing nitrogen. It is also formed during the destructive distillation of animal and vegetable substances; the chief source of our present supply of ammonia and its compounds being, in fact, the processes of illuminating-gas and bone-black manufacture. There results from these latter operations an aqueous liquor of an insupportable odour, termed *ammoniacal liquor*, which contains a considerable quantity of the carbonate and sulphide of ammonium; on the addition of hydrochloric acid to this liquor, these ammoniacal compounds are decomposed, and chloride of ammonium formed, together

with carbonic acid and sulphuretted hydrogen gases, which latter escape into the atmosphere.

$$\underbrace{NH_4O, CO_2}_{\text{Carbonate of ammonia.}} + \underbrace{HCl}_{\text{Hydrochloric acid.}} = \underbrace{NH_4Cl}_{\text{Chloride of ammonium.}} + \underbrace{CO_2}_{\text{Carbonic acid.}}.$$

$$\underbrace{NH_4S}_{\text{Sulphide of Ammonium.}} + HCl = NH_4Cl + \underbrace{HS}_{\text{Sulphuretted Hydrogen.}}.$$

When the chloride of ammonium thus formed is mixed with its own weight of slaked lime, and heat applied to the mixture, abundance of gaseous ammonia is evolved, and may be collected either in glass vessels over mercury or by the displacement of atmospheric air from inverted jars. [GASES, COLLECTION OF.]

$$NH_4Cl + \underbrace{CaO}_{\text{Lime.}} = \underbrace{NH_3}_{\text{Ammonia.}} + \underbrace{CaCl}_{\text{Cloride of calcium.}} + \underbrace{HO}_{\text{Water.}}.$$

Ammonia cannot be produced by the direct union of its elements; but when hydrogen is presented to nitrogen in the nascent state, the elements unite and form ammonia. This is the case when moistened iron filings are exposed either to air or to pure nitrogen.

Ammonia is also formed when zinc, iron, or tin is dissolved in dilute nitric acid.

Properties.—At ordinary temperatures and pressures ammonia exists as a colourless and invisible gas, possessing a powerful and extremely pungent odour and an alkaline taste. Its specific gravity is 0·5902, and 100 cubic inches weigh almost exactly 18 grains.

Mr. Faraday ('Phil. Trans.' 1823, p. 189) found, that by subjecting ammoniacal gas to a pressure of about $6\frac{1}{2}$ atmospheres, at the temperature of 50°, it became a colourless transparent liquid, the density of which was 0·760, water being 1.

An animal plunged into ammoniacal gas is immediately killed, and a taper when immersed in it is extinguished: it appears, however, to be slightly inflammable; for the flame is rather enlarged before it goes out, and a small jet of the gas may be burned in oxygen.

Dr. Priestley found that, by moderate degrees of heat, ammoniacal gas is merely expanded; but when passed through an ignited porcelain tube, it is decomposed, and, increasing to double its volume, rendered inflammable. ('Experiments on Air,' vol. ii. p. 393.) He also first proved that it is decomposed by the electric spark, and separated into hydrogen and nitrogen gases (vol. iii. p. 389). These experiments have been repeated by Berthollet, Davy, and Gay-Lussac. Dr. Henry ('Annals of Philosophy,' N. S., viii. p. 347) also found that when ammoniacal gas is exposed to a current of electric sparks, its volume is exactly doubled, and it is resolved into three volumes of hydrogen gas, and one volume of nitrogen gas. As the result of these experiments it is obvious that ammoniacal gas is a compound of three volumes of hydrogen and one volume of nitrogen gas, the four volumes being condensed to two: by weight it is composed of

Three atoms of hydrogen $1 \times 3 =$	3	or per cent.	17·64
One atom of nitrogen . .	14	„ „	82·36
Weight of the atom . . =	17		100·

That this is the composition of the gas in question is also shown by comparing its calculated and actual density. According to Dr. Thomson ('Chemistry of Inorganic Bodies,' vol. i. p. 704), 300 cubic inches of hydrogen gas weigh 6·4842 grains, and 100 cubic inches of nitrogen gas weigh 30·2794 grains, making together 36·7636 grains; but during combination the gases condense to half their volume, consequently 200 cubic inches of ammoniacal gas weigh theoretically 36·7636 grains, and 100 weigh 18·3818. Now, according to Allen and Pepys the weight by actual experiment is 18·18 grains, which is sufficiently near the calculated statement to prove its correctness.

Ammonia is powerfully alkaline, restoring the blue colour to reddened litmus, turning turmeric paper reddish-brown, and perfectly neutralising the strongest acids forming the different salts of ammonia.

Water dissolves ammoniacal gas with great rapidity, and in large quantity; a few drops of water thrown up into a jar of the gas instantly condense it; a piece of ice also immediately liquifies in and condenses the gas. Water at 50° is capable of condensing 670 times its volume; the density of the solution diminishes as its strength increases, so that, according to Davy, with whom other chemists nearly agree, when water contains $9\frac{1}{2}$ per cent. of ammonia, its density is 0·9692; but when it holds $32\frac{1}{2}$ per cent., it is reduced to 0·8750. The aqueous solution is colourless, transparent, and has the pungency and alkaline property of the gas; by exposure to the air, the ammonia partially escapes, and by the application of heat it is expelled from the water; on account of this volatility of ammonia, vegetable colours which have been altered by it regain their original tints as it evaporates, which is not the case when the change has been caused by the fixed alkalies.

The annexed table shows the percentage of ammonia in aqueous solutions of the gas of different specific gravities :—

Specific Gravity.	Ammonia in 100 parts by weight.	Specific Gravity.	Ammonia in 100 parts by weight.
0·8750	32·50	0·9435	14·53
0·8875	29·25	0·9476	13·46
0·9000	26·00	0·9513	12·40
0·9054	25·37	0·9545	11·56
0·9166	22·07	0·9573	10·82
0·9255	19·54	0·9597	10·17
0·9326	17·52	0·9619	9·60
0·9385	15·88	0·9692	9·50

The presence of ammonia may be detected by its strong odour, by holding moistened turmeric paper where it is suspected to exist, and by the formation of a white vapour, when exposed to a glass rod moistened with hydrochloric acid. Ammonia can only thus be recognised when it is in the free state, and therefore, in testing for it, caustic soda or quicklime should be added to the solution, in order to liberate the ammonia from its combination with any acids that may be present.

Ammonia is used for many purposes, both in medicine and in scientific chemistry; as, however, it would be impossible in some cases, and inconvenient in almost every one, to employ it in its gaseous state, it is used in solution in water, and then frequently called *liquid ammonia:* but this term can be applied with propriety only to the gas rendered fluid by cold or pressure. Solution of ammonia may be readily prepared by mixing chloride of ammonium with lime, in the mode and proportions already mentioned, and passing the gas liberated into water: this may be done either by inserting a glass tube bent at right angles into the mouth of the retort, and then putting the other end into a bottle of water; or, which is better, in case absorption should take place, a tubulated receiver may be used instead of the bent tube, securing it properly by a perforated cork to the retort, and luting it so that it may withstand the pressure caused by passing the gas into the water. Alcohol also dissolves a large quantity of ammonia.

We shall now briefly notice the nature and results of the action of ammonia upon certain elementary bodies. It has been already stated that ammoniacal gas may be burned in oxygen gas: a mixture of these gases may also be fired by the electric spark, the results being water and nitrogen gas; a little nitric acid is also generated, if the quantity of oxygen gas be more than sufficient to combine with all the hydrogen of the ammonia. (Dr. Henry, 'Phil. Trans.,' 1809.) Chlorine gas, by mere admixture with ammonia, decomposes it completely, and the action is attended with the evolution of light and heat. The chlorine combines with the hydrogen of the ammonia; hydrochloric acid is thus formed, which uniting with the ammonia remaining undecomposed, the result is chloride of ammonium, while nitrogen gas is liberated. The same effects are obtained if the aqueous solutions of the gases in question be employed; but then the changes are unaccompanied by light or heat.

Ammonia has no action upon carbon, except at a high temperature; if however a piece of well-dried charcoal be passed up into ammoniacal gas over mercury, it is capable of absorbing ninety times its volume in twenty-four hours. The gas undergoes no chemical change, and from Saussure's experiments it appears that the absorption is analogous to the capillary attraction of liquids by very small tubes. Sulphur, when strongly heated in ammoniacal gas, partially decomposes it, and sulphide of ammonium is one of the products. At a high temperature, phosphorus also decomposes ammonia, and phosphuretted hydrogen is formed; when no heat is employed, phosphorus absorbs the gas, and a deep brown-coloured substance is formed, which is almost pulverulent: its properties have not been examined. Iodine and ammonia, if put in contact with water, form the well-known detonating substance *iodide of nitrogen*, generally prepared by putting iodine into the aqueous solution of ammonia.

The action of the metals upon ammonia varies considerably, according to their nature. Gay-Lussac and Thénard have shown that potassium and sodium absorb ammoniacal gas, and are covered with a white crust. The absorption is more rapid when the heat of a spirit-lamp is employed; the white crust becomes deep yellow, the surface of the metal is brilliant and smooth, whilst the new compound is greenish, fuses, and runs upon the sides of the tube; when the operation is continued until the potassium entirely disappears, ammoniacal gas is not only absorbed, but a portion is decomposed and hydrogen gas given out. The compound formed is of a deep olive-green colour, its fracture crystalline, and its density greater than that of water. It fuses at a temperature higher than boiling water, does not conduct electricity, burns in oxygen gas, and yields hydrate of potash and nitrogen gas. Water decomposes it rapidly; the results are potash and ammoniacal gas. [POTASSIUMAMIDE.]

When ammoniacal gas is passed over ignited iron or copper, the density of the metals is much dimished; and by the repeated action and decomposition of the gas, iron may be increased in weight, as proved by Despretz, 11·5 per cent., which increase is owing to the absorption of nitrogen by the metal.

Ammonia, Salts of.—The general properties of the salts of ammonia are as follow: soluble in water, with few exceptions; decomposed by the fixed alkalies and alkaline earths, with the evolution of ammonia; decomposed when a magnesian salt and a soluble phosphate are added to them, a crystalline precipitate being formed, which is a double salt, composed of phosphate of ammonia and magnesia; decomposed and dissipated by heat, unless the acid, like the phosphoric or boracic, be a fixed one, in which case the ammonia is expelled, and the acid remains. A solution of chloride of platinum occasions a yellow precipitate in concentrated solutions of ammoniacal salts.

A few of the more important salts of ammonia are described below.

Ammonia, Carbonates of.—Several carbonates of ammonia exist; the most important are the sesquicarbonate and the bicarbonate.

Ammonia, sesquicarbonate of ($2NH_4O, 3CO_2$).—This salt is contained in the *Pharmacopœia* under the incorrect name of *Ammoniæ subcarbonas*, or *subcarbonate of ammonia*. It is directed to be prepared by heating, in a subliming vessel, a mixture of one part of chloride of ammonium, or sal-ammoniac, and one part and a half of carbonate of lime or chalk; it is however usually and more economically obtained by decomposing sulphate of ammonia with carbonate of lime. In this case, double decomposition ensues; sesquicarbonate of ammonia is formed, volatilised, and is condensed in the upper part of the vessel, while sulphate of lime remains in the lower.

Sesquicarbonate of ammonia is a colourless, translucent, moderately hard salt. It has a pungent smell, and a sharp, penetrating taste. It is soluble in about four times its weight of cold water, and is decomposed by hot water. It acts upon vegetable blues and yellows, like an alkali; and on this account, as well as its ammoniacal smell, has been called a subcarbonate.

It is composed of

Three atoms of carbonic acid	66
Two atoms of ammonia	34
Two atoms of water	18
Atomic weight	118

As three atoms of carbonic acid are combined with two atoms of ammonia, and these being as one and a half to one, this salt, like others similarly constituted, is generally termed a *sesquicarbonate*.

It is used in medicine as a stimulant, and usually called *smelling salts*. It is also employed as a substitute for yeast in making some of the finer kinds of bread. As a chemical reagent, it is extensively used; and also for preparing various other ammoniacal salts.

Ammonia, bicarbonate of ($NH_4O, CO_2 + HO, CO_2$).—This salt may be prepared by passing carbonic acid gas into a solution of sesquicarbonate of ammonia, in which way it may be obtained in crystals; by heating a mixture of equal weights of chloride of ammonium and carbonate of lime in a subliming vessel; or lastly, and with the greatest facility, by exposing powdered sesquicarbonate of ammonia to the air until it becomes inodorous; in this case, a larger proportion of ammonia escapes than remains, and the residue thus becomes a bicarbonate. When obtained by sublimation, it resembles the sesquicarbonate in appearance, but differs from it in being devoid of pungency; it is rather hard, soluble in cold, and decomposed by hot water. When perfect, it has no alkaline action on vegetable colours, like the preceding carbonates. The salt obtained by sublimation, or by exposing the sesquicarbonate to the air, consists of

Two atoms of carbonic acid	44
One atom of ammonia	17
Two atoms of water	18
Atomic weight	79

It is rarely used, either in medicine, or as a chemical reagent.

Ammonia, nitrate of ($NH_4O\,NO_5$).—A salt best obtained by saturating nitric acid with sesquicarbonate of ammonia. On evaporating the solution the salt crystallises in long prisms which are anhydrous. It is somewhat deliquescent, readily soluble in cold water, and when heated to 480° it is decomposed into protoxide of nitrogen and water. Hence its use for the preparation of protoxide of nitrogen.

Ammonia, sulphate of ($NH_4O\,SO_3, HO$).—A salt of ammonia prepared on a large scale by neutralising *gas-liquor* or *bone-liquor* with sulphuric acid and then crystallising. In small quantity, it is best made by saturating dilute sulphuric acid with sesquicarbonate of ammonia. The solution is colourless, and by evaporation yields small prismatic crystals; these have a saline taste, and are readily dissolved by water.

Crude sulphate of ammonia is largely employed in agriculture—either alone as a top-dressing, or as a constituent of artificial manures. It powerfully stimulates the growth of cereal, grass, and root crops.

AMMONIA, *Medical properties of.* This alkali is distinguished from the others by the appellation of Volatile, because at the ordinary temperature and pressure of the atmosphere it never exists in a fixed state, but either in a gaseous form, in which case it immediately combines with any carbonic acid which it encounters in the air, or is absorbed by water or spirit, from both of which it is easily liberated, particularly if heat be applied. Having been formerly obtained by distillation of shavings of hartshorn or other animal matters, it is familiarly known under the name of Spirit of Hartshorn. The combinations with carbonic acid have the same properties as the pure alkali, in respect to volatility, and only a diminished degree of causticity.

The gas in an undiluted state is highly pungent, with a suffocating odour, is irrespirable, and irritates and inflames the animal tissues. (Christison.) Diluted by passing through the air, from which it absorbs moisture and carbonic acid, which serve further to lessen its acrimony, it is occasionally, but rarely, applied to the eyes, in some passive inflammations, and to keep up vigilance in cases of somnolence from narcotic poisons. This last mode of using it is scarcely to be recommended, as dangerous inflammation of the eyes may subsequently follow. Indeed all employment of even the less caustic forms of administration, when much insensibility exists, such as in faintings, epileptic fits, or from narcotic poisons, likewise in experiments on persons in the state termed mesmeric coma, requires great care. Fatal inflammation of the windpipe has ensued by merely holding carbonate of ammonia (smelling salts) or a handkerchief dipped in strong aqua ammoniæ under the nostrils. (Nysten.) When it is to be introduced into the stomach, this should be done by means of the stomach-pump, to avoid any of it passing into the windpipe. Besides its local action, exciting inflammation and its effects, ammonia is itself poisonous, its secondary effect on the nervous system, particularly the spinal column, being sufficient to cause tetanic convulsions. Though Eau de Cologne may be grateful to adults, the vapour is unsafe for children. (See 'Lancet' for April, 1844.)

Ammoniacal gas absorbed by water constitutes the *aqua* or *liquor ammoniæ*. This is formed of two different degrees of strength: the one of a density of 882 at 62° F. called *fortior*, much too strong for any medicinal purpose, and only employed for some chemical purposes; the other of the density of 960, which also generally requires to be diluted further with water when intended for internal use, or with oils for external use, as it is very frequently, to form rubefacient liniments. The solution of the carbonate is likewise frequently employed in combination with oils. These, if long applied, or frequently repeated, cause inflammation which terminates in suppuration and ulceration.

Ammonia, when suitably diluted so as to be taken into the stomach, causes a feeling of warmth, with increased energy of the nervous power. Hence it acts as a prompt and valuable counter-poison to prussic acid, the bites of serpents, and the poison of many diseases, such as cholera asiatica, and typhoid fevers, at the commencement of which great depression of the nervous system is observed. In lesser degrees of depression, such as the languor of hysterical females, or in atonic gout, ammonia or its carbonates are daily resorted to. It is likewise employed to counteract acidity in the stomach. It must not be overlooked however that the long continued use of ammonia produces the same ill effects as the other alkalies when taken in excess. [ALKALIES.]

The salts of ammonia require a brief notice. The properties of the different combinations of ammonia with carbonic acid are too similar to those of the pure alkali to be noted separately, except to state that carbonate of ammonia furnishes a good emetic in the earliest stage of fever with great depression, and is in smaller doses given freely throughout adynamic fevers, sometimes in the effervescing form, especially when action of the skin is desired. Citric acid is employed to cause it to effervesce.

Hydrochlorate of ammonia is little employed in this country internally, but it may be beneficially used in combination with cinchona bark in fevers. In large doses it is poisonous. It is however chiefly employed to form discutient and evaporating lotions in conjunction with vinegar and spirit. For these it is most valuable, at the moment of solution.

Acetate of ammonia has little of the causticity of the pure alkali or the carbonates, neither is it volatile. It is so deliquescent that it cannot be kept in the solid form, and is always administered in weak acetic acid. This forms a most grateful refrigerant at the commencement of slight inflammatory complaints, and if the patient be kept warm, generally induces perspiration. For this purpose it requires to be freely given. It is also a diuretic, but not much employed. Properly diluted with rose-water it forms a cooling eyewash, most grateful after some forms of inflammation, to relieve the turgescence which remains, or even to remove turgescence which has not been preceded by inflammation. Scarpa thought it useful against commencing amaurosis.

AMMONIAC (GUM), a concrete juice produced in Persia, Abyssinia, &c., but the plant from which it is obtained does not appear to have been ascertained. Willdenow refers it to the *Heracleum gummiferum*, in which he is followed by the British College of Physicians. Others refer it to the *Ferula orientalis*. It consists of grains of various sizes, usually called *tears*: they are either separate or agglutinated into masses; their colour is whitish, but they become yellow by the action of the air; they are shining, opaque, irregular in shape, and more or less globular. When cold, ammoniac is rather hard and brittle; it softens by the heat of the hand, but does not entirely liquify at a stronger heat. The smell is peculiar and disagreeable, and the taste is nauseous, at first mucilaginous and bitter, and afterwards acrid. Its specific gravity is 1·207. When triturated with water, it is partly dissolved, forming an emulsion which becomes clearer on standing. When distilled with water, it loses its volatile oil, and becomes inodorous; the distilled water has the odour of the gum, and small drops of limpid, colourless oil float on its surface. Alcohol takes up about half its weight, forming a brownish-yellow solution, which becomes turbid when mixed with water. It is combustible, burning with a white flame, little smoke, and a strong smell; the ashes left consist of small portions of the carbonates of potash and lime, and phosphate of lime.

Sulphuric acid readily dissolves ammoniac, and water precipitates the solution; nitric acid converts it into a bitter substance; the fixed alkalies form with it a turbid solution, which is extremely bitter.

According to Bucholz, ammoniac consists of

Resin	72·0
Gum	22·4
Bassorine	1·6
Volatile oil, water, and loss	4·0
	100

It is used in medicine as a stimulant and expectorant.

AMMO'NIACUM—*Medical properties of.* This gum-resin is correctly referred to the *Dorema ammoniacum* (Don, in 'Linnæan Trans.,' vol. xvi. p. 599), which was discovered by Lieut.-Col. Wright, growing near Yezd Khâst, a town of Irâk Ajemi, the ancient Persis, about 42 miles south of Ispahan. Its Persian names are Ooshk and Ooshook. It has more recently been found on the low hills near Herat, likewise abundantly in Syghan, near Bameean, on the north-west slope of the Hindu-Coosh range of mountains. (Christison.)

Ammoniacum was known to the ancients: but it is supposed that what they used came from Africa as well as Asia, and was procured from a species of Ferula, *F. tingitana* (Linn.)

The Persian plant yields the juice chiefly from the stalk, especially the points of divarication of the umbels, owing to the punctures of numerous coleopterous insects. "The gum is so abundant, that upon the slightest puncture being made, it instantly oozes forth, even at the ends of the leaves." (Capt. Hart, 'Trans. of Medical Society of Calcutta,' vol. i. p. 369.) The juice quickly dries, and is either picked off or allowed to accumulate till it falls on the ground. This collection takes place about the middle of June. A tenth part is remitted as tribute to the government; the rest is sent to Bushire, on the Persian Gulf, and thence to Europe. The best comes by Bombay. The juice of the Syghan plant is obtained by making successive slices of the root, as in the case of assafœtida. The samples vary much in quality. The directions given to purify the inferior sorts, by softening them in boiling water, and squeezing them through a cloth, though capable of removing mechanical impurities, impair the power of the gum-resin, by driving off the volatile oil, which even in good specimens is not very abundant, 32 ounces yielding by distillation only one drachm.

The officinal form for administering ammoniacum is the *mixture*, in which it is partially dissolved and partially suspended in water. It is a most valuable expectorant, and may have its virtues increased by the addition of squills or ipecacuanha. Dilute nitric acid greatly heightens its powers. It is also an ingredient in the compound squill pills. Externally it is applied as a plaster, to disperse indolent swellings, either softened by vinegar, a form which has kept its place amid all the changes in medical agents for nearly 2000 years, or combined with mercury, which is often beneficial.

AMMONITES, a nation descended, according to Gen. xix. 38, from the incestuous connection of Lot with his younger daughter, about the year 1898 B.C. The name of their progenitor, *Ben Ammi*, means *son of my kindred*, and the name *Ammon* has nearly the same signification. The Ammonites, or the children of Ammon, are called by the Septuagint and Josephus, Ammanitæ. The country which they inhabited was situated between the rivers Arnon and Jabbok, north-north-east of the Moabites, and east of the tribes of Reuben and Gad. The Israelites, under Moses, smote the Amorites, and possessed their land from Arnon unto Jabbok, even unto the children of Ammon, about the year 1452 before Christ: but they did not enter the territory of the Ammonites, for the border of the children of Ammon was strong. (Num. xxi. 24.) The Israelites were directed not to distress the children of Ammon, because the Lord had given the land unto the children of Lot for a possession. The Ammonites, however, showed the Israelites no kindness while passing through the country, and they were therefore forbidden 'entering the congregation of the Lord.' Their active hostility is first mentioned in Judges iii. when they helped Eglon, king of Moab, to subjugate Israel, and their hostile feelings continued. They sustained, in consequence, a severe defeat from Jephthah. (Judges xi.) The history of the wars between the Israelites and the Ammonites are recorded in the Pentateuch and other books of the Old Testament, and in the book of Maccabees.

From the prophetic writings we derive some further information as to the history and character of the Ammonites. Their destruction is predicted by Isaiah xi. 14; Zephaniah ii. 9; Jeremiah xlix. 1-5; Ezekiel xxv. In the days of Justin Martyr, the Ammonites were still very numerous; and in the days of Origen, the Ammonites and Edomites went under the general name of Arabians.

Their metropolis was Rabbah. The surrounding country was called Arabia Philadelphiensis.

The Ammonites were uncircumcised (Jer. ix. 26), and worshipped Molech or Milcom, and their idolatry was, by the Ammonitish wives of Solomon, introduced among the Israelites. (1 Kings xi. 7, 33; 2 Kings xxiii. 13.)

Of their kings, we know only Nahash and Hanun, in the time of David; and Baalis, contemporary with Nebuchadnezzar. (Jer. xl.)

AMMONIUM. (NH_4). The hypothetical compound radical of the salts of ammonia. When ammoniacal gas unites with acids to form salts, the latter are regarded as no longer containing NH_3, but as compounds of the radical NH_4. Thus, when ammoniacal gas unites with hydrochloric acid, the salt chloride of ammonium is formed, containing the radical in question united with chlorine.

$$NH_3 + HCl = (NH_4)\,Cl.$$

In like manner, when ammoniacal gas unites with a hydrated oxyacid, it is supposed that the water of hydration of the acid coalesces with the body, NH_3, so as to form oxide of ammonium, which then unites with the acid to form a salt of ammonia. Thus, ammoniacal gas and hydrated nitric acid form nitrate of ammonia, $NH_3 + HO, NO_5 = (NH_4)O, NO_5$. In the salts of ammonia, therefore, the radical ammonia takes the place of the metal in ordinary metallic salts; and nitrate of ammonia, and chloride of ammonium, for instance, thus become analogous in their constitution to nitrate of potash and chloride of potassium.

Nitrate of potash	KO, NO_5
Nitrate of ammonia	$(NH_4)O, NO_5$
Chloride of potassium	KCl
Chloride of ammonium	$(NH_4)Cl$

This view, first suggested by Ampere, and subsequently applied by Berzelius, is frequently termed the *ammonium theory*. Ammonium has never been obtained in a separate state, and is probably incapable of existing free from any other body. Reasoning from the analogy of its compounds with those of the metals, it has by some been regarded as a true metal; but although its compound with mercury [AMALGAM] lends some support to this notion, yet the non-metallic character of other isolated radicals renders the metallic attributes of ammonium highly improbable.

Acetate of Ammonia (NH_4O, $C_4H_3O_3$).—This salt is prepared by adding sesquicarbonate of ammonia to dilute acetic acid. Owing to the superior affinity of the acetic acid for ammonia, the carbonic acid is expelled from it with effervescence, and a colourless solution remains, which contains neutral acetate of ammonia, but which, when concentrated and placed under the exhausted receiver of an air-pump over sulphuric acid, loses ammonia and yields transparent prismatic crystals, which are very deliquescent, and consist of an acid salt. The neutral salt may be obtained in the crystalline form by saturating glacial acetic acid with ammoniacal gas. It is white, and very soluble in water and in alcohol.

Acetate of ammonia is directed to be prepared in the 'London Pharmacopœia,' and kept in solution under the name of *Liquor Ammoniæ Acetatis*. It is used externally as a refrigerant, and internally as a diaphoretic, and is commonly known by the name of *Spirit of Mindererus*.

Oxalate of Ammonia (C_4O_6, $2NH_4O$, $+2$aq.).—This salt is prepared by adding sesquicarbonate of ammonia to a solution of oxalic acid, until it is saturated. The solution by evaporation yields small prismatic crystals; these are devoid of smell, have a bitter, saline taste, and dissolve readily in water. By dry distillation they yield oxamide. Oxalate of ammonia is used as a test of the presence of lime, and to precipitate it from solution in chemical analyses.

AMMONIUM, CHLORIDE OF. (NH_4Cl.) This salt has been long known, and extensively used, under the name of *Sal Ammoniac*. The substance from which it was first procured, was the soot of camel's dung. It is now largely manufactured in Europe, by combining hydrochloric acid, either directly or indirectly, with the ammonia obtained from the decomposition of animal matter, but principally from the liquor obtained during the preparation of coal-gas. This impure ammoniacal liquor is at once saturated with hydrochloric acid, and evaporated to crystallisation. The crystals are then sublimed.

Chloride of ammonium, as obtained by sublimation, is an amorphous, translucent, colourless salt; but when separated from water by crystallisation, its form is cubic. It has a sharp, saline taste, but no smell, and dissolves readily in water; exposure to a dry air produces no change in it; by heat, it volatilises without decomposition. Lime and the fixed alkalies decompose it, evolving ammoniacal gas; and sulphuric acid expels hydrochloric acid gas. It is composed of equal volumes of hydrochloric acid gas and ammoniacal gas, as may be shown by the perfect condensation of these proportions in a jar over mercury; or by weight, of

One atom of hydrochloric acid	36·5
One atom of ammonia	17.0
Atomic weight	53·5

This salt is much employed in the tinning of iron, copper, and brass, and in agriculture. It is generally used for preparing ammoniacal gas, and the sesquicarbonate of ammonia, in the modes already described.

AMMONIUM AMALGAM. [AMALGAM.]

AMMONIUM, IODIDE OF (NH_4I). Prepared by saturating a solution of hydriodic acid with ammonia, and then evaporating until the salt crystallises. Iodide of ammonium crystallises in cubes which are deliquescent, and is slowly decomposed on exposure to air and light. It ought, therefore, to be preserved in well stopped and opaque bottles. It is easily soluble in water, and also in alcohol and ether. The latter property has led to its extensive use in photography for iodising collodion. Iodine is very soluble in an aqueous solution of iodide of ammonium.

A'MNESTY is a word derived from the Greek *ἀμνηστία, amnēstia*, which, literally, signifies nothing more than non-remembrance. The word *amnestia* is not used by the earlier Greek writers; but the thing intended by it was expressed by the verbal form (*μὴ μνησικακεῖν*). The word ἀμνηστία occurs in Plutarch and Herodian. Some critics suppose that Cicero ('Philipp.' i. 1) alludes to his having used the word; but he may have expressed the thing without using the word *amnestia*. It occurs in the life of Aurelian by Vopiscus (c. 39), according to some editions in the Latin form, but it is possible that Vopiscus wrote the word in Greek characters, and it is doubtful whether the word was ever incorporated into the Latin Language. Nepos, in his life of Thrasybulus (c. 3), expresses the notion of an act of Amnesty by the words "lex oblivionis," and it is clear from a passage in Valerius Maximus (iv. 1), that the word was not adopted into the Latin language when Valerius wrote, whatever that time may be.

The notion of an amnesty among the Greeks was a declaration of the person or persons who had newly acquired or recovered the sovereign power in a state, by which they pardoned all persons who composed, supported, or obeyed the government which had been just overthrown. A declaration of this kind may be either absolute and universal, or it may except certain persons specifically named, or certain classes of persons generally described. Thus in Athens, when Thrasybulus had destroyed the oligarchy of the Thirty Tyrants, and had restored the democratical form of government, an exceptive amnesty of past political offences was declared, from the operation of which the Thirty themselves, and some few persons who had acted in the most invidious offices under them, were excluded. (Xenophon, 'Hellen.' ii, 4, 38; Isocrates, 'Against Callimachus,' c. 1.). So when Bonaparte returned from Elba in 1815, he published an amnesty, from which he excluded thirteen persons, whom he named in a decree published at Lyon. The act of indemnity, passed upon the restoration of Charles II., by which the persons actually concerned in the execution of his father were excluded from the benefit of the royal and parliamentary pardon, is an instance of an amnesty from which a class of persons were excepted by a general description and not by name. Of a like nature was the law passed by the French Chambers in January, 1816, upon the return of Louis XVIII. to the throne of France after the victory at Waterloo, which offered a complete amnesty to "all persons who had directly or indirectly taken part in the rebellion and usurpation of Napoleon Bonaparte," with the exception of certain persons, whose names had been previously mentioned in a royal ordinance as the most active partisans of the usurper. It was objected to this French law of amnesty, that it did not point out with sufficient perspicuity the individuals who were to be excepted from its operation. Instead of confining itself to naming the offenders, it excepted whole classes of offences, by which means a degree of uncertainty and confusion was occasioned, which much retarded the peaceable settlement of the nation. "In consequence of this course," says M. de Châteaubriand in a pamphlet published soon after the event, "punishment and fear have been permitted to hover over France; wounds have been kept open, passions exasperated, and recollections of enmity awakened." The act of indemnity, passed at the accession of Charles II., was not liable to this objection, by the distinctness of which, as Dr. Johnson said, "the flutter of innumerable bosoms was stilled," and a state of public feeling promoted, extremely favourable to the authority and quiet government of the restored prince.

AMO'MUM—*Medical Properties of this and allied Genera*. This comprehensive heading is adopted to include many aromatic stimulants, such as cardamoms, grains of paradise, &c., which are obtained from several plants related to amomum. German pharmacopolists even term Pimento berries, or Jamaica allspice, *semen amomi*; but this is never so called in Great Britain. Much obscurity hung over the history of the true cardamoms, which recent investigations have removed; and as Dr. Pereira has treated the whole subject at great length in his 'Materia Medica,' his statements are chiefly followed here.

The true, officinal, or Malabar cardamoms are procured from the *elettaria cardamomum* (Rheede, 'Hortus Malabaricus,' vol. ix.), White; the botanical characters of which were described by Dr. Maton ('Trans. Linn. Soc.' x. p. 254). The Edinburgh College term it *renealmia* (Rosc.); the London, *alpinia cardamomum* (Roxb.). It occurs in the mountainous parts of Malabar, and is also cultivated. The cardamoms of the Wynaad, which are the most esteemed and bring the highest price, are cultivated. The fruit is the part collected, but the seed alone is used. The seed-vessel or husk is altogether devoid of aroma or pungency; but the seeds should never be taken out of it till required for use, as they keep much better in their natural envelope: 100 parts of best cardamoms yield 74 parts of seed and 26 of husks. This kind of cardamoms, called the small or lesser, presents three varieties in commerce; namely, shorts, short-longs, and long-longs, placed in the order of their merit. The first and best are about three to six lines long; the second, about six; the last, from seven lines to an inch. Trommsdorf analysed the small cardamoms, and obtained—essential oil, 4·6; fixed oil, 10·4; a salt (probably malate) of potash, combined with colouring-matter, 2·5; fecula, 3·0; nitrogenous mucilage, with phosphate of lime, 1·8; yellow colouring-matter, 0·4; and woody fibre, 77·3.

The fixed oil somewhat resembles castor oil. The excellence of the specimen depends on the volatile oil; this is small in inferior kinds; the best yield about 6¼ drachms for every pound of the fruit. Jamaica cardamoms yield only four scruples for one pound of fruit. Like oil of turpentine, lemon, &c., it consists only of carbon and hydrogen.

Ceylon cardamoms, or larger, sometimes termed long, are produced in that island; but some of the less valuable of the Malabar fruits are termed Ceylon cardamoms. The name of "grains of paradise" is sometimes given to this plant. One kind of "grains of paradise" is from an African plant *Amomum Grana-Paradisi* (Smith); the other from *A. Meleguetta* (Roscoe), cultivated in Demerara. Grains of paradise are used to sharpen vinegar, beer, liquors, &c., and brewers who have them in their possession are liable to heavy penalties. [ADULTERATION.] The duty on grains of paradise was reduced from 2*s.* per lb. to 15*s.* per cwt. by 5 & 6 Vict. c. 47.

Cardamoms are in great favour in the East as a spice, and also as an aromatic stimulant in the treatment of disease. In Europe, they are as highly esteemed as carminative and stomachic agents. Dr. Christison observes that they form part of eighteen officinal preparations, besides their own tinctures.

AMORITES, the most powerful tribe of the Canaanites, or the aborigines of Palestine. The name Amorites seems sometimes to be used for all the Canaanites who were the descendants of Ham, through Canaan, Sidon, and Heth. (Gen. x. 15—20.) The Amorites are mentioned among the ten nations whose country was given to the seed of Abraham. (Gen xv. 19—21.) The original Amorites dwelt chiefly in the mountains, which afterwards belonged to the tribe of Judah. (Numbers xiii. 29; Deut. i. 20.) The name has been said by Simonsis and Gesenius to mean 'mountaineer.' Some Amorites dwelt in the plains bordering upon the tribe of Dan, and others between the rivers Jordan and Arnon. At the time of Moses the river Arnon was the border between Moab and the Amorites on the south, the Jordan on the west, and the Jabbok on the north, separated them from the kingdom of Bashan, and the Great Desert and the territory of the Ammonites formed their eastern boundary. (Numbers xxi. 13.) Of the cities of the Amorites it was said to the people of Israel, "Thou shalt save alive nothing that breatheth: but thou shalt utterly destroy the Hittites, Amorites, Canaanites, Perizzites, Hivites, and Jebusites, as the Lord thy God hath commanded thee, that they teach you not to do after all their abominations, which they have done unto their gods." (Deut. xx. 16-18.) The Amorites were attacked by the four confederate kings who took Lot captive (Gen. xiv. 13; Joshua x. 11), slew great numbers of them, and more died stricken with hailstones from heaven. But after all this, the Amorites retained so much power, that they forced (B.C. 1425) the children of Dan into the mountain, for they would not suffer them to come down to the valley. The remarkable fact, that the Israelites conquered the mountains sooner than the plains is explained (Judges i. 19): it was because the inhabitants of the plains had chariots of iron.

The Gibeonites (to whom seven descendants of Saul were delivered by David about the year B.C. 1020, that they might revenge themselves for Saul's atrocities) were of the remnant of the Amorites whom Joshua had made hewers of wood and drawers of water. (Joshua ix; 2 Samuel xx.) Moses and the children of Israel slew two kings of the Amorites, namely Sihon, who dwelt at Heshbon, and Og, king of Bashan, in the plain east of Jordan. These kings had refused to let the Israelites pass through their borders. (Judges xi. 18-23.) Still the Amorites were not extirpated, and their descendants formed, even during the time of the Maccabees, a distinct tribe; for we read in Josephus ('Antiquit.' xiii. chap. 1.) that the Amorites from Medaba fell suddenly upon the corps of Johannes Gaddis, when he was conveying the baggage of the Jewish host, according to the command of his brother Jonathan, and killed him.

The Amorites were of tall stature. According to Amos (ii. 9) they were high as cedars and strong as oaks. This poetical description is illustrated by the historical statement, that the size of the iron bedstead of the Amoritish king, Og of Bashan, was nine cubits by four. (Deut. iii. 11.) The rabbins have some wild legends respecting him; but it may be concluded that in ancient times the natives of Syria exceeded in stature the inhabitants of the desert and of Egypt.

AMPELIC ACID. ($C_{14}H_6O_6$). Obtained by the action of nitric acid upon the oily products of the destructive distillation of bituminous shale and of coal. Picric acid and a flocculent matter are collaterally formed, but on evaporating the liquor the two latter substances are first deposited. On then neutralising with ammonia, evaporating to dryness, and extracting with alcohol, ampelate of ammonia is dissolved. From the aqueous solution of this salt, nitric acid precipitates ampelic acid in a flocculent condition.

Ampelic acid is a white inodorous solid, insoluble in cold and only very sparingly soluble in hot water. Boiling alcohol and ether dissolve it readily. It fuses at 500° F., and may be distilled without decomposition. It is isomeric with salicylic acid.

AMPELINE, a brownish-yellow liquid resembling creosote, found amongst the oily products of the destructive distillation of bituminous shale. It is soluble in water, does not solidify at —4° F., and cannot be distilled alone without decomposition.

AMPHI'CTYONS, members of a celebrated council in ancient Greece, called the Amphictyonic Council.

According to the popular story, this council was founded by Amphictyon, son of Deucalion, who lived, if he lived at all, many centuries before the Trojan war. It is supposed by a writer quoted by Pausanias, x. 8, to derive its name, with a slight alteration, from a word signifying 'settlers around a place.' Strabo, who professes to know nothing of its founder, says that Acrisius, the mythological king of Argos, fixed its constitution, and regulated its proceedings. Amidst the darkness which hangs over its origin, we discover with certainty, that it was one of the earliest institutions in Greece. No full or clear account has been given of it during any period of its existence by those who had the means of informing us. The fullest information is supplied by Æschines the orator; but before any attempt is made, by the help of some short notices from other writers, and of conjecture, to trace its earlier history, it may not be amiss to state what is certainly known of this council as it existed in his time.

According to Æschines, the Greek nations which had a right to be represented in the council were twelve, though he only names eleven, the Thessalians, Bœotians, Dorians, Ionians, Perrhæbians, Magnesians, Locrians, Œtæans, Phthiots, Malians, Phocians: the twelfth were probably the Delphians. Each nation was represented by certain sovereign states, of which it was supposed to be the parent: thus Sparta, conjointly with other Dorian states, represented the Dorian nation. Amongst the states thus united in representing their common nation, there was a perfect equality. Sparta enjoyed no superiority over Dorium and Cytinium, two inconsiderable towns in Doris, and the deputies of Athens, one of the representatives of the Ionian nation, sat in the council on equal terms with those of Eretria in Eubœa, and of Priene, an Ionian colony in Asia Minor. From a rather doubtful passage in Æschines, 'De Fals. Leg.' 43, compared with a statement in Diodorus, xvi. 60, it seems that each nation, whatever might be the number of its constituent states, had two, and only two votes. The council had two regular sessions in each year, meeting in the spring at Delphi, and in the autumn near Pylæ, otherwise called Thermopylæ; but special meetings were sometimes called before the usual time. From its meeting at Pylæ, a session of the Amphictyons was called a Pylæa, and the deputies were called Pylagoræ, that is, councillors at Pylæ. There were also deputies distinguished by the name of Hieromnemons, whose office it was, as their name implies, to attend to matters pertaining to religion. Athens sent three Pylagoræ and one Hieromnemon. The former were appointed for each session; the latter probably for a longer period, perhaps for the year, or two sessions. The council entertained charges laid before it in relation to offences committed against the Delphic god, made decrees thereupon, and appointed persons to execute them. These decrees, as we learn from Diodorus, xvi. 24, were registered at Delphi. The oath taken by the deputies bound the Amphictyons not to destroy any of the Amphictyonic cities, or to debar them from the use of their fountains in peace or war; to make war on any who should transgress in these particulars, and to destroy their cities; to punish with hand, foot, voice, and with all their might, any who should plunder the property of the god (the Delphic Apollo), or should be privy to, or devise anything against that which was in his temple. This is the oldest form of the Amphictyonic oath which has been recorded, and is expressly called by Æschines the ancient oath of the Amphictyons. It has inadvertently been attributed to Solon by Mr. Mitford, who has apparently confounded it with another oath imposed on a particular occasion. An ordinary council consisted only of the deputed Pylagoræ and Hieromnemons; but on some occasions at Delphi, all who were present with the Amphictyonic deputies to sacrifice in the temple and consult the oracle of the god, were summoned to attend, and then it received the name of an *ecclesia* or assembly. Beside the list of Amphictyonic nations given by Æschines, we have one from Pausanias which differs a little from that of Æschines, and another from Harpocration which differs slightly from both. Strabo agrees with the orator as to the number being twelve. It is further remarkable, that whilst Æschines places the Thessalians at the head of his list, Demosthenes, 'De Pac.' p. 62, expressly excludes them from a seat in the council.

Æschines has left us much in the dark as to the usual mode of proceeding in the Amphictyonic sessions; and we shall look elsewhere in vain for certain information. It should seem that all the Pylagoræ sat in the council and took part in its deliberations; but if the common opinion mentioned above, respecting the two votes allowed to each nation, be correct, it is certain that they did not all vote. The regulations according to which the decisions of the twelve nations were made can only be conjectured. We know that the religious matters which fell under the jurisdiction of the Amphictyonic body were managed principally, at least, by the Hieromnemons, who appear, from a verse in Aristophanes, 'Nub.' 613, to have been appointed by lot, but we are not as well informed respecting the limits which separated their duties from those of the Pylagoræ, nor respecting the relative rank which they held in the council. (See Æsch. 'Contr. Ctes.' p. 68—72; 'Fals. Leg.' p. 43.) The little that is told is to be found for the most part in the ancient lexicographers and scholiasts, or commentators, who knew perhaps nothing about the matter, and whose accounts are sufficiently perplexing to give room for great variety of opinions among modern writers. Some have seemed to themselves to discover that the office of the Hieromnemons was of comparatively late creation, that these new deputies were of higher rank than the Pylagoræ, and that one of them always presided in the council; others again have supposed, what, indeed, an ancient lexicographer has expressly asserted, that they acted as secretaries or scribes. Two Amphictyonic decrees are found at length in the oration of Demosthenes on the Crown, both of which begin thus: "When Cleinagoras was priest, at the vernal Pylæa, it was resolved by the Pylagoræ and the Synedri (joint councillors) of the Amphictyons, and the common body of the Amphictyons." Some have assumed that Cleinagoras the priest was the presiding Hieromnemon, and others that the Hieromnemons are comprehended under the general name of Pylagoræ. Æschines again has mentioned a decree in which the Hieromnemons were ordered to repair at an appointed time to a session at Pylæ, carrying with them the copy of a certain decree lately made by the council. Of the council, as it existed before the time of Æschines, a few notices are to be found in the ancient historians, some of which are not unimportant. According to Herodotus, vii. 200, the council held its meetings near Thermopylæ, in a plain which surrounded the village of Anthela, and in which was a temple dedicated to the Amphictyonic Ceres; to whom, as Strabo tells us, ix. 429, the Amphictyons sacrificed at every session. This temple, according to Callimachus, 'Ep.' 41, was founded by Acrisius; and hence arose, as Müller supposes in his history of the Dorians (vol. i. p. 289, English translation), the tradition mentioned above.

We are told by Strabo, ix. 418, that after the destruction of Crissa by an Amphictyonic army, under the command of Eurylochus, a Thessalian prince, the Amphictyons instituted the celebrated games, which from that time were called the Pythian, in addition to the simple musical contests already established by the Delphians. Pausanias also, x. 7., attributes to the Amphictyons, both the institution and subsequent regulation of the games; and it is supposed by the most skilful critics, that one occasion of the exercise of this authority, recorded by Pausanias, can be identified with the victory of Eurylochus, mentioned by Strabo. According to this supposition, the Crissæan, and the celebrated Cirrhæan war, are the same, and Eurylochus must have lived as late as B.C. 591. But the history of these matters is full of difficulty, partly occasioned by the frequent confusion of the names of Crissa and Cirrha.

From the scanty materials left us by the ancient records, the following sketch of the history of this famous council is offered to the reader, as resting on some degree of probability :—

The council was originally formed by a confederacy of Greek nations or tribes, which inhabited a part of the country afterwards called Thessaly. In the lists which have come down to us of the constituent tribes, the names belong for the most part to those hordes of primitive Greeks which are first heard of, and some of which continued to dwell north of the Malian bay. The bond of union was the common worship of Ceres, near whose temple at Anthela its meetings were held. With the worship of the goddess was afterwards joined that of the Delphic Apollo; and thenceforth the council met alternately at Delphi and Pylæ. Its original seat and old connections were kept in remembrance by the continued use of the term Pylæa, to designate its sessions wherever held; though eventually the Delphic god enjoyed more than an equal share of consideration in the confederacy. It may be remarked that the Pythian Apollo, whose worship in its progress southwards can be faintly traced from the confines of Macedonia, was the peculiar god of the Dorians who were of the Hellenic race; whilst the worship of Ceres was probably of Pelasgic origin, and appears at one time to have been placed in opposition to that of Apollo, and in great measure to have retired before it. There is no direct authority for asserting that the joint worship was not coeval with the establishment of the council; but it seems probable from facts, which it is not necessary to examine here, that an Amphictyonic confederacy existed among the older residents, the worshippers of Ceres, in the neighbourhood of the Malian bay, before the hostile intruders with their rival deity were joined with them in a friendly coalition. The council met for religious purposes, the main object being to protect the temples and maintain the worship of the two deities. With religion were joined, according to the customs of the times, political objects; and the jurisdiction of the Amphictyons extended to matters which concerned the safety and internal peace of the confederacy. Hence the Amphictyonic laws, the provisions of which may be partly understood from the terms of the Amphictyonic oath. Confederacies and councils, similar to those of the Amphictyons, were common among the ancient Greeks. Such were those which united in federal republics the Greek colonists of Asia Minor, of the Æolian, Ionian, and Dorian nations. Such also was the confederacy of seven states whose council met in the temple of Neptune, in the island of Calauria, and which is even called by Strabo, viii. 374, an Amphictyonic council.

The greater celebrity of the northern Amphictyons is attributable partly to the superior fame and authority of the Delphic Apollo; still more, perhaps, to their connection with powerful states which grew into importance at a comparatively late period. The migrating hordes, sent forth from the tribes of which originally or in very early times the confederacy was composed, carried with them their Amphictyonic rights, and thus at every remove lengthened the arms of the council. The great Dorian migration especially planted Amphictyonic cities in the remotest parts of Southern Greece. But this diffusion, whilst it extended its fame, was eventually fatal to its political authority. The early members, nearly equal perhaps in rank and power, whilst they remained in the neighbourhood of Mounts Œta and Parnassus, might be willing to submit their differences to the judgment of the Amphictyonic body. But the case was altered when Athens and Sparta became the leading powers in Greece. Sparta, for instance, would not readily pay obedience to the decrees of a distant council, in which the deputies of some inconsiderable towns in Doris sat on equal terms with their own. Accordingly in a most important period of Grecian history, during a long series of bloody contests between Amphictyonic states, we are unable to discover a single mark of the council's interference. On the other hand, we have from Thucydides i. 112, a strong negative proof of the insignificance into which its authority had fallen. The Phocians (B.C. 448) possessed themselves by force of the temple of Apollo at Delphi; were deprived of it by the Lacedæmonians, by whom it was restored to the Delphians; and were again replaced by the Athenians. In this, which is expressly called by the historian a sacred war, not even an allusion is made to the existence of an Amphictyonic council. After the decay of its political power there still remained its religious jurisdiction; but it is not easy to determine its limits, or the objects to which it was directed. In a treaty of peace made (B.C. 421) between the Peloponnesians and the Athenians (Thucyd. v. 17), it was provided that the temple of Apollo at Delphi, and the Delphians, should be independent. This provision, however, appears to have had reference especially to the claims of the Phocians to include Delphi in the number of their towns, and not to have interfered in any respect with the superintendence of the temple and oracle, which the Amphictyons had long exercised in conjunction with the Delphians. We have seen that the Amphictyons were charged in the earliest times with the duty of protecting the temple and the worship of the god. But the right of superintendence, of regulating the mode of proceeding in consulting the oracle, in making the sacrifices, and in the celebration of the games, was apparently of much later origin, and may, with some probability, be dated from the victory gained by Eurylochus and the Amphictyonic army. The exercise of this right had the effect of preserving to the council permanently a considerable degree of importance. In early times the Delphic god had enjoyed immense authority. He sent out colonies, founded cities, and originated weighty measures of various kinds. Before the times of which we have lately been speaking, his influence had been somewhat diminished; but the oracle was still most anxiously consulted both on public and private matters. The custody of the temple was also an object of jealous interest on account of the vast treasures contained within its walls.

The Greek writers, who notice the religious jurisdiction of the council, point our attention almost exclusively to Delphi; but it may be inferred from a remarkable fact mentioned by Tacitus, 'Ann.' iv. 14, that it was much more extensive. The Samians, when petitioning in the time of the Emperor Tiberius for the confirmation of a certain privilege to their temple of Juno, pleaded an ancient decree of the Amphictyons in their favour. The words of the historian seem to imply that the decree was made at an early period in the existence of Greek colonies in Asia Minor, and he says that the decision of the Amphictyons on all matters had at that time pre-eminent authority.

The sacred wars, as they were called, which were originated by the Amphictyons in the exercise of their judicial authority, can here be noticed only so far as they help to illustrate the immediate subject of inquiry. The Cirrhæan war, in the time of Solon, has already been incidentally mentioned. The port of Cirrha, a town on the Crissæan bay, afforded the readiest access from the coast to Delphi. The Cirrhæans, availing themselves of their situation, grievously oppressed by heavy exactions the numerous pilgrims to the Delphic temple. The Amphictyons, by direction of the oracle, proclaimed a sacred war to avenge the cause of the god; that is, to correct an abuse which was generally offensive, and particularly injurious to the interests of the Delphians. Cirrha was destroyed, the inhabitants reduced to slavery, their lands consecrated to Apollo, and a curse was pronounced on all who should hereafter cultivate them. We are told that Solon acted a prominent part on this occasion, and that great deference was shown to his counsels. Mr. Mitford, indeed, has discovered without help from history, which is altogether silent on the subject, that he was the author of sundry important innovations, and that he in fact remodelled the constitution of the Amphictyonic body. He has even been able to catch a view of the secret intentions of the legislator, and of the political principles which guided him. But in further assigning to Solon the command of the Amphictyonic army, he is opposed to the direct testimony of the ancient historians.

From the conclusion of the Cirrhæan war to the time of Philip of

Macedon, an interval exceeding two centuries, we hear little more of the Amphictyons, than that they rebuilt the temple at Delphi, which had been destroyed by fire B.C. 548; that they set a price on the head of Ephialtes, who betrayed the cause of the Greeks at Thermopylæ, and conferred public honours on the patriots who died there; and that they erected a monument to the famous diver Scyllias, as a reward for the information which, as the story goes, he conveyed under water from the Thessalian coast to the commanders of the Grecian fleet at Artemisium. If Plutarch may be trusted, the power of the Amphictyons had not at this time fallen into contempt. When a proposition was made by the Lacedæmonians to expel from the council all the states which had not taken part in the war against the Persians, it was resisted successfully by Themistocles, on the ground that the exclusion of three considerable states, Argos, Thebes, and the Thessalians, would give to the more powerful of the remaining members a preponderating influence in the council dangerous to the rest of Greece.

After having, for a long period, nearly lost sight of the Amphictyons in history, we find them venturing, in the fallen fortunes of Sparta, to impose a heavy fine on that state as a punishment for an old offence, the seizure of the Theban Cadmeia, the payment of which, however, they made no attempt to enforce. In this case, as well as in the celebrated Phocian war, the Amphictyonic council can be considered only as an instrument in the hands of the Thebans, who after their successful resistance to Sparta, appear to have acquired a preponderating influence in it, and who found it convenient to use its name and authority, whilst prosecuting their own schemes of vengeance or ambition. Though the charge brought against the Phocians was that of impiety in cultivating a part of the accursed Cirrhæan plain, there is no reason to think that any religious feeling was excited, at least in the earlier part of the contest; and Amphictyonic states were eagerly engaged as combatants on both sides. For an account of this war, the reader is referred to a general history of Greece. The council was so far affected by the result, that it was compelled to receive a new member, and in fact a master, in the person of Philip of Macedon, who was thus rewarded for his important services at the expense of the Phocians, who were expelled from the confederacy. They were, however, at a subsequent period restored, in consequence of their noble exertions in the cause of Greece and the Delphic god against the Gauls. It may be remarked, that the testimony of the Phocian general Philomelus, whatever may be its value, is rather in favour of the supposition that the council was not always connected with Delphi. He justifies his opposition to its decrees, on the ground that the right which the Amphictyons claimed was comparatively a modern usurpation. In the case of the Amphissians, whose crime was similar to that of the Phocians, the name of the Amphictyons was again readily employed; but Æschines, who seems to have been the principal instigator of the war, had doubtless a higher object in view than that of punishing the Amphissians for impiety.

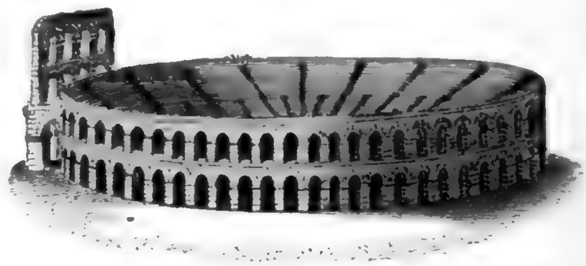
The Amphictyonic council long survived the independence of Greece, and was, probably, in the constant exercise of its religious functions. So late as the battle of Actium, it retained enough of its former dignity at least, to induce Augustus to claim a place in it for his new city of Nicopolis. Strabo says that in his time it had ceased to exist. If his words are to be understood literally, it must have been revived; for we know from Pausanias (x. 8.), that it was in existence in the second century after Christ. It reckoned at that time twelve constituent states, who furnished in all thirty deputies; but a preponderance was given to the new town of Nicopolis, which sent six deputies to each meeting. Delphi sent two to each meeting, and Athens, one deputy; the other states sent their deputies according to a certain cycle, and not to every meeting. For the time of its final dissolution, we have no authority on which we can rely.

It is not easy to estimate with much certainty the effects produced on the Greek nation generally, by the institution of this council. It is, however, something more than conjecture, that the country which was the seat of the original members of the Amphictyonic confederacy, was also the cradle of the Greek nation, such as it is known to us in the historical ages. This country was subject to incursions from barbarous tribes, especially on its western frontier, probably of a very different character from the occupants of whom we have been speaking. In the pressure of these incursions, the Amphictyonic confederacy may have been a powerful instrument of preservation, and must have tended to maintain at least the separation of its members from their foreign neighbours, and so to preserve the peculiar character of that gifted people, from which knowledge and civilisation have flowed over the whole western world. It may also have aided the cause of humanity; for it is reasonable to suppose that in earlier times, differences between its own members were occasionally composed by interference of the council; and thus it may have been a partial check on the butchery of war, and may at least have diminished the miseries resulting from the cruel lust of military renown. In one respect, its influence was greatly and permanently beneficial. In common with the great public festivals, it helped to give a national unity to numerous independent states, of which the Greek nation was composed. But it had a merit which did not belong to those festivals in an equal degree. It cannot be doubted that the Amphictyonic laws, which regulated the originally small confederacy, were the foundation of that international law which was recognised throughout Greece; and which, imperfect as it was, had some effect in regulating beneficially national intercourse among the Greeks in peace and war, and, so far as it went, was opposed to that brute force and lawless aggression, which no Greek felt himself restrained by any law from exercising towards those who were not of the Greek name. To the investigator of that dark but interesting period in the existence of the Greek nation, which precedes its authentic records, the hints which have been left us on the earlier days of this council, faint and scanty as they are, have still their value. They contribute something to those fragments of evidence with which the learning and still more the ingenuity of the present generation are converting mythical legends into a body of ancient history.

AMPHIPROSTYLE. This is an architectural term, compounded of three Greek words. It is used to designate structures having the form of an ancient Greek or Roman parallelogramic temple, with a prostyle or portico on each of its ends or fronts, but with no columns on its sides or flanks. [TEMPLE.]

AMPHI'SCII, literally *double shadowed*, a Greek term applied by ancient astronomers to the inhabitants of the torrid zone, with whom the sun passes the meridian at noon, sometimes on the north, sometimes on the south, of the zenith, and whose shadows at noon are therefore turned to the south during one part of the year, and to the north during the remainder.

AMPHITHE'ATRE, the name by which a species of structure much used by the Romans, and combining the forms and some of the uses



Amphitheatre of Verona.

of the ancient theatre and circus, is generally distinguished; indeed most of the Roman classical writers apply to it the name of circus also. A distinction, however, is now always made; the term amphitheatre being applied to the species of structure here referred to, and circus being restricted to the Roman stadium or hippodrome. [CIRCUS.]

The name amphitheatre seems intended to convey the idea of a double theatre; but what is termed a theatre is, with reference to its original uses, more strictly an odeum, and what we call an amphitheatre was truly a theatre. The one was for hearing music and recitations, and the other for seeing sights,—as the words import. [THEATRE.]

The form of the amphitheatre is, on the plan, that of an ellipsis, with a series of arcaded concentric walls, separating corridors which have constructions with staircases and radiating passages between them. It encloses an open space called the arena, either on, or a very little above or below the level of the surface of the ground on which the structure is raised. From the innermost concentric wall,—which bounds the arena, and which will be from ten to fifteen feet above its level,—an inclined plane runs upwards and outwards over the intermediate wall, staircases, and corridors, to a gallery or galleries over the outermost corridors. The inner and upper part of the inclined plane is covered with a graduated series of benches following the general form of the plan; these are intercepted at intervals by radial passages leading by a more easy gradation to and from the staircases which pass through the substructions of the benches to the corridors. These corridors, in the principal stories, continue uninterruptedly all round the edifice, and afford easy access to, and egress from, every part. In cases where the radiating passages through the bank of benches were few, concentric platforms or precinctions went round to make the communications complete. The external elevation of an amphitheatre is almost dictated by its internal arrangement and construction, and it generally falls into two or more stories of open arches, which are necessary to give light and air to the corridors and staircases.

The Amphitheatre seems to have been contrived for the more convenient exhibition of such shows as were confined throughout to the same place, such as combats, which could not be seen advantageously along the length of the circus; and moreover the circus had not the lofty stereobate, podium, or cincture, to protect the spectators from the savage and powerful brute animals which were frequently used in the public shows of the Romans. Indeed, it is reported that this defect was a cause of the abandonment of the circus for such exhibitions as required the use of wild beasts. The great length also of the circus would be a sufficient reason for adopting the more compressed and lofty form given to the amphitheatre, whose arrangement admits of a far greater number of persons being brought within a smaller area, and consequently within more convenient view of the arena.

At first, and for some time, amphitheatres were constructed of timber. Several accidents occurred, indeed, in consequence of the use of such, from fire, and from their incapacity to bear the weights they were subjected to; and, in one instance, it is related (Tacitus, 'Annal.' iv. 62; Suetonius, 'Tiber.' 40), that an amphitheatre of this kind fell during the exhibition of the shows, in the town of Fidena, when a very large number of persons, variously stated at 20,000 and 50,000, were either killed or hurt. Afterwards they were more securely and more permanently constructed of brick or stone, according to the facilities the place afforded, or the means of the people at whose expense the structures were raised.

It was in the latest period of the Republic that the Romans were debased by the gladiatorial and other shows which led to the use and construction of amphitheatres; and to the gratification of this passion for demoralising public spectacles may be attributed, in some degree, its eventual overthrow, in all but form, and the establishment of the despotism of the emperors. All the powerful men in the state who aimed still higher, sought favour with the people by these barbarous entertainments; and the sums expended and the numbers of men and beasts engaged, and for the most part destroyed, in furnishing them seem almost incredible.

The difference in the national characteristics of the Greeks and Romans is by nothing more forcibly illustrated than by the constant indications of theatres or odeums which mark the sites or immediate vicinities of ancient Greek cities, and the remains of amphitheatres which are common to those of the Romans.

To save unnecessary expense, the Grecian theatre was formed on or in the side of a hill, whenever the locality would afford this advantage; the seats were generally cut in the living rock, and such constructions added before it in the formation of the orchestra and proscenium and their accessories, as were absolutely necessary to complete the theatre. The amphitheatre of the Romans was raised, for the most part, within the town or city, on the level plain, of costly magnificence, and generally of enormous extent, while their theatres are in every respect secondary, and of inferior importance. Indeed, theatres for music and the drama are seldom found among the remains of purely Roman cities, but almost every Roman colony, and even camp, bears indications of a constructed or excavated amphitheatre. The great mother city of Rome herself can hardly be said to exhibit the remains of a theatre, unless it be that which is called the theatre of Marcellus; and even this appears to have been more used for games of the circus, or amphitheatrical shows, than for dramatic representations, and is not of extraordinary extent. But the Colosseum would contain from eighty to a hundred thousand persons;—and the little city of Pompeii, which has indeed two theatres, has, moreover, an amphitheatre, whose arena alone would contain them both. The Grecian cities of Sicily, on the contrary, exhibit remains and indications of spacious theatres where those of the amphitheatres of their Roman masters are few and unimportant; and the old cities of Greece itself, and the Grecian cities of Asia Minor, are almost entirely free from the pollution of the amphitheatre,—the Roman garrisons appearing to have contented themselves with castrensian or camp-built amphitheatres alone. Of this sort,—the castrensian amphitheatre,—we have indications still existing in England;—the principal are at Banbury, Cirencester, Dorchester, Richborough, Silchester, and Caerleon; but these were originally little more than mere excavations, or turf-built cinctures made up with what walling was absolutely necessary to form the grand concentric bank of benches. In the provinces of Gaul,—both transalpine and cisalpine,—Nîmes and Verona, by the remains of their amphitheatres, show how much more completely the inhabitants were nationalised, or Romanised, than were those of Greece or of Britain.

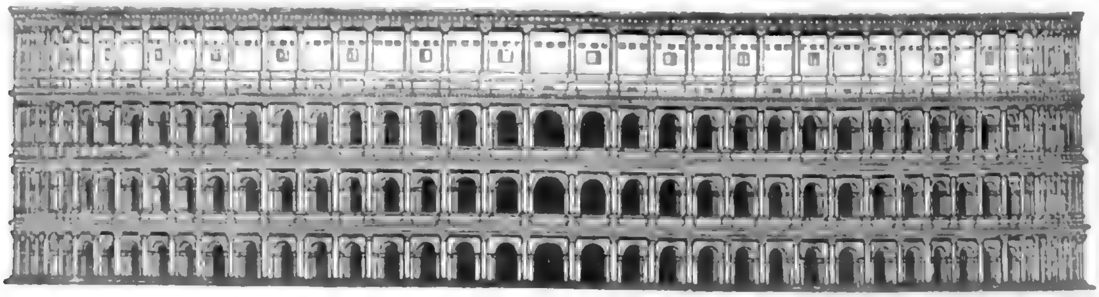
There is, perhaps, no species of structure peculiar to the Romans, with the details of which we are so well informed, as of those of the amphitheatre, and there is hardly any one of which we have fewer descriptions by ancient writers. The remains which still exist in various places tell us much more plainly what they were than the most elaborate descriptions can do; and although there is no example of an amphitheatre in complete preservation, or even nearly so, yet the existing specimens preserve the various parts so completely, that there is but little difficulty in supplying from one of them what is defective in another. Still there are minor particulars of which we must remain ignorant, unless we take them from such descriptions as exist, or supply them from analogy. We know of no sort of ancient edifice, generally, in which so much ingenuity is displayed in the arrangement, or so much skill in the construction, as were exemplified by the Romans in the design and execution of the amphitheatre; but for architectural character, the external composition of the amphitheatre is very far from being entitled to praise.

As the most remarkable, and one of the most perfect in its details, of the remaining examples of the amphitheatre, that which is known as the Colosseum at Rome is here used to illustrate this kind of edifice; the plan and elevation are almost entirely made out from the existing remains; and the section also, to a certain extent, as well as from the analogy afforded by other examples and from probability. The vignette sketch at the head of this article is a view of the amphitheatre of Verona, as it exists, looking down into it; this will aid the section in giving an idea of the arrangement of the benches, and the mode of access to them.

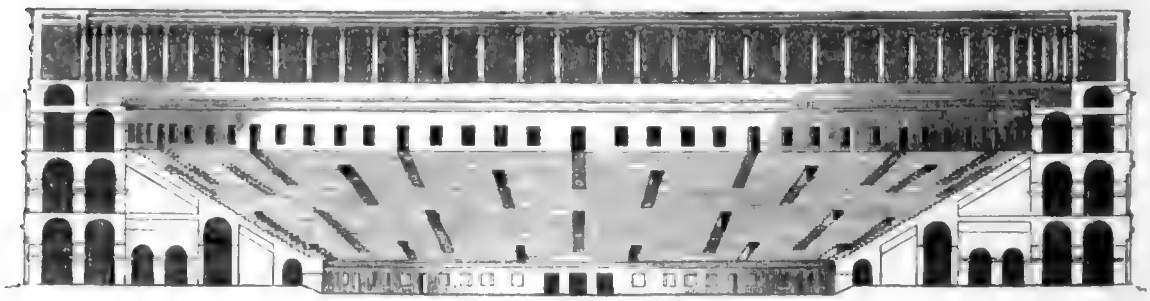
The form of the external periphery of the plan is that of an ellipsis, whose conjugate diameter, or minor axis, is to the transverse, or major axis, as five to six, nearly,—the length through, from outside to outside of the external wall, being 620 feet, and the breadth to the same extent, 513 feet; but as these dimensions are variously stated by different authorities, something may be allowed for inaccuracy, and the proportion between one diameter and the other may be fairly assumed in the original draft to have been as above stated. Of course, in the diminishing series of concentric walls, the proportion of the ellipsis is continually altering, so that the diameters of the arena are as five to eight, as nearly as may be, the length being 287 feet, and the breadth 180 feet. The difference between the external and internal diameters, of 333 feet, or 166 ft. 6 in. at each end, is occupied by four corridors and two blocks of radiating substructions,—in, or between, which are the staircases and ways from the outer corridors to the inner, and to the arena, together with the concentric or encircling walls which gird the structure, separate the corridors, and enclose the arena. Two of the surrounding corridors lie together, or adjoin each other, on the outer side; and in this particular the Colosseum exceeds every other structure of the kind of which we have any knowledge, all the rest having but one only; it thus acquires a second gallery, as may be perceived by referring to the section, in which, also, it is singular. The space covered by this immense edifice will be found to be little short of six acres. Seats were provided for 80,000 spectators; while the arena was sufficiently capacious to admit of several hundred animals fighting within it at one time, or the evolutions of numerous vessels in mimic sea-fights, and several other exhibitions requiring great amplitude of space.

The outer encircling wall is pierced with eighty openings, leaving, of course, an equal number of piers; every opening is arched, and in or against every pier is a column projecting about half its diameter, and supporting an entablature which runs in an unbroken line all round the structure. With the exception of the four central openings, which lie on the diameters of the ellipsis, and are each nearly two feet wider than the rest, all the openings are very nearly the same, their width being 14 feet 6 inches. An exactly similar series of arches, diminished only in proportion to the smaller extent of the ellipsis, separates the second corridor from the first; and another, bearing the same relation to the second series, that the second does to the first, or outer, bounds the second corridor. The inner faces of the outer piers, both faces of the piers of the intermediate series, and the outer faces of the piers of the innermost series, have pilasters projecting from them, corresponding in height with the external columnar ordinance, and bearing a moulded architrave from the top of which semicircular arches are turned over the corridors and continued all round the edifice. The accompanying plan and section exhibit the general arrangement of the corridors here described, though the details cannot, on so small a scale, be made obvious. The elevation shows how a second and third columnar ordinance, with corresponding and nearly similar arched intervals, superimpose the lowest, and each other, and that each of these two upper ordinances rests upon a continued stylobate or dado, which is broken into every interval or under every column. The section indicates the repetition of the double series of outer corridors in every story, or behind every one of the three columnar ordinances, and above the outermost corridor in the third story, a mezzanine, or small middle story, for a corridor behind the first, and under the second, or upper, gallery. The same diagrams show that the third story of columns is superimposed by a pilastrated ordinance on a continued and recessed dado also, with a deep plinth; they show, moreover, that a bold and massive entablature crowns the whole elevation, and runs its cornice round in one unbroken line.

From the third series of eighty piers, on the ground story, as many walls, with the exceptions to be noticed, run inwards to the third concentric corridor, which is arched over as the outer ones are; the walls are continued on the other side of it to the fourth or innermost corridor, which is bounded on the other side by the massive wall of the podium encircling the arena, and is also arched over, though it is not so lofty as the other three corridors are. Between the radiating walls of the two blocks separating the second from the third, and the third from the fourth corridors, are of course as many intervals. Some of these form the traversing passages; and the rest, in the outer block, contain the staircases which lead to the upper concentric corridors, and so onward to the upper benches and galleries; in the inner block are those which lead to the lower benches, and small staircases in the thickness of the innermost wall conduct to the benches immediately on the podium. The benches extend in one long graduated and concentric series from the podium up to the level of the second story of the outer corridors, and over all the constructions within the second of them. They are bounded above by a wall which is pierced with doors; these give access from the upper and inner corridor to the radiating flights of steps which intercept the benches at intervals, and cut them up into wedges, by which name in Latin, *cunei*, the divisions thus made were distinguished. This encircling wall has windows in it also, which may have been requisite to aid in ventilating the immense area; or they may have been intended merely to afford a view of the arena to persons who

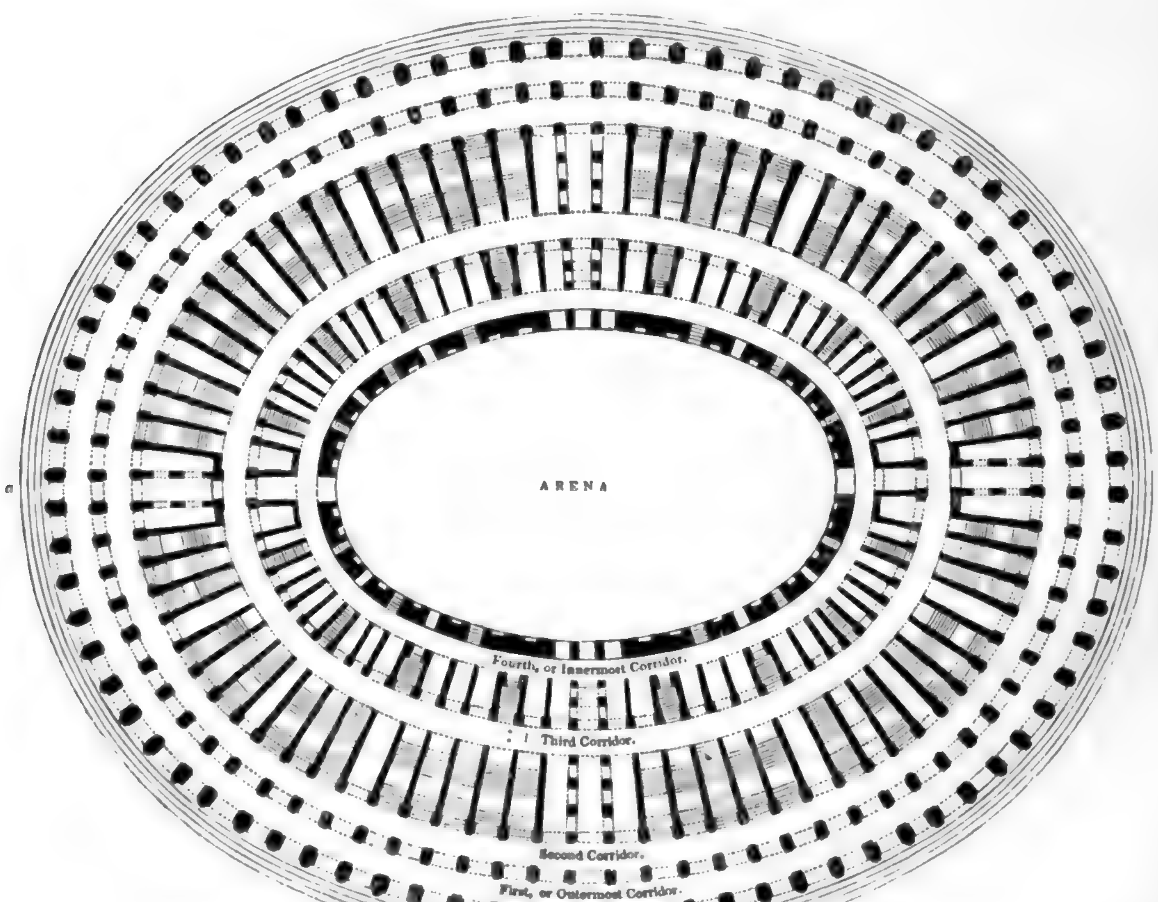


Longitudinal Elevation of the Flavian Amphitheatre, or Colosseum, Rome.



Arena.

Longitudinal Section—on the line of *a* to *b* of the plan of an Amphitheatre—The Colosseum.



Ground Plan of an Amphitheatre—The Colosseum.

could not find room on the benches. The section shows that the radiating flights of steps intercepting the benches do not run through their whole extent, but are themselves intercepted and taken up again, other lines or flights commencing intermediately and at intermediate heights. Access is given to these flights at their upper ends by doorways from the corridors behind, sometimes directly, and sometimes by means of the internal staircases; and in most cases a short reversed flight of steps is made on the outside of the doorways, or vomitories, as they are termed, to afford headway, and avoid intercepting the benches further back than could be possibly helped. Almost every thing that appears in the section above the level of the third story, except the external wall itself, is restored from analogy and conjecture. The peristyle, or encircling range of columns before the upper gallery, is entirely from conjecture; but for the galleries themselves there is sufficient evidence in the existing indications of stairs, and in the toothings of the remaining walls and piers. The benches in the grand series were probably of stone, perhaps of marble; but in the galleries it is most likely they were of wood, and graduated so as to give their occupiers a view of the arena.

The most distinguished seats were those on the podium, and these were assigned to the emperor, whose place was, by way of eminence, called the *suggestum*, and to the senators, to foreign ambassadors, and to the great officers of the state. The magistrates appear to have sat here in their curule chairs: and the person who gave the games seems to have occupied a sort of pulpit on the podium, called the *editoris tribunal*. The *cunei*, or wedges, behind and above, were assigned to different classes, according to their rank, station, and tribe. The Vestal virgins had one of the best positions assigned to them, and with them sat such ladies of high rank as could obtain the advantage; but the women generally occupied the open gallery at the top.

As the plan indicates, the four central entrances—those which lie on the ends of the diameters of the ellipsis—are wider than the corresponding parts of the rest of the structure. They were arcaded through, and finished more carefully, especially those leading from the sides, or on the minor axis; these, it is most likely, were reserved for those persons who went to the seats on the podium, and as they gave access also to the arena, they would of necessity be more strictly guarded.

It does not appear that any part of the structure above the level of the ground, and outside of the arena, was appropriated as dens for the beasts which were used in the shows; for indeed the corridor leading to the principal seats in the amphitheatre must have been traversed by them in their way to the arena, if that were the case. Substructions were discovered and excavated a few years ago over the whole extent of the arena; these lead to a belief that it was floored with wood, so that the animals required for the day may have been kept in dens under the floor, and allowed to issue at traps in it. But some have supposed dens ranged all round the arena, within its surface and below the podium, from which the beasts would issue to the combat directly.

In the Colosseum the great crowning cornice of the external elevation is pierced through at regular intervals with square holes or mortises, from which grooves are cut down through the rest of the entablature flush with the outer surface of the wall; and every mortise and groove is immediately above a strong projecting stone or corbel at about two-thirds the height of the pilastraded ordinance. These are supposed to have been used to insert and receive poles to carry an awning strained over the whole inclosure to protect the spectators from the sun and from rain. It is however difficult to understand how such an extent of cloth or canvass could have been borne in that manner without some intermediate support, of which we are not aware.

The external elevation is composed,—as it has been already described, and as the elevation indicates,—of three series or stories of attached or engaged columns with their usual accessories, and a pilastraded ordinance, forming a species of attic, which is pierced with windows, —one in every other interspace. The lowest ordinance of columns rests on the upper step of the substructions, or on the ground floor of the structure; it is of what is termed the Doric style or order, but in the debased Roman manner, and its entablature wants the distinguishing feature of that style, the triglyph. The intervening arches are semicircular; they spring from moulded imposts, and have moulded archivolts on their outer faces. The second ordinance is in the Roman Ionic style, having voluted capitals to the columns; and the third is in the Corinthian or foliated style: these, as before stated, rest upon continued, but broken or recessed, stylobata, but their entablatures are, like the rest, perfectly unbroken throughout, and the arches in the intercolumniations in both, correspond exactly—except in minor details—with those of the lowest or Doric ordinance. The pilasters have foliated capitals also, and are called composite; they rest on deep plinths under which there is a continued and recessed dado superimposing the Corinthian entablature;—this dado is pierced with holes or small windows, alternating with those of the ordinance above, to give light to the corridor behind the lower and under the upper gallery on the inside. The crowning entablature is made bold and effective by deep modillion blocks or consoles occupying the whole depth of the frieze.

The style of these architectural decorations is, for the most part, rude and tasteless; the Colosseum, however, from its magnitude, from its general form, and no doubt also from the feelings arising from the contrast between its present state and ancient splendour, never fails to produce a profound impression on the spectator. Internally the amphitheatre must always have been strikingly grand and impressive; here none of the littlenesses of storied columns appeared, but the long unbroken lines of the podium, and the graduated series of the benches, and the galleries with the encircling peristyle above—when it existed —would have been as beautiful in general effect, as anything architecture ever produced.

There are varieties in the arrangement of the details of the amphitheatre, as other examples show. Intermediate concentric galleries, platforms, or precinctions sometimes intercepted the great bank of graduated benches to serve as passages of communication; and sometimes each staircase communicated directly and exclusively with one vomitory, instead of leading to encircling corridors which communicated generally, and gave access alike to every part of the enclosure.

Next in importance to the Colosseum at Rome, of existing structures of the kind, is the Ampitheatre of Verona. The prefixed vignette will give a tolerable idea of its state of preservation. The great external cincture is entirely gone, with the exception of four arches and their accessories; but the great bank of concentric benches, with the staircases leading to them, and the parts about the arena, remain in a comparatively perfect state. The outer cincture was pierced with seventy-two arches, which number appears in the inner, with the corresponding radiating walls to the traversing passages and staircases, —for this had not a second encircling corridor on the outside of the stairs block as the Colosseum has. The outer dimensions of this structure were 502 feet by 401 feet; the length of its arena is 242 feet, and its breadth or length, on the conjugate, 146 feet; the form, of course, was ellipitical.

The amphitheatre at Nîmes in Languedoc is large (430 feet by 378), and in comparatively good preservation. The great external cincture of an amphitheatre (436 feet by 346) remains in a very perfect state at Pola in Istria. Rome contains the remains of a second amphitheatre called the Castrensian. There are also considerable remains of an amphitheatre at Capua, rivalling in size that at Verona; and of another at Pozzuoli near Naples. That of Pompeii, it has been already remarked, was an extensive structure. It was also in many respects peculiar, but it is not so well preserved as some other examples which have been more exposed, as it suffered considerably from earthquakes before it was buried. At Pæstum, there are indications of an amphitheatre, though not a large one; at Catania, in Sicily, the upper and outer encircling corridor of an extensive amphitheatre is accessible, considerably under the level of the modern city, buried by the torrents of lava from Mount Etna. Syracuse and several other of the ancient cities of Sicily exhibit remains or indications of small amphitheatres. In our own country, as has been noticed, there are several vestiges of amphitheatres; indeed, wherever Roman remains are found to any extent, whether at home or abroad, some indication may be almost certainly discovered of the existence at some time of an amphitheatre.

AMPHITRI'TE, is represented by Hesiod as a goddess, the wife of Poseidon or Neptune, to whom she bore three sons; and she changed Scylla into a horrible monster when she had become jealous of her. By later poets she is treated as the goddess of ocean generally. There was a temple to Neptune and Amphitrite at Tenos, as is shown by an inscription on one of the marbles of the Elgin collection in the British Museum; and in the temple of Poseidon on the Corinthian Isthmus, there was a statue of the goddess. Amphitrite was represented in Greek art as resembling Aphrodite, but her hair was confined by a net. There is a colossal statue of her in the Villa Albani at Rome. She is also frequently represented on coins, especially on those of Syracuse.

AMPHITRITE. One of the group of small planets revolving between Mars and Jupiter. [ASTEROIDS.]

A'MPHORA (ἀμφορεύς), in its ordinary acceptation, means an earthen vessel, used as a measure for liquids both by the Greeks and Romans, and for preserving wine, grapes, olives, oil, and other articles which required careful keeping. It received its name on account of its two ears or handles. It is generally two feet, or two feet and a half in height: and the body, which is usually about six inches in diameter, ending upwards with a short neck, tapers toward the lower part almost to a point. This pointed end was inserted in a hole in the ground, or in a stand to keep the vessel upright. The Attic amphora contained three Roman urnæ, or seventy-two sextaries, equal to about two gallons five pints and a half of English wine-measure. The Roman, sometimes called the Italic amphora, contained two urnæ or forty-eight sextaries, about seven gallons one pint English. Homer mentions amphoræ both of gold and stone; in later times glass amphoræ were not uncommon; and the Egyptians had them of brass. There are various specimens of earthen amphoræ in the British Museum, in the Elgin and Townley Galleries.

There was another amphora among the Romans, which was a dry-measure, and contained about three bushels.

Earthen amphoræ of the Roman time have been frequently found in England. Like other domestic vessels of the Romans, they appear to have been sometimes used as funeral urns. They were also used as coffins: the amphora was cut in half in the direction of its length, and the corpse having been placed inside, the two halves were united again and buried. Amphoræ used for wine were usually lined with pitch or some other coating, on account of the porous nature of the material of which they were formed. Amphoræ were placed as urinals in the public streets of Rome till the time of Vespasian. The burden of ships was reckoned by amphoræ.

The amphora is still the largest liquid measure used by the Venetians, containing sixteen quarts.

AMPLITUDE, the angular distance of a celestial body from the east point when it rises, or from the west point when it sets. It depends upon the declination of the star and the latitude of the place, and may be computed from the formula,

$$\text{sin. amplitude} = \frac{\text{sin. declination}}{\text{cos. latitude.}}$$

It must be measured towards the north or south points of the horizon, according as the declination is north or south. For the fixed stars, the amplitude remains the same throughout the year: but for the sun it varies with the declination, being nothing at the equinoxes, and about $3\frac{1}{2}$ points of the compass at the solstices, or more exactly 39° 44′ of amplitude, in the latitude of London; that is, at the summer solstice, it rises between N.E. by E. and N.E., and sets between N.W. by W. and N.W.; and at the winter solstice, it rises between S.E. by E. and S.E., and sets between S.W. by W. and S.W.

The term amplitude was also applied to what is more commonly called the *range* of a gun; that is, the whole horizontal distance which the gun will carry. It is sometimes also used in the integral calculus.

AMPUTATION, from *amputo*, to cut off; the operation of cutting off a limb from the body. Such is the constitution of the animal body in general, and especially of the more perfectly organised body, that if one part of it be diseased, the whole system suffers, while a general disturbance of the system cannot exist long without producing specific disease in some individual organ. Hence constitutional and local diseases are found to exert a most important influence over each other. Some local diseases are of an incurable nature, and proceed progressively from bad to worse. At first, these diseases may not materially affect the general health, but in their progress they produce so much constitutional disturbance, as to endanger life, and ultimately to destroy it. In this case, life is really endangered and destroyed by the local malady; remove that, provided the removal can be effected before the general health is irreparably impaired, and not only is death averted, but health itself is restored. Hence, in all ages, the necessity and advantage have been obvious enough, of removing a part of the body for the sake of preserving the remainder, and men have always been willing to submit to the loss of a limb in order to save the body, on the ground "that it is better to live with three limbs than to die with four."

But although it must always have been clear, that it is a gain to save life even at the cost of a limb, when nothing but the removal of the limb can preserve the body, yet it was not always easy to make the sacrifice. Whoever understands the circulation of the blood, and considers the quantity that is sent, and that must necessarily be sent, to each member of the body for its nourishment, and the magnitude of the blood-vessels that are divided in cutting off a limb, will readily perceive how impossible it must have been to perform the operation of amputation before any certain mode was known of stopping the flow of blood from the wounded blood-vessels. But no such mode of stopping hæmorrhage was known to the ancients: consequently, though they daily saw the necessity of performing the operation of amputation, yet they looked upon the operation with terror, and shrunk from the responsibility of undertaking it. And no wonder: when they did venture upon it, the consequences were appalling. They cut through the flesh with a red-hot knife, hoping by this means to prevent a fatal loss of blood. After having performed this operation, they dressed the wound with scalding oil, in order to complete what the burning knife may have left imperfect. But these expedients stopped only for a short time the flow of blood. The whole surface of the wound was converted into an eschar, which for a time stopped the bleeding. But the eschar being dead matter it was at length thrown off by the action of the living parts beneath. The moment this took place, the mouths of the blood-vessels were again opened, hæmorrhage took place just as at first, and the patient perished from loss of blood. The uniformity with which this event took place after amputation performed in this mode, could not but cause the operation to be regarded with dismay. Nevertheless, it is pretty clear, that in the time of Celsus, the surgeons of that age were not without some notion of the true mode of stopping hæmorrhage from wounded blood-vessels, for that writer gives particular directions to take hold of the vessels, to tie them in two places, and then to divide the intermediate portion; certain, however, it is, that this practice was not extended to amputation, because nothing was ever amputated by the ancients but a part absolutely mortified or dead; and in a part thus mortified or dead, it is not practicable to secure the blood-vessels by the needle and ligature. The general introduction into surgery, of the method of stopping hæmorrhage by taking up the divided blood-vessel with a needle, and placing a ligature around it, must, therefore, be considered as much a modern improvement, as if no allusion whatever had been made to it by ancient writers.

But if a knowledge of the mode of stopping hæmorrhage by tying the blood-vessel, be indispensable to the safety of surgical operations in general, the knowledge of some mode of preventing the loss of blood during the actual performance of an operation is indispensable to the safety of the operation of amputation in particular. So large are the trunks of the main blood-vessels that supply the limbs, and so great is the quantity of blood that flows from them in a short space of time, that loss of life is always the consequence of a want of command over these great vessels. By the invention of the instrument termed the tourniquet, an invention of the 17th century [TOURNIQUET], this command is obtained. By these instruments, then, namely, the tourniquet, and the needle and ligature, modern surgeons have such a perfect command over the blood-vessels, that operations may be performed, in which the largest trunks are divided without the loss scarcely of a single drop of blood. On this account, the mere removal of a limb excites in the modern surgeon no degree of anxiety; the operation of amputation is scarcely ever attended with the slightest hazard; nevertheless, there are circumstances connected with amputation of the greatest possible importance, delicacy, and difficulty, on a clear and correct view of which life depends; to obtain such a view, the most extensive knowledge, and the most accurate discrimination, are requisite; while, to act in conformity with it, a high degree of moral courage is often no less necessary. Perhaps the determination of the exact time at which to amputate is sometimes among the most difficult points of surgery; that is, the determination of the time when the preservation of the limb is no longer possible; and when, therefore, it is right to put an immediate stop to any further exhaustion of the health and strength by the removal of the limb. The recent introduction of the use of anæsthetics, in order to produce a state of insensibility in those submitting to the operation of amputation, has been found to exercise a most beneficial effect on recoveries after amputation. [ANÆSTHETICS.]

AMULET, in barbarous Latin, *Amuletum*, or *Amoletum*. It comes from the Arabic *Hamalet*, a thing suspended. An amulet hung round the neck, or carried in any other way about the person, is absurdly believed to have the effect of warding off morbid infections and other dangers, and even of curing diseases by which the body has been already attacked. The belief in the efficacy of amulets has subsisted at some time among almost every people, and the thing has been denoted by a great variety of names, which it is unnecessary here to enumerate. The phylacteries, or bits of parchment with passages from the Bible written upon them, which the Jews were wont to carry about with them, were amulets; such were probably the ear-rings mentioned in Genesis xxxv. 4; and in Hosea ii. 13. Jerusalem is represented as decking herself with the ear-rings of Baalim. Of the same character as the Jewish phylacteries are the scraps of paper inscribed with sentences from the Koran, which the Moorish priests sell to the negroes of Africa, and to which the latter give the name of *Fetishes*. This superstition, which existed also among the Greeks and Romans, appears to have in early times prevailed extensively among the converts to Christianity, if we may judge by the denunciations directed against it by St. Chrysostom, and others of the fathers. But even down to our own day, it has continued to be an article of the popular creed, that certain medical preparations, and other things, merely carried about the person, have the power both of repelling and of healing diseases. Even the celebrated Robert Boyle adopts this notion, assuring us that he once experienced the efficacy of such an amulet in his own case. "Having been one summer," he says, "frequently subject to bleed at the nose, and reduced to employ several remedies to check that distemper; that which I found the most effectual to stanch the blood was some moss of a dead man's skull (sent for a present out of Ireland, where it is far less rare than in most other countries), though it did but touch my skin till the herb was a little warmed by it." ('Essay of the Porousness of Animal Bodies.' See also his 'Essays on the Usefulness of Natural Philosophy,' and his 'Experimental Discourse on some Unheeded Causes of the Insalubrity and Salubrity of the Air.') The anodyne necklace, which consists of beads formed from the roots of white bryony, and is sometimes hung around the necks of infants with the view of assisting their teething, is an instance of the still surviving confidence in the medical virtue of amulets. Such also is the belief generally entertained by seafaring people, that a child's caul on board their ship will preserve them from being lost—and many other examples might be easily quoted. Even in 1858, though probably without much superstitious belief, *charms* were advertised set as jewels, and among them were pieces of the Atlantic cable.

AMYGDALIC ACID. ($C_{40}H_{26}O_{24}$). Produced by the action of alkalies upon amygdalin.

$$\underbrace{C_{40}H_{27}NO_{22}}_{\text{Amygdalin.}} + 2HO = \underbrace{C_{40}H_{26}O_{24}}_{\text{Amygdalic acid.}} + NH_3.$$

Evaporated on the water-bath, solution of amygdalic acid dries up to a gummy mass, which is highly deliquescent, insoluble in ether, and in boiling absolute alcohol. By the aid of heat it reduces the salts of silver. Its salts are generally gummy and uncrystallisable. Like amygdalic acid itself, they yield formic acid, carbonic acid, and hydride of benzöyl, when boiled with a mixture of peroxide of manganese and sulphuric acid.

AMYGDALIN. ($C_{40}H_{27}NO_{22}+6aq.$) A crystalline substance first obtained by Robiquet, and Boutron Charlard, and afterwards studied by

Liebig and Wöhler. It is met with in bitter almonds, the leaves of the cherry laurel, the kernels of peaches, and is probably also contained in all those parts of vegetables which yield hydrocyanic acid when distilled with water.

Amygdalin is prepared as follows:—Bitter almonds are strongly pressed between hot plates of iron, so as to expel the fixed oil they contain. The resulting mass is extracted with boiling alcohol of 90 or 95 per cent., and to the filtered and clarified alcoholic solution, evaporated to one-sixth its volume, is added half its bulk of ether, which precipitates the whole of the amygdalin. The precipitate is finally washed with ether and purified by recrystallisation from alcohol. Four pounds of bitter almonds yield about an ounce of amygdalin.

Amygdalin crystallises in white pearly plates, which are very slightly soluble in cold, but easily soluble in boiling absolute alcohol. It dissolves readily in water, but is insoluble in ether. Its aqueous solution possesses a slightly bitter taste. The most interesting property of amygdalin is, that when its solution is placed in contact with *emulsin*, it is transformed by a species of fermentation into hydrocyanic acid, hydride of benzöyl (essential oil of bitter almonds), and grape sugar.

$$\underbrace{C_{40}H_{27}NO_{22}}_{\text{Amygdalin.}} + 4HO = \underbrace{C_2HN}_{\text{Hydrocyanic Acid.}} + \underbrace{C_{14}H_6O_2}_{\text{Hydride of Benzöyl.}} + \underbrace{2C_{12}H_{12}O_{12}}_{\text{Grape sugar.}}$$

Bitter almonds contain both amygdalin and emulsin, and, therefore, when treated with water they yield the well known essential oil mixed with hydrocyanic acid; but sweet almonds contain emulsin and no amygdalin, and consequently do not yield these products when macerated with water.

AMY'GDALUS—*Medical Properties of. Amygdalus communis*, a tree native of Asia and Africa, cultivated in the southern parts of Europe, of which there are two varieties, sweet and bitter. Of the sweet almonds, the parts which are officinal are the seeds or kernels. When covered with the skin, these are of a clove-brown colour, smooth, with vessels traversing the skin, and forming a raphe. Deprived of the skin, the egg-shaped seed, formed of two cotyledons, is seen of a white colour. They have a sweet and mucilaginous, rather oily taste, and scarcely any odour when fresh but when spoiled a disagreeable rancid taste.

Analysed by Boullay, they yielded emulsin, and a fat oil of a very bland kind. Ten pounds of seeds yield four pounds of oil. Upon being subjected to pressure, or treated by means of ether, the oil is separated, and there remains the cake, or farina amygdalæ. The commercial varieties are numerous, but the most esteemed are the Jordan almonds.

Triturated with water, sweet almonds form a grateful, sweetish emulsion, which possesses considerable nutritious as well as demulcent properties. This emulsion should never be prepared long before it is required for use, and should always be made with sweet almonds. Almond-paste forms a good emollient application to chapped hands in winter.

Almonds, as an article of dessert, are nutritive, but rather indigestible. In some persons they occasion—more particularly bitter almonds—an eruption similar to nettle-rash, and other troublesome symptoms.

Oil of Almonds.—The almonds having been freed from the skins, must be bruised, and pressed in the cold, or, if warmed, they must be pressed in iron presses. The oil when first obtained is turbid, but becomes pure by time or by filtration. It is yellowish, or nearly white, if the almonds have been completely freed from the skins before being pressed, translucent, and when cold-drawn is without odour. The taste is purely oily. Specific gravity, 0·911 to 0·920. Consists of, elain 75; stearin 25. It is fluid at the ordinary temperature of the air, and rarely or never becomes turbid or white. Alcohol when cold takes up 1-25th part. Sulphuric ether and the volatile oils combine with it in every proportion. Caustic potash forms with it a very solid soap. When it has been carefully expressed, it does not become rancid so easily as is believed.

It may be obtained from either variety, but is yielded in greatest abundance by the bitter almond: 10 lbs. of sweet, when cold-drawn, yield from 4 to 4½ lbs.; 16 lbs. of bitter almonds yield 7 lbs.

Almonds which have become rancid yet yield by expression good oil, if a little calcined magnesia be added to the bruised almonds before being subjected to pressure.

Almond oil is often adulterated with poppy oil. It is employed more as an external application, especially to the ears, than internally. It is also used for hair oil.

Amygdal. Amaræ, bitter almonds, are smaller and flatter than the sweet. Those most esteemed come from Provence; those least esteemed from Barbary. They have a very bitter taste, and scarcely any odour, but if rubbed between the fingers with a little water, they emit a peculiarly agreeable odour. Triturated with water, they form an emulsion, which by distillation yields a volatile oil, containing hydrocyanic acid. This oil is procured in very variable quantity; 1 lb. of almonds yielding in some instances 1 drachm, in others only 50 grains, in others only 10 grains.

A fat or fixed oil is also contained, which may be procured by expression. Hence, in the Pharmacopœia, Oleum amygdalarum is directed to be expressed from the kernels of either variety. For the sake of economy, this fixed oil is first procured, and the cake which remains is employed either to yield the volatile oil containing hydrocyanic acid or to furnish amygdalin.

The essential oil of bitter almonds is prepared by distilling the emulsion of bitter almonds.

It is sold in different degrees of dilution to cooks, confectioners, and others, to flavour cakes and liqueurs, under the name of essence of ratafia, peach-essence, &c. (See 'Lancet,' June 8, 1844; and 'The Chemist,' vol. v. p. 335.) From its indiscriminate use, as well as variable strength, many fatal cases result from it. It is also used as a criminal means of destroying life. [AMYGDALIN; BENZOYL, HYDRIDE OF.]

AMYL ($C^{10}H^{11}$) or $\left(\begin{matrix}C_{10}H_{11}\\C_{10}H_{11}\end{matrix}\right\}\Big)$. A compound radical, discovered by Frankland. It is procured by the action of zinc on iodide of amyl. It is an oily liquid, boiling at a temperature of 311° Fahr., and is homologous with methyl, ethyl, &c. Its compounds form a series of highly interesting bodies, resembling those containing ethyl and methyl.

The following are some of the most important of these compounds:—

Hydrated oxide of amyl (Amylic alcohol) $\left(\begin{matrix}C_{10}H_{11}\\H\end{matrix}\right\}O_2\Big)$. This body, from which amyl and all its compounds are derived, is formed along with common alcohol during the fermentation of the mash of potato starch, and the starch of common grains. The process of its formation under these circumstances is not well understood, although it undoubtedly depends on some peculiar conditions of the fermentation. It is on account of its being obtained from the decomposition of starch (*Amylum*) that it has obtained its name. The latter portions of the alcohol produced in the distillation of these fermented matters contain an oil separable by water and termed *Fusel oil*, the greater portion of which consists of amylic alcohol. It is the occurrence of this oil in crude distilled spirits that gives them a part of their noxious qualities, and it is the object of the distiller to prevent the development of fusel oil. When fusel oil is submitted to distillation, its boiling point gradually rises until it reaches 270° F., at which point it then frequently remains stationary during the remainder of the distillation. The portion of the fusel oil distilling at 270° is pure hydrated oxide of amyl. It is a colourless, somewhat oily liquid, almost insoluble in water, and boiling at a temperature of 270°. It has a powerful odour, which is very unpleasant, and produces when inhaled a sense of suffocation. Its taste is nauseous and acrid. When heated in contact with potash, hydrogen is given off, and valeric acid is formed, which unites with the potash. Distilled with a mixture of dilute sulphuric acid and bichromate of potash, it also yields valeric acid,

$$\underbrace{C_{10}H_{12}O_2}_{\text{Amylic alcohol.}} + O_4 = \underbrace{C_{10}H_{10}O_4}_{\text{Valeric acid.}} + 2\,HO.$$

and is now the source of the salts of this acid used in medicine. When heated with dry phosphoric acid, it yields the carbo-hydrogen $C^{10}H^{10}$, which is isomeric with olefiant gas, and which is known by the name of *Amylene* or *Valerene*. This substance has lately obtained some repute, since it has been administered in common with chloroform and ether as an anæsthetic. [ANÆSTHETICS; MATERIA MEDICA; ALCOHOLS.]

Iodide of Amyl ($C_{10}H_{11}I$).—This compound is formed by distilling together a mixture of 10 parts of amylic alcohol, 12 parts of iodine, and 1¼ parts of phosphorus. The product, after being washed with water, and then dried over chloride of calcium, is again submitted to rectification, a thermometer being inserted through the tubulure of the retort. That portion which distils over whilst the thermometer stands at 295° F. is pure iodide of amyl, and must be collected apart.

Iodide of amyl is a colourless and transparent liquid, refracting light strongly, possessing a slight ethereal odour and a pungent taste. Its specific gravity is 1·511. It boils at 295° F. Exposed to direct sunlight, it gradually becomes brown from the separation of free iodine. It is decomposed by an alcoholic solution of potash, amylic alcohol being reproduced.

$$\underbrace{C_{10}H_{11}I}_{\text{Iodide of amyl.}} + \underbrace{KO,HO}_{\text{Hydrate of potash.}} = \underbrace{C_{10}H_{12}O_2}_{\text{Amylic alcohol.}} + \underbrace{KI.}_{\text{Iodide of potassium.}}$$

Heated with amalgam of zinc to 356° F., in a strong sealed glass tube, it gives amyl, hydride of amyl, amylene, and iodide of zinc. Heated to 212° F. with alcoholic solution of ammonia, it yields amylamine.

The following are the names and formulæ of the remaining more important compounds of amyl:—

Oxide of amyl	$C_{10}H_{11}O,\ C_{10}H_{11}O$
Chloride of amyl	$C_{10}H_{11}Cl$
Bromide of amyl	$C_{10}H_{11}Br$
Sulphide of amyl	$C_{10}H_{11}S$
Amylamine	$C_{10}H_{13}N$
Diamylamine	$C_{20}H_{23}N$
Triamylamine	$C_{30}H_{33}N$

Zincamyl	$C_{10}H_{11}Zn$
Sulphamylic acid	$C_{10}H_{11}O, SO_3HOSO_3$
Hydride of amyl	$C_{10}H_{11}H$
Nitrate of amyl	$C_{10}H_{11}ONO_5$
Acetate of amyl (Pear oil)	$C_{10}H_{11}OC_4H_3O_3$
Valerate of amyl (Apple oil)	$C_{10}H_{11}OC_{10}H_9O_3$
Amylurea	$C_{12}H_{14}N_2O_2$
Amylphenylamine	$C_{22}H_{17}N$
Amyldiethylamine	$C_{18}H_{21}N$

AMYLAMINE. [AMYL.]

AMYLENE. [AMYL.]

AMYLUREA. [AMYL.]

AMYLIC ALCOHOL. [AMYL.]

AMYRINE. A resinous substance of unknown composition, extracted from the *Canarium album*, a tree growing in the Philippine islands. It is soluble in ether, from which it crystallises in lustrous satiny fibres. It is insoluble in water, soluble in hot absolute alcohol, and fuses at 345° Fah.

ANA, a Latin termination of the neuter plural form. It appears in our language, divested of the sign of gender, number, and case, in such words as subterranean, metropolitan, Christian, Anglican, Ciceronian, Johnsonian. The Latin *ana* is the form appropriated to the neuter plural; and, therefore, *Ciceroniana*, for instance, would signify matters, or things of any sort, about or appertaining to Cicero. Cicero, in one of his epistles, mentions an *ana* (book vii. ch. 32), in which he complains of having all sorts of sayings attributed to him, even the Sextiana.

In modern times this termination has been used to denote collections, either of remarks made by celebrated individuals in conversation, or of extracts from their note-books, letters, or even published works, or generally, of particulars respecting them.

The earliest recorded modern *ana* were certain manuscript collections in the possession of Guy Patin, in 1659, relating to Grotius, Nicholas Bourbon, and Gabriel Naudé, which he called Grotiana, Borboniana, and Naudeana. They were never published; those published as 'Naudeana' at Paris in 1701, being, as is generally acknowledged, a mere forgery.

The first printed Ana was the collection of the colloquial remarks of Joseph Scaliger, now distinguished as the 'Scaligerana Secunda.' Two brothers, Jean and Nicholas de Vassan, having gone to study at Leyden, carried with them letters of recommendation from Casaubon to Scaliger, who was then one of the professors in that university. In consequence they were much at his house, and heard a great deal of his conversation, both in company and in private. Such of his observations upon all sorts of subjects as they considered to be most valuable or remarkable they wrote down till the collection at last formed a thick octavo volume. The book was published in 1666, with the title of 'Scaligeriana, sive Excerpta ex ore Josephi Scaligeri:' per FF. PP. (contraction for 'Fratres Puteanos').

It happened, however, that the Vassans were not the only persons by whom Scaliger's conversations had been noted down. A physician of the name of François Vertunien, who attended the family of the MM. Chateigners de la Rochepozai, in whose house Scaliger resided, had been in the habit for seventeen years, namely, from 1575 to 1592, of keeping a record of the remarks that dropped from the lips of the great scholar. After his death they were published along with the former collection, in 1669, bearing the following title, 'Prima Scaligerana, nusquam antehac edita, cum Prefatione T. Fabri; quibus adjuncta et altera Scaligerana, quam antea emendatiora, cum notis cujusdam V.D. anonymi.'

The next of the Ana which appeared was the 'Perroniana,' being notes (in French) of the conversations of Cardinal du Perron. It appeared in 1669. In the same year, the same person gave to the world another of these collections, the 'Thouana,' or remarks of the President de Thou. These works had extraordinary success; and the avidity with which they were read, produced a long succession of similar productions. It was in France, or at least in the French language, that most of the Ana appeared; and their popularity may be said to have lasted for fully half a century. One of the most valuable of this class of publications is the 'Menagiana,' a record of the conversations of Menage, who was a man of distinguished wit and talent, as well as a great scholar. He died in 1692, and the following year the 'Menagiana' appeared in a 12mo volume, both at Paris and Amsterdam.

Of our English *Ana*, by far the most celebrated is the 'Walpoliana,' being a collection of the conversational remarks of Horace Walpole.

There are many works, which, without bearing the characteristic title of such collections, belong in all other respects to the class of the *Ana*. One of the earliest and most celebrated of such works in modern times is the 'Colloquia,' or 'Table-Talk' of Luther, first published in German at Eisleben, in 1565. Another very celebrated work of this kind is the 'Table-Talk of John Selden,' which is stated to have been collected by Richard Milward, and was first published in 1689. Boswell's 'Life of Johnson' is undoubtedly the most remarkable work of this description in existence.

ANABAPTISTS, a religious sect. The word, composed of two Greek terms, properly signifies those who baptise a second time, or insist upon the necessity of a second baptism in persons whom they admit to their communion. It is sometimes applied to designate that large body of Christians in our own and other Protestant countries, one of whose articles of belief is, that baptism ought only to be administered to adults, and who, accordingly, rebaptise those who seek to join them. But this application of the name is quite unwarranted, and one against which the community in question have always protested. They do not maintain the necessity of a new or second baptism, nor are those who have been born and brought up in their persuasion ever baptised twice. Others, who may have been previously baptised in infancy, are indeed baptised once again when they have grown up; but this is done on the principle that the former ceremony was no baptism at all. *Baptists* is the designation assumed by those who thus hold the doctrines of the non-validity of infant, and the necessity of adult, baptism; and they will accordingly be properly noticed under that head.

We are not aware, indeed, that there has ever been a sect which maintained the necessity of two successive baptisms. On the other hand, it is certain that there were various sects in the earlier ages of the church which agreed with the modern Baptists in allowing no validity except to adult baptism. But the epithet Anabaptists appears to have been first employed to describe a body of fanatics who made their appearance in Germany soon after the commencement of the Reformation; and although it has been since frequently applied to other religious bodies as being alleged to have sprung from these, such a use of it can only be considered as one of those imputations with which different sects have been in the habit of assailing each other.

The Anabaptists were, no doubt, the growth of the Reformation—though Protestant writers have laboured hard to make it appear that such was not the case. They were the ultra-radicals of the Reformation. Munzer, Stubner, and Storck, who were the first heads and apostles of the sect, had all been disciples of Luther; although no person could have more earnestly condemned their proceedings than did that great reformer. They first began to preach their peculiar doctrines in the town of Wittenberg, in Saxony, in the year 1521. In 1525, their followers, composed almost exclusively of the lowest rabble, rose in a general rebellion against the established authorities throughout that province, Suabia, Thuringia, and Franconia. But this insurrection, which it is but fair to remark was partly of a political character, and occasioned by the oppression to which the peasantry were subjected, was soon defeated; and Munzer, himself, being taken, was put to death. The novel notions, however, which he had preached, spread as usual under persecution; and, some years afterwards, the mischief broke out again with new fury. In 1532 a numerous mob of these fanatics, conducted by John Matthias, a baker, of Haarlem, and John Boccoldt, a tailor, of Leyden, suddenly attacked the city of Münster during the night, and made themselves masters of the place. Their adherents immediately flocked thither from all quarters: and elated by their success, the congregated enthusiasts are stated to have given themselves up to extravagances far exceeding anything they had before practised. Matthias named Münster Mount Zion, and proclaimed himself its king. Having madly undertaken, however, attended with only thirty followers, to attack and disperse the forces which came to recover the town, he perished, with all who accompanied him. John of Leyden now assumed the royal dignity, and under his conduct the multitude is said to have proceeded to wilder excesses than ever. The city, however, was at length recaptured by the army which the Bishop had brought up against it on the 24th of June 1535; and Boccoldt, having fallen into the hands of the victors, was soon after executed with the most terrific cruelties that hatred and revenge could dictate.

The most extravagant tenets, as well as conduct, have been commonly ascribed to the Anabaptists of Münster; but the accounts of a proscribed sect by their enemies, it is to be remembered, are scarcely to be received with implicit credit. The doctrine which gave occasion to their distinctive appellation was one of the least remarkable of all their peculiar articles of belief, although they are said to have inculcated it with singular emphasis and vehemence, being in the habit of declaring that infant baptism was an invention of the devil. A much more pernicious principle which they are accused of having held, at least in so far as the peace of society was concerned, was that of the unwarrantableness of all civil government, and the emancipation of the faithful from subjection to either laws or taxes. They are also said to have maintained that, among the saints, all things ought to be in common. Their speculative theology is described as having been much the same with that which has been, and still is, patronised by various other denominations of enthusiasts. It rested principally on the notion that God made his will known to them individually by special inspirations, by way of enhancing the importance of which they are said to have expressed themselves with some degree almost of contempt or disparagement of the written word. Besides the internal impressions which they called inspirations, they had dreams and visions in which they put much confidence; and some of them conceived themselves to have the gift of prophecy, which they were especially accustomed to exercise in predicting the speedy approach of the end of the world. Akin to these delusions was another favourite and fundamental dogma, that every true believer attained even in this life perfect freedom from sin. This position soon led them a great way. Finding that what had commonly been called sin could not be altogether extirpated from the bosoms even of the stoutest believers, they found it necessary, in order to save the doctrine, to declare that certain things which had hitherto been deemed contrary to the divine law, were not so at all, but in reality either indifferent or meritorious. It does not appear that they are accused of having gone quite to the extreme to which the principle in question has sometimes led, of maintaining generally that the belief of the sinner sanctified or neutralised his sin, or, in other words, that an act which would have been sinful in another became divested of its sinful character when committed by a believer. If all that is stated of them be true, indeed, they were under no necessity to resort to this device in order to give a loose to their inclinations, having put down in their list of universally permissible indulgences most of those things to which there is any violent disposition in the multitude of mankind. They condemned, for instance, with great severity, all ornamental attire, and some even went the length of objecting to clothing altogether. Boccoldt himself, in one of his fits of exaltation, solemnly promenaded the streets of Münster, stark naked. The love of dress, they said, was an artificial vanity, and as such hateful to God. But whatever, on the other hand, they held to be natural, they looked upon as harmless or commendable. Boccoldt is stated to have urged upon his followers, as in the highest degree conducive to their spiritual welfare, the practice of a liberal polygamy, and to have illustrated and enforced his doctrine by taking to himself no fewer than fourteen wives.

For a long time after the events which have been related, it was dangerous in Germany and other parts of the continent to profess an adherence to the doctrine of adult baptism; those who held that tenet being all most absurdly classed as belonging to the sect of the Anabaptists of Münster. It has been commonly said, that to avoid the persecution to which they were subjected, the remains of these fanatics in course of time adopted various new denominations, some congregations calling themselves Mennonites, after an eminent leader of the sect, others Waterlandians, from the place of their principal church, others Baptists, &c. But there is really no proof that any of the communities bearing these names had, in their origin, any connection whatever with the Münster insurgents. For further information on the subject of the Münster Anabaptists, the reader may be directed to Mosheim's 'Ecclesiastical History,' century xvi. section iii., part ii., chapter iii. and century xvii., section ii., part ii., chapter v., where he will find the subject treated with great learning, though not in a spirit of much liberality or candour. The principal works relating to the Anabaptists are all referred to in that dissertation.

ANA'BASIS, the title of a Greek work, in seven books by Xenophon of Athens, which describes the circumstances of an expedition undertaken by the younger Cyrus, B.C. 401, against his brother, Artaxerxes, king of Persia. The expedition is remarkable as being the first long march of which we possess a detailed account, and also the oldest extant document which gave to Europeans any tolerably precise notion of the country watered by the Upper Tigris and Euphrates.

The army of Cyrus contained a large body of Greek mercenaries, among whom Xenophon, at first, held no military rank: he went apparently as a mere spectator, and only took command after the death of most of the generals. Cyrus set out from Sardes (now Sart), 38° 34′ N. lat., 28° E. long., and marched through Asia Minor to the passes in Mount Taurus, that lead into Cilicia. He next passed through Tarsus, along the Gulf of Scanderoon, and through the north part of Syria to the Euphrates, which he crossed at Thapsacus, about 35° 14′ N. lat. He then marched S.E. through Mesopotamia, crossing the Araxes (the Khabour); and finally lost his life in an engagement with his brother on the plains of Cunaxa (the site of which is unknown), about forty miles from Babylon (now Hillah), 32° 28′ N. lat., 44° 14′ E. long.

From this point commenced the retreat, commonly known as the "Retreat of the Ten Thousand." Instead of returning by the way which they came, it was determined to reach some of the Greek colonies on the Black Sea. Accordingly they crossed the Tigris, and advancing along the east bank of this river up the stream, they crossed in succession the Diala and other tributaries of the Tigris. They followed the course of this river, till they were stopped about 37° 20′ N. lat. by the mountains pressing close on the river, and allowing no passage along its banks. They then crossed the mountains, and advanced probably nearly due north, but their course from this point is very uncertain. It is probable that the army passed to the west of Lake Van, and in its progress it must have crossed the Morad, or Eastern Euphrates, and that branch of the Araxes which is now the Faz, and is called by Xenophon the Phasis. After enduring much hardship from snow, want of food and clothing, and the opposition of the native tribes, the army at last reached Trapezus, now Trebizond, on the Black Sea, in 41° 2′ N. lat., 39° 28¼′ E. long. From Trapezus the army marched along the coast westwards for about 100 miles (direct distance) to Cotyora.

The narrative of Xenophon contains a statement of the army's marches, with some few omissions, expressed in Persian parasangs, at the rate of thirty stadia to a parasang. The following are the distances given by him in round numbers:—

	Stadia.
From Ephesus to Cunaxa	16,050
From Cunaxa to Cotyora (eight months)	18,600
	34,650

Xenophon adds the march of the Greek auxiliaries from Ephesus to Sardes (about fifty miles) to the distance from Sardes to Cunaxa.

The march may be considered as having terminated at Cotyora, as the army sailed from this place to Sinope, now Sinub: their troubles, however, continued till they reached Byzantium, now Constantinople, and even beyond that point.

If we take the stadia of Xenophon at the rate of ten to a mile, an estimate which is above the truth, we find the whole distance marched to be 3465 English miles, which was accomplished in fifteen months, and a large part of it through an unknown mountainous and hostile country, and in an inclement season. The reader will find the expedition of the younger Cyrus discussed in the work of Major Rennel, and the various difficulties that occur in the narrative of Xenophon explained, as far as means of information will allow, with the Major's usual good sense and sagacity. [XENOPHON, in BIOG. DIV.]

Anabasis is also the name given by Arrian, who was in all things an imitator of Xenophon, to his work, in seven books, in which he describes the campaigns of Alexander the Great. [ARRIAN, in the Division of BIOGRAPHY.]

ANACARDIC ACID. ($C_{44}H_{32}O_7$?) A white crystalline aromatic acid contained in the shell of the acajou nut.

ANÆMIA, a diseased condition of the human body, in which is implied either a morbid condition of the blood, or a relative diminution of some of its most important constituents. This disease is also called *oligonæmia* and *spanæmia*, terms which, like anæmia, express a deficiency or paucity of the constituents of the blood. This state of the system is generally indicated by the excessive paleness of the face and the whole surface of the body. The lips are pale. The conjunctiva is of an unnatural white, having a pearly lustre. The veins on the surface are small, blue, and collapsed. These general symptoms are frequently attended with derangements of the nervous system. There is frequently violent pain in the head, and not unfrequently disordered sensation, as singing in the ears and flashings before the eyes. The whole surface of the body is frequently preternaturally tender, the slightest touch causing the patient to start. The course of the spine is often excessively tender, leading to the supposition that there is spinal irritation. The circulating system is deranged; palpitations of the heart come on after slight exertion. The pulse is mostly small, feeble, and quick, excited to rapid action on slight exertions. The breathing is quickened by exertion, and there is generally lassitude and inability to take much exercise. This disease is accompanied with disturbances of the circulating system, which may be detected by means of the stethoscope. These are heard in the heart, arteries, and veins. The sound heard in the heart is a "bellows" murmur of varying intensity, and is heard most distinctly at the apex. This sound is not present in all cases of anæmia, nor is its occurrence diagnostic of anæmia; but it is very important to know that it may be entirely dependent on the anæmic condition, and removed with it. The arterial murmurs are not frequently heard; they are synchronous with the beat of the pulse, and when present may even be recognised by the character of the pulse. The venous murmurs are much more common. They are continuous, and produce various buzzing, humming, musical, and singing murmurs. "They are most frequently heard on the right side of the neck, at the junction of the external and internal jugular vein." (Aitken.)

The venous murmurs are seldom absent to a greater or less extent in anæmia.

When the blood of anæmic persons is examined under the microscope a deficiency of blood globules is observed. Andral records a case in which there were but 30 parts of blood globules in 1000 of blood. The other constituents of the blood, as far as observations at present go, seem to suffer little alteration.

The *causes* of anæmia are anything acting on the system by which the quantity of blood is diminished or the healthy development of the blood cells prevented. Thus, amongst the causes of this disease we may reckon: 1. Want of food. 2. Want of proper food. 3. Indigestion or imperfect nutrition, from whatever cause. 4. Derangement of the liver, spleen, &c. 5. Hæmorrhages, as from hæmorrhoids, the stomach, lungs, wounds, &c. 6. All extensive discharges from wounds, ulcers, or mucous surfaces.

A knowledge of the causes of anæmia at once suggests its treatment. Where it depends on a want of food altogether, or of proper food, then food of a proper kind must be supplied. Where improper food, as alcohol, produces imperfect assimilation, it must be withdrawn. Deficient nutritionary changes often come on as the result of impure air, and change from an impure to a pure air often acts most beneficially. In certain cases dependent on imperfect blood-cell formation great benefit results from the administration of iron. Cases are recorded in which, under an iron treatment, the blood-cells have increased from 32 to 95 in 1000. Other tonics may also be administered with advantage. In cases of anæmia in marshy districts quinine is of great service.

ANÆSTHETICS, is the term applied to those agents, which, on being applied or administered to the human body, produce either a local or general insensibility. Such agents act more especially on certain parts of the nervous system, depriving it both of its power of communicating and perceiving impressions made upon its sensitive function. The state of anæsthesia comes on in various forms of paralytic disease, and as such has been known and described by medical writers. Anæsthesia can also be produced by artificial means, as in those states of the nervous system brought on by what is called animal magnetism. In this state of the system the anæsthesia is sometimes so perfect that surgical operations have been performed on persons whilst in it perfectly unconsciously. This was known previous to the general introduction of anæsthetic agents during the performance of surgical operations generally. All narcotic medicines will produce conditions of anæsthesia, in which surgical operations may be performed without pain. During the action of alcohol on the nervous system in drunkenness, operations have been performed without the knowledge of the patient. Although these circumstances have been generally known, it was not till about the year 1847 that any attempt was made to introduce anæsthetic agents as a means of alleviating pain during the performance of surgical operations. About this time, two gentlemen in America, Drs. Morton and Jackson, made experiments on human beings with the nitrous oxide (laughing gas), and found that a state of insensibility could be produced by its agency, under which operations could be performed. The effects of this gas in producing excitement of the nervous system had been made known by the experiments of Sir Humphry Davy, and its peculiar action was often exhibited in the lecture-room of the chemist. It was also known that sulphuric ether produced similar effects on the human system. The merit however of the application of these remedies to the production of insensibility during the performance of surgical operations is due to Drs. Morton and Jackson. Having discovered that ether was much preferable for this purpose to nitrous oxide, they made known the important fact, that under the influence of this agent an insensibility might be produced under which persons might undergo the most severe operations without pain, and might be restored from this condition without injury to their health. This announcement was speedily made known, and in the course of a few months the facts were realised in all parts of the world. In London the action of this agent was extensively tried, and realised the most sanguine expectations. The action of ether, and the best method of administering its vapour, was investigated by Dr. John Snow, who, in September 1849, published a work on the 'Inhalation of the Vapour of Ether.' After the success of the first experiments with ether, it was found that other agents similarly constituted acted in the same way upon the human system. This subject was investigated with great success in Edinburgh, and led to the discovery by Dr. Simpson of that city, that chloroform, a terchloride of formyle, acted more speedily and efficaciously than even ether. From this time chloroform became more generally used, and is now the substance which is generally employed for the production of artificial anæsthesia. After this, Dr. Snow found that amylene was capable of producing the same effects as chloroform.

These agents appear to act entirely through the nervous system, and according to the time employed in their administration will be their effect on the nervous centres. The first part of the nervous system which appears to be affected is the brain, and a kind of intoxication comes on in which the patient is excited, the intellectual powers are deranged, and the person acts as though drunk. This effect is produced much more quickly by the vapours of the above-mentioned substances than by drinking alcohol; it also passes off much more rapidly. It was to this action more especially that the effects of the nitrous oxide and ether were confined previous to the discovery of their anæsthetic properties. If however the use of the vapour is persevered in, the effect extends from the brain to the cerebellum, and this organ loses the power of regulating the movements of the body. This effect on the body is also produced by the drinking of alcohol. As the vapour continues to act on the system, the next nervous centre affected is the spinal chord, and the functions of sensation and motion more immediately under the control of this part of the nervous system, are more or less affected. It is in this stage that consciousness and the powers of motion and sensation are entirely lost, and the individual is pronounced in a state of anæsthesia. In this condition animal life is held in abeyance, and the body is insensible to all external agents. There is still however a sufficient amount of nervous power left to maintain the functions of organic life. The heart beats, the lungs perform their functions, and other actions essential to life are carried on. These functions are however under the influence of these anæsthetic agents, and should too large a dose of them be administered, they cease, and death ensues. This is one of the accidents to which the employment of these remedies is exposed, and against which the greatest precaution should be employed.

Dr. Snow, who has practically studied the agency of these remedies more extensively than any other writer, divides the action of ether into five stages. "In the *first degree* the person experiences various changes of feeling, but still retains a correct consciousness of where he is, and what is occurring around him, and a capacity to direct his voluntary movements. In this stage the patient's feelings are generally agreeable, often highly so. In this stage it is not practicable to perform operations without a certain amount of pain. When, however, persons have experienced the more intense degrees of the anæsthetic agent, they return to this stage, and are free from the pain of an operation, whilst their consciousness has sufficiently returned to enable them to know what is going on. In the *second degree* the mental functions may be exercised and voluntary actions performed, but in a disordered manner. In this stage persons are often seized with a tendency to laugh, sob, or scream. They throw themselves about, their actions are instinctive, and not under the direction of their intelligence. In this stage it is not advisable to perform operations, and many operators not carrying the action of the anæsthetic further than this stage have regarded it as useless. The patient may return to this stage from a further one, but it is most desirable that operations should not be performed in it. In the *third degree* there is no evidence of any mental function being exercised, consequently no voluntary motions occur, but muscular contractions in addition to those concerned in respiration may occur. There is sometimes great rigidity of the muscles, but more frequently this is not present. There is a tendency to moan, but not to utter any articulate sounds."—"If this degree is well established, and if the patient has been detained in it at the same point, by inhaling at intervals, or by inhaling dilute vapour, an operation may usually be performed without producing any other effect than a distortion of the features expressive of pain, and perhaps a slight moaning and an increased frequency of respiration, and in some instances a general rigidity of the muscular system." There is never any recollection of operations in this degree, even when symptoms of pain have been exhibited.

In the *fourth degree* no movements are seen, except those of respiration, and they are incapable of being influenced by external impressions. All the muscles are relaxed, and the limbs hang down, or rest in any position in which they are supported. The breathing is deep, regular, and automatic, and there is much snoring. In this degree the patient always remains perfectly passive under every kind of operation. It lasts seldom more than two or three minutes after the inhalation is discontinued. The integrity of the functions of respiration and circulation is not impaired. The pulse is distinct, and however much deranged in previous stages, is little disturbed in this; the sensibility of the glottis and pharynx is maintained, and the patient swallows without difficulty. In the *fifth degree* the movements of respiration and circulation become impaired, and every care should be taken to prevent the action of the vapour from arriving at this point, as death may shortly ensue.

With regard to the quantity of ether required, and the time necessary, Dr. Snow makes the following remarks: "If a middle-aged man, about the average size, is supplied with air mixed with vapour of ether in the proportion of 45 per cent. vapour to 55 per cent. air, and breathes it easily and without obstruction, he usually consumes about two drachms of ether per minute. It is not all absorbed, for a part is expired after passing no further than the trachea. At the end of the first minute he is usually in the first degree of etherisation; of the second minute in the second degree; of the third minute in the third degree; and at the end of four minutes, having inhaled an ounce of ether, in the fourth degree. If the inhalation is now discontinued, he commonly remains in this degree of etherisation for one or two minutes, passes gradually back into the third degree, which lasts for three or four minutes, at the end of which time he is in the second degree, which lasts about five minutes, to give place to a feeling of intoxication and exhilaration, which lasts for ten or fifteen minutes, or longer, before it entirely subsides."

The general effects of chloroform resemble closely those of ether. It is, however, a more potent remedy, and produces anæsthesia more rapidly and certainly than ether. Hence it has been employed more generally. This substance was originally discovered by Liebig and Soubeiran in 1831, and its chemical nature was investigated by Dumas. He first pointed out that the liquid which had been called chloric ether, and chloride of carbon, was composed as follows, $C_2\,H\,Cl_3$, and called it chloroform. Liebig subsequently pointed out that it was a terchloride or perchloride of the base formyle. This substance is prepared, according to the Pharmacopœia of the London College of Physicians, as follows: Take of chlorinated lime iv. lb.; rectified spirit Oss; water Ox; chloride of calcium broken into pieces ℥j. Put the chlorinated lime first mixed with the water into a retort, and then add the spirit, so that the mixture may fill only a third part of the retort. It is then heated in a sand-bath, and as soon as ebullition begins, the heat is withdrawn. The liquid is then distilled into a receiver. A quart of water is then added to the distilled liquid and well shaken. The heavier portion which subsides is then separated, and the chloride of calcium added to it, and frequently shaken for an hour. The liquid, which is the chloroform, is again distilled from a glass retort into a glass receiver. It is a transparent colourless liquid, having a specific gravity of 1·48. It boils at 140° Fah., and the density of its vapour is 4·2. It has a fragrant ethereal apple-like odour, and a slightly acid sweet taste. It is soluble in alcohol and ether, but requires 2000 parts of water for its solution. It dissolves camphor, Indian-rubber, wax, and resins. It is not inflammable. This substance is sometimes given internally in doses of from five to ten minims, and acts as a stimulant sedative antispasmodic and anæsthetic.

Administered in the form of vapour as an anæsthetic, chloroform is much more powerful than ether. This effect seems to arise from its being much more sparingly soluble in the blood than ether. "The quantity of chloroform," says Dr. Snow, "required to induce insensibility is less than one-tenth as much by measure as in the case of ether. Viewed in this manner, it is more than ten times as strong; but to ascertain their comparative physiological power, when inhaled in a similar manner, their volatility requires to be taken into account. In order to perceive the relative strength of these two medicines, we may suppose that the air which a patient breathes is saturated at 60°,—the ordinary temperature of a dwelling room,—with one or other of the vapours, and see how much air he would have to breathe in either case in order to be narcotised to the third degree,—the extent of insensibility usually required in a surgical operation. Thirty-six minims is about the average quantity of chloroform required to produce this degree of narcotism in the adult, and this would saturate 257 cubic inches of air at 60°, making it expand to nearly 300 cubic inches, which would be breathed in 12 ordinary respirations of 25 cubic inches each. The quantity of ether usually required to produce the same amount of insensibility in the adult, is about 7½ fluid drachms; this would saturate 440 cubic inches of air at 60°, and increase its volume to rather more than 800 cubic inches, which would require 32 ordinary respirations to breathe it. We see, therefore, that 12 inspirations of air charged with vapour of chloroform are equal to 32 similar inspirations of air charged with vapour of ether, at the same temperature; and that, consequently, choloroform is nearly three times as strong as ether. In actual practice the difference in strength is generally greater than this, for ether abstracts much more caloric than chloroform during its evaporation, thereby reducing the temperature of the air passing over it, and the sponge or whatever contains it, and limiting its own evaporation, in a greater degree."—'Edinburgh Medical and Surgical Journal,' No. 180.

It is on account of its greater strength that a larger number of accidents have occurred with chloroform than with ether. At the same time, where great care is taken in its administration, there seems to be no reason why chloroform should not be employed for the production of anæsthesia. The usual method of administering this agent is to sprinkle a few drops upon a handkerchief and apply it to the mouth and nostrils of the patient, in such a way that the patient may take air into the lungs which is saturated with the vapour of chloroform. During this operation care should be taken that a larger quantity of the vapour is not inhaled than will produce the fourth stage of anæsthesia. By removing the handkerchief from time to time the patient may be kept in the third or fourth stage, according as it seems desirable. Although the administering of chloroform in the handkerchief is undoubtedly the most simple and convenient plan, it appears to be much safer to use an instrument called an inhaler, by which the quantity administered can be regulated and controlled with certainty. Such an instrument was early introduced and employed by Dr. Snow, and the accidents which have occurred have certainly been fewer when this instrument has been employed than with the handkerchief. In the inhaler employed by Dr. Snow, the compartment containing the chloroform is surrounded with cold water, to limit the quantity taken up by the air, and the expiration valve of the face-piece is so adapted as to admit additional air to any extent to dilute the vapour still further. From an investigation of the fatal cases, and experiments upon animals, Dr. Snow has arrived at the following conclusions:—

1. Chloroform vapour, if it be inhaled in large proportion with atmospheric air, destroys life by paralysing the heart.

2. In smaller proportions, but long continued, it produces death apparently by the brain, and by interfering with the respiratory function. In such cases the heart is found to beat after the respiration has ceased.

3. Chloroform vapour, if it be blown upon the heart, paralyses it immediately.

4. Atmospheric air loaded with from 4 to 5, or even 6 per cent. of chloroform vapour may be safely administered, inasmuch as that mixture will not act directly upon the heart, but will give timely notice of its increasing effects in modifying the normal discharge of the functions of life. The average time occupied in producing insensibility is from three to four minutes.

5. The proportion of as much as from 8 to 10 per cent. of vapour of chloroform to atmospheric air is a dangerous mixture, as it suddenly charges the blood going into the heart with a poison capable of acting directly on that organ.

In cases where an over-dose of chloroform has been administered, the only remedy which appears to offer a chance of relief is artificial respiration. Where the muscles of the tongue become relaxed, and this organ falls back over the glottis, it should be pulled forward till the patient revives. It might be desirable to open the jugular vein in order to relieve the distension of the right cavities of the heart.

The cases in which ether was first employed, and in which chloroform is to be recommended as an anæsthetic, are those in which operations producing pain are performed. There are no operations, from the extraction of a tooth to the capital operations of surgery, in which it may not be employed. At the same time it may always become a question whether it is worth while running the slight hazard of fatal effects for the sake of relieving a small amount of pain. Where chloroform is skilfully administered, there appears to be little or no hazard, but unfortunately it is not every one who is prepared to administer chloroform successfully. As a rule it may be stated, that it is not advisable for the surgeon who operates to administer the chloroform, and a competent assistant should always be employed to do this. Whatever may be the doubt in the minor operations of surgery, the beneficial effect of relieving pain upon the subsequent welfare of the patient in the capital operations of surgery, have led surgeons very generally to insist on its administration in these cases. It has now been shown, both by Dr. Simpson and Dr. Snow, that the fatal cases, after capital operations, more especially amputations, are fewer when chloroform has been administered, than when this or some other anæsthetic has not been employed. Looking to these results, it would appear that the life saved by the use of chloroform has been much greater than that sacrificed by its careless administration. When in addition to this it is recollected how great an amount of suffering is prevented, there can be little doubt about the propriety of its administration.

It has been supposed that certain states of the system are less favourable to the administration of chloroform than others, but Dr. Snow has pointed out that in these states of the system the pain of an operation would be as likely to act as injuriously as the chloroform. At the same time, it would appear that a certain number of the fatal cases have occurred in persons with diseased heart, and perhaps in these caution should be employed.

Besides in operations with the knife, chloroform has been employed to facilitate the reduction of dislocations and of hernia. It has also been recommended in asthma, and as a means of procuring sleep in excessive watchfulness. It was first introduced by Dr. Simpson, of Edinburgh, as a means of alleviating the pain attendant upon child-birth, and although it has been much opposed in these cases, it is at the present day very largely administered by the obstetric practitioners of Great Britain. In some of the more difficult cases it becomes an important aid to the accoucheur, and in all cases it diminishes the suffering without in any way interfering with the natural actions attendant upon this condition. The injurious effects attributed to chloroform are at most problematical, and the benefits so decided as to lead to its use wherever circumstances will permit. At the same time here, as in other cases, it is not desirable that the operator should administer the chloroform, and as the services of an assistant, or person competent to administer cannot always be procured, it is not likely to come into general use throughout the country. But when assistants can be found, there is no doubt that it is an alleviation of suffering that ought not to be discountenanced.

From having experimented with various agents, Dr. Snow was induced to try the action of Amylene as an anæsthetic on the human system. This substance is a colourless mobile fluid, having a specific gravity of 0·659. It is very volatile, and boils at 102°. Its composition is $C^{10} H^{10}$. It is soluble in ten or eleven pints of water, and its odour is not disagreeable. The quantity of amylene required to produce anæsthesia is intermediate between that of chloroform and ether. The quantity of amylene consumed in Dr. Snow's inhaler was at the rate of rather more than a fluid drachm in a minute, and in this way insensibility was produced in about three minutes. Although Dr. Snow successfully administered this remedy in several cases, he met with two fatal cases, and afterwards abandoned its use.

Other substances are capable of producing anæsthesia in the form of vapour, but none of these have been generally employed.

(Snow, *On the Inhalation of the Vapour of Ether*, 1847; *On Narcotism by the Inhalation of Vapours, Medical Gazette*, 1848 to 1851; *On Death from Chloroform, Lancet*, 1856. Pereira, *The Elements of Materia Medica and Therapeutics*, 1853. *On Chloroform and other Anæsthetics*, by Dr. Snow: this work was published in 1858, after the author's death.)

A'NAGRAM signifies a new word formed out of the letters of any given word by the process of writing them over again, as the term literally signifies, or placing them in a new order. Sometimes the anagram is formed out of two or more words, and it may be itself always either one word or several. Some traces of this species of trifling have been detected in the writings of the ancients; but the taste for it does not seem to have spread much among the Greeks or Romans. The artifice appears to have first become fashionable in modern literature in the early part of the sixteenth century. Many authors, instead of putting their names on the title-pages of their works, have, with an affectation of modesty, used the anagrams of their names. At one time also the anagram was made much use of by mathematicians in announcing discoveries, the credit or property of which they wished to secure to themselves without revealing the secret in which they consisted. Huyghens, Galileo, and Newton intimated several of their discoveries in this way.

ANAKIM, or Benei-Anak, the sons of Anak, were a race descended from Ahiman, Sheshai, and Talmai, the three sons of Anak mentioned in Numbers xiii. 22. They inhabited the mountainous parts of southern Canaan, which afterwards formed part of the territory of the tribe of Judah. At the time of the invasion of that country by the Israelites, the Anakim possessed the towns of Anab, Hebron, Debir, and others. They were apparently above the common size of men. The spies sent by Joshua represented them as giants, to whom they were but as grasshoppers; and their mere appearance alarmed them when sent to examine their land. They were, however, eventually conquered by the Israelites under Caleb, and expelled, but a remnant took refuge with the Philistines. The total number could not have been large, as, though described as consisting of three tribes under separate kings, it would appear that all three of the sons were alive at the time of the conquest, and that Ahiman dwelt in Hebron. Sons of Anak, may, however, mean descendants; and in Numbers xiii. 23, the three chiefs are called children of Anak, which may imply a more remote relation than the filial one, as we say children of Israel for the whole race even at the present time. Hebron and Debir, moreover, are the Hebrew names of towns built on the sites of Kerjath-arba and Kirjath-sepher, the proper names of the Anakim towns. Anab has disappeared.

ANALEPTICS, from a Greek verb which signifies to *restore*, comprise all the means, whether medicines, diet, or regimen, which are generally employed to restore the vigour of the system when it has fallen below the healthy standard, either from previous disease or any other cause. The term analeptic was formerly applied indiscriminately to any medicine which increased the powers of the system, whether it belonged to the class of stimulants or to the class of tonics; but as the progress of chemistry, anatomy, and physiology has enabled us to recognise a difference in the chemical composition of members of these two classes of medicinal agents, as well as in their manner of acting upon the human frame, we propose to limit the application of the word to the latter of them, or to tonics, reserving the consideration of the other till we come to the word stimulant. The following brief explanation of their effects will suffice to justify this proceeding. Stimulants act primarily on the nervous system, while tonics act primarily on the muscles and blood-vessels. Stimulants render the movements more frequent; tonics render them stronger. Stimulants, as we see with wine, exhaust the excitability; tonics, within a certain limit, maintain it. The action of the one is immediate and transitory, that of the other is slow and progressive, but more permanent, as is the case from cinchona bark, or food. To take an example from their effects on the stomach, excitants quicken the digestion, as we see with capsicum or cayenne pepper, which we take with articles difficult to digest, as salmon; while tonics render the digestion more perfect, as occurs when we use cinchona in convalescence from disease. Though the most perceptible effect of tonics be upon the muscular system, as it is by a display of its powers that we judge of strength, yet the whole system feels the benefit of them when appropriately administered. Every person knows that he can, at one time, lift a weight with ease which, at another time, he cannot move but with difficulty and exertion. In the former case, he is pronounced *strong*; in the latter, *weak*.

The nature of the muscular fibre need not be discussed here; it is enough for us to remark, that to execute its functions properly, it must be in a certain state of tension, that it may be possessed of sufficient elasticity. A cord proceeding from a fixed point cannot influence a moveable body till it be drawn tight; so a muscle cannot raise a limb unless it possess a certain degree of tightness. The difference of the power of muscles varies greatly, according to the state of health or disease of the individual. If a muscle be taken from an animal in good health, it will not only bear a greater weight than the same muscle taken from an animal which has long been sick, but the former will be many days before it goes to decay and allows the weight to drop, while the latter will decay very speedily.

To maintain the muscular fibres in this condition, a due supply of blood and of nervous energy is requisite. The sources of these are in a healthful and vigorous digestion, and as this rarely goes on when the system is much disordered, or suffering under general or considerable local disease, scarcely any morbid action, or even the natural exercise of mind or body, if pushed to an extreme, can continue without producing debility. Tonics are, sooner or later, required, seldom, indeed, to remove disease, but to obviate its effects, or that of the treatment it has been necessary to employ. The use of these requires the greatest circumspection, for, till we have removed the cause of the disease, they can rarely be of service; on the contrary, they often do harm.

We have above pointed out the connection between the state of the digestive functions and the energy of the other functions, and it is important to bear in mind that anything loading and oppressing the stomach and bowels will lessen the tone of the system, diminish the disposition for exertion, and clog alike the action of mind and body. A judicious practitioner will here give, according to circumstances, an emetic or a purgative, and repeat this last for three or four days successively; in proportion as these act well, the languor and listlessness disappear, the mind resumes its wonted activity, for the cloud which had obscured the mental faculties is dissipated, and all again is energy, elasticity, and strength. An unskilful practitioner, and still more frequently the patient or his friends, would recommend some stimulant, a little brandy, or some bitters, under the influence of which all the symptoms become aggravated. It is a still worse case when the debility which occurs at the commencement of fevers, particularly ague and typhus, is so treated, though this is not so common an occurrence. A state of great irritation (morbid sensibility), or subacute inflammation of the mucous or inner membrane of the stomach, is a frequent condition of that organ with the inhabitants of towns, particularly among merchants and others engaged in extensive business which engrosses their whole attention, giving rise to much anxiety and leaving little time for exercise or food at proper times. The employment here of tonics, in the first instance, will only convert a manageable case into a difficult and serious one. It is, therefore, rather in the stage of convalescence from acute disease that tonics are required, and as a sequence to other medicines, than articles to be employed in the commencement, if we except some affections of the nervous system.

We need not enter into details respecting the particular action of tonics upon each set of organs of the body, as it may be stated generally that they all, sooner or later, begin to execute their functions more vigorously, the stomach first feeling the beneficial effects. But this state of improved action follows their use (that is, when they are medicinal or material tonics) only for a time; for their continued employment leaves the stomach in a state of debility, perhaps greater than at first—a fact of which we should never lose sight. These remarks will, we trust, induce all to observe caution both in taking upon themselves to use the articles termed analeptics merely because they feel weak, without knowing what is the cause of the weakness, or in urging their friends to have recourse to them at the commencement of disease, or even when it is subsiding, as more relapses are occasioned by a premature employment of tonics, whether medicinal or dietetic, than by all other causes combined.

It is impossible to enumerate here, and give directions for the use of, all the analeptics, comprising, as they do, medicines, food, and regimen. The medicines are either from the mineral or vegetable kingdoms; when the former, they are chiefly preparations of the metals, as the salts of iron and flowers of zinc (oxide of zinc); from the latter, they are invariably bitter substances, as cinchona bark, calumba, quassia, chamomile, &c. The analeptic means which fall under the head of regimen are, bathing, exercise, and the diversion of the mind.

The employment of the medicines will be stated under the diseases to which they are suited; bathing will be treated of under that head: it is, therefore, only upon the last two means that we will make any remarks here.

An examination of the human frame demonstrates that it was intended for motion, alternately with repose, and not for a state of absolute quiescence. Nor is the mind, which is furnished with so many faculties and provided with so many organs of sense, which serve to connect it with the external world, less calculated for active exertion. Any attempt to contravene the law of nature which enjoins a reasonable exercise of mind and body, brings a punishment upon the individual; the mind which he allows to be inactive loses the capacity for exertion, when required, and the body becomes a prey to disease in some shape or form. The action of the muscles is necessary to aid in circulating the blood and in completing the process of digestion, as well as to ensure a regular motion of the bowels. Where the muscles are not exercised, the blood, instead of reaching the surface and the extreme vessels, accumulates in the large internal trunks, leaving the skin dry and bloodless, as seen in young chlorotic females, who, instead of appearing buoyant with life in every limb, are as pale, and almost as inanimate, as a statue. Disorders of the nervous system, such as hysteria, likewise show themselves. These states can only be warded off by regular exercise. The rising generation would be much benefitted, if instruction in any branch of natural history formed a part of their education; young persons would then be furnished with motives for taking exercise out of doors—to the manifest advantage of the figure of the body and the tendencies of the mind.

Where older people have neglected exercise, it is more difficult to find means to induce them to resume its use; but some such device as the following may be tried: "Ogul, a voluptuary, who could be managed but with difficulty by his physician, on finding himself extremely ill from indolence and intemperance, requested advice: 'Eat a basilisk stewed in rose-water,' replied the physician. In vain did the slaves search for a *basilisk*, until they met with Zadig, who, approaching Ogul, exclaimed, 'Behold that which thou desirest! But, my lord,' continued he, 'it is not to be eaten; all its virtues must enter through thy pores; I have, therefore, inclosed it in a little ball, blown up, and covered with a fine skin; thou must strike this ball with all thy might, and I must strike it back again, for a considerable time, and by observing this regimen and taking no other drink than rose-water for a few days, thou wilt see and acknowledge the effect of my art.' The first day Ogul was out of breath, and thought he should have died of fatigue; the second he was less fatigued, and slept better: in eight days he recovered all his strength; Zadig then said to him, 'There is no such thing in nature as a basilisk! but *thou hast taken exercise and been temperate, and hast, therefore, recovered thy health!*'"

The Indian-rubber, or caoutchouc balls, will be found as useful for those confined by the weather within doors during the winter months, as the ball of Zadig.

It is possible to fatigue the body beyond a proper point, in which case repose becomes necessary; but this is a rare occurrence compared with the instances where the mind is stretched beyond its natural power to bear by the ambitious student, the covetous and care-worn merchant, or the adventurer in political life. If, in consequence of long-continued exertion, the balance of the mind be not already lost, abstraction from his books for the one, and a withdrawing from their pursuits for the others, with change of scene and occupation, must be enjoined; by doing this before it is too late, each may, in time, return to his usual station, to be useful in his sphere to himself and others, and may still be permitted to enjoy the greatest of earthly blessings,—a sound mind in a healthy body.

ANALOGY is the similarity of ratios or relations. A *ratio*, or *relation*, means that two objects (which are called *the terms of the ratio*) are considered together in reference either to some quality which they have in common, or to some manner in which one has affected the other.

Thus, two things may stand in a certain relation to each other, in respect of their quantity, magnitude, shape, colour, strength, height, &c.; in which cases the subject of comparison is common to both, and belongs to them to a greater or less amount. Thus, when we say that one thing is larger, taller, thicker, smaller, darker, more beautiful, more lasting, more desirable, more formidable, more probable, &c., than another, we mean that each of the pairs in question having in common the quality referred to, the former has it in a greater degree than the latter. These, which might be called *ratios of degree*, differ altogether from the other class, which includes all those relations arising from the manner in which one term of the ratio has affected the other, or is necessarily connected with it, and not from any attribute which they possess in common. Thus, we may speak of the relation of God and man, of the relations of men as members of the same political society or of different political societies, of the relation of a bird to its egg, of a tree to its fruit, &c., in which instances some act done by one to the other party, or by both reciprocally, or some influence which one term has exercised over the other, is signified, and not any quality or attribute common to both. In some cases of the latter kind there are words which express each term of the ratio *in respect of the relation*; and, therefore, they mutually imply each other. Such are, for example, parent and child, debtor and creditor, agent and principal, lessor and lessee, &c. As in these cases it is impossible to conceive the one without conceiving the other term, the latter might be called *ratios of implication*, as distinguished from those ratios in which a comparison is made of qualities existing independently in the things compared. For example, there cannot be a husband without a wife, or subjects without a sovereign, nor is there any quality which a husband has, as husband, independent of the wife, or the sovereign as sovereign, independent of the subject; but although there cannot be a short man or a tall man without a man of middle size, yet the height of the short or tall man is an absolute quantity, and independent of the comparison. In the cases of a common property, or ratios *of degree*, there are words which denote the *relation* of one term to the other, as lowness, height, depth, and consequently imply both terms of the ratio; but there is no word which expresses the *term* of the ratio itself, as in the case of ratios of *implication*. (Locke 'On the Understanding,' ii. 25.) There are some words used to denote the state of one of the terms of a ratio of implication when the relation has been destroyed; thus, *widow* means an unmarried woman who was once a wife; *orphan*, a child whose father is dead, &c. Sometimes the terms denoting a relation are applied by anticipation before the ratio begins to exist; thus, a person is popularly called an heir in the ancestor's lifetime although *nemo est heres viventis*.

When two ratios are compared, that is, when it is affirmed that the relation of two things is like the relation of two other things, the two ratios together form an *analogy*, and each pair of the corresponding terms of the two ratios is *analogous*. Thus, the bark stands in a similar relation to a tree as the skin to an animal; and consequently the one bears an analogy to the other: so the feathers of a bird are analogous to the hair of a quadruped, the admiral of a fleet is analogous to the general of an army. Of this nature are all fables and parables, in which the circumstances of the person to whom the lesson is addressed are illustrated by a parallel case, that is, by supposing a relation similar to that in which he is placed. Thus the case of a man who affects to despise what is out of his reach is vividly pourtrayed by the fable of the 'Fox and the Grapes;' and so in other cases, the parables of Holy Writ are instances of a similar mode of instruction, only the examples are not, as in fables, chosen among irrational animals. The same is the principle of grammatical and etymological analogy; thus, if *to give* is conjugated *I give, thou givest, he gives, to live* would be conjugated *I live, thou livest, he lives*; the inflexions of the verbs standing in a like relation to each. So the verb *prattle* is derived from *to prate*, as *hobble* is from *to hop*; *little* is derived from the old word *lite*, as *mychel* or *myckle* from *much*, &c. Thus, *kingly* is to *king*, as *royal* to the French *roy*, and *regal* to the Latin *rex*, or rather to the root *reg*. The formation and development of language proceed almost exclusively on this principle.

From what has been said it is evident, 1, that in an analogy there must be two ratios, and consequently four terms or objects of comparison; and 2, that there is no connection between resemblance and analogy, and that things may be analogous without being similar, and similar without being analogous.

1. With regard to the first of these propositions, it should however be observed, that, although there must be four terms, it is not necessary that all the four terms should be different. If there was such a necessity, one of the chief uses of analogy, as an engine of argument and discovery of truth, would be destroyed. All that is required is, that there should be two distinct ratios: of what terms those ratios may consist is indifferent. Thus in the case of brethren, the parents are in an analogous situation in respect of each brother: so the grandfather is to the son, as the son is to the grandson. In such cases as these, both the relations are known: frequently, however, the relation in which one thing stands to another being known enables us to discover, with greater or less certainty, the relation which the same thing bears to something else, which is unknown. Thus the moral government of mankind by the Deity, in this world, furnishes a means of conjecturing his religious government, both in this world and the next, independently of Divine revelation. So the past conduct or performances of a nation, a government, a minister, a general, a lawyer an architect, a painter, a poet, a racehorse, &c., afford materials for judging what will be their future conduct or performances under similar circumstances. It is to this most important use of analogy that Quintilian refers, when he says that its purpose is to discover what is unknown by what is known, to prove what is uncertain by what is certain.

2. Resemblance being the similarity of some sensible quality, as form, colour, taste, smell, or sound, it has evidently no connection with analogy; and if things analogous happen to resemble one another, their resemblance is a mere accident, independent of their analogy. Thus, two brothers may resemble each other; but they might equally resemble each other without being brothers, and would be equally brothers if they did not resemble each other. The confusion of analogy and resemblance is however of very frequent occurrence, and numerous examples of it might be cited. When Homer says that Apollo and Minerva sat, like birds, on the branches of a tree near the Scæan gate of Troy, he meant, as birds sit on the branches, so did the god and goddess: but Pope, and other translators, represent them as undergoing a change of form, and assuming the appearance of birds.

The above example may serve to illustrate an error of frequent occurrence in the use of the argument from analogy. As, in the instance just cited, the similitude is extended beyond its proper limits, and it is supposed that because the two objects are like each other in *one* respect, they are like in *all*; so the analogy between two things is sometimes pressed beyond its just application, and is carried out of the bounds of the relation in virtue of which the comparison was made. Thus the injunction to be "as wise as serpents and harmless as doves," does not recommend to our imitation either the envenomed ferocity of the one animal, or the helpless timidity of the other. Two false analogies may be mentioned which at one time had a powerful influence on political discussions, nor are even now quite exploded, namely, that the existence of the human race, and the existence of nations, are analogous to the life of a single man. For some purposes these two relations might doubtless be compared; but when it is argued that a nation will pass through a series of changes corresponding to the childhood, manhood, and old age of a single human being, or that the early state of mankind was like the innocence and simplicity of an infant, the comparison is unwarrantably wrested out of the range of its proper application. The notion of the corruption of a nation by luxury appears to have had a like origin; for single individuals may be, and often are, depraved by a sudden change from poverty to riches; but the process by which a nation enriches itself, is a mark of habits very different from vicious indulgence and effeminate indolence.

All analogical comparisons are made by means of abstraction. A certain attribute belonging to each of two objects is considered separately from all the other attributes which those objects may possess, and a comparison is instituted between them in respect of that common attribute. Thus, the analogy between the skin of an animal and the bark of a tree arises from our leaving out of our consideration all those circumstances in which they differ, such as their colour, consistency, animation, sensibility, &c., and paying attention only to the use of each, as the outward covering, in one case, of the body and limbs of the organised being, and in the other as the outward covering of the woody matter of the tree. It is by a like process of abstraction that an extended and vague meaning is given to many general terms, particularly those belonging to the moral sciences; and in this manner they are applied to objects to which they are only analogous, and which they do not properly designate. Thus a law, in its original and strict sense, is a general command of one rational being to another: but as one of the effects of such a command is to produce a uniformity of conduct in the person or persons to whom the command is addressed, the word has been transferred to inanimate objects in which there is a uniformity of phenomena; and although there is no command received, no command given, and no intelligence to work upon, we yet speak of the laws which regulate the motion of matter, the succession of the seasons, the diffusion of heat and light, and other physical appearances which follow in a constant relation of cause to effect. In this case the proper characteristics of a law being neglected, one of its relations is alone considered; and hence the analogical application just mentioned. When such an application is made, not from a vague or inaccurate use of language, but from a desire to add beauty or energy to the expression by the transfer of words, this transfer and sometimes the transferred word itself, is called a *metaphor*. Thus, when Shakspere represents Macbeth as saying of Duncan that

> "His virtues
> Will plead like angels, *trumpet-tongued*, against
> The deep damnation of his taking off,"

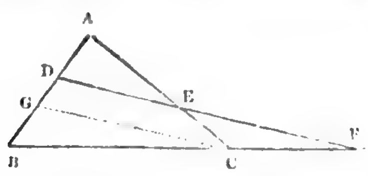
he means that Duncan's virtues will arrest the public attention as forcibly as the sound of trumpets. The analogy is obtained by referring the two objects compared to the general class of things which instantly attract universal notice.

The word *proportion* properly signifies an analogy of quantities or magnitudes, as a proportion of numbers, lines, surfaces, &c. In popular usage however proportion is commonly made synonymous with *ratio*, as when we speak of the proportion of deaths to births, the proportion of wages to profits, the proportion of convictions to commitments, &c. Sometimes also it is used for *portion*, as when we speak of a large proportion, a small proportion, a fair proportion; in this case however, a ratio is meant, as the part is considered as bearing a certain relation to the whole.

(On the subject of Analogy see Aristotle's *Poetic*, c. 21; *Rhetoric*, b. ii. c. 2; *Hist. An.* i. c. 1; Coplestone in the Appendix to *Whately's Rhetoric;* Whately's *Rhet.*, part i, c. 2, s. 6; Mill's *System of Logic*, cap. iii. s. 12.)

ANA'LYSIS, a Greek word, signifying literally *the act of unloosing* or *untying;* its opposite is *synthesis*, which is the act of putting together. The modern meaning of the term analysis is the process by which facts, results, or reasonings are separated into their simple and component parts, or by means of which a simple truth is obtained when given in a more complicated form; so that, in its most general sense, the greatest part of human knowledge consists in the results of analysis. It is, however, for the most part applied in a more particular manner to the methods employed in those branches of inquiry, which most strikingly exhibit direct analysis; namely, mathematics and natural philosophy, particularly chemistry. By a very incorrect misnomer, algebra, the differential calculus, &c., have been called by the general name of *analysis*, in opposition, not to *synthesis*, but to *geometry*, in which latter science synthetical methods are most usually applied. This perversion of the term prevails on the Continent to such an extent, that it must always be taken for granted, that '*analyse*' stands for the algebraical branches of pure mathematics. In this sense it is again subdivided into 'algebraical analysis' and 'infinitesimal analysis,' the latter including the fluxional or differential calculus. And by 'geometrical analysis' is frequently understood the application of algebra to geometry. It must, however, be remarked, that the exact sciences have appropriated this word, simply because in these branches of knowledge the use of analysis has been made most conspicuous.

Confining ourselves to the primitive meaning of the term, it is obvious that all discovery must be entirely either the work of analysis or of accident; and that, therefore, geometrical analysis must be as old as geometry. Nevertheless, this does not appear from the earliest treatises. The work of Euclid is strictly synthetical. Instead of taking the proposition asserted, and examining it by means of preceding propositions, and in the mean time assuming it to be true, in order to ascertain whether the results deduced from it agree or disagree with what has been already proved,—Euclid first enunciates the point which he means to establish, and then proceeds to put together the considerations by which it is demonstrated, leaving the learner nothing to do but to judge of the truth or falsehood of each argument as it arises, without taking into consideration the methods by which the arguments themselves were first obtained. This is the natural and proper method of teaching what has already been discovered, for its own sake; not only because it neglects to introduce difficult and embarrassing considerations, and allows of the subject being broken up into portions which are easily learnt at one time, but because there is, in reality, no perfectly general and certain method of analysis which can be made obvious to the beginner. In attempting the analysis of a new problem, though the discoverer will naturally first try those methods which have been successful in preceding cases, he has no means of assuring himself beforehand which will be successful. The chemist is similarly circumstanced. Let a new substance, or one supposed to be such, be presented to him, from which he is required to find out whether it is already known, or if not, of what it is composed. No effective analysis can commence without requiring the results of all his previous knowledge; for he must have some method of recognising each and every substance with which he is acquainted, previously to pronouncing whether or not that under consideration is one of them. He must then proceed to trials of that substance with various others, and nothing but the sagacity which arises from previous experience can direct him in his choice of the methods to be employed. No general rules of analysis can be laid down: that is, no processes which must end in the discovery of the component parts required. The same observations may be made on mathematical analysis. We give a geometrical instance, with its result, and the synthetical form of the proposition arising out of it.



The sides of a triangle ABC are cut in D, E, and F, by a straight line. Six segments are thus formed, AD and DB, whose sum is the side AB; AE and EC, whose sum is the side AC; and BF and FC, whose difference is the side BC. It is required to investigate the relation which exists between these six segments, if there be any relation.

Some relations will be thrown out of the question upon the slightest consideration: the sum of the six lines is not the same in every triangle, neither is their product. Leaving this unorganised method of examination, we recollect, that if CB were parallel to DE, the then similar triangles ADE, ABC, would give a well-known relation between AD, DB, AE, and EC. To try whether this may help us, draw CG parallel to DE, which gives the proportion

$$AD : DG :: AE : EC,$$

or if we represent the lines by the number of units which they contain,

$$AD \times EC = AE \times DG \quad . \quad . \quad (1.)$$

Because GC is parallel to DF, we have

$$GD : BD :: CF : BF,$$

$$\text{or } GD \times BF = BD \times CF \quad . \quad . \quad (2.)$$

and the equations (1.) and (2.) multiplied together, and the result divided by the common factor GD, gives

$$AD \times EC \times BF = AE \times BD \times CF \quad . \quad . \quad (3.)$$

whence the relation required between the six lines is as follows: Let them be separated into two lots of three lines each, in such a way that no two lines which have a common extremity are both in the same lot; then the product of the first three will be equal to the product of the second three.

If instead of asking for the relation, if any exist, between the six lines, the equation (3.) had been given, and it had been required to detect whether it were true or false, the process would have been similar; and we should have found that the equation (3.) is true, and a necessary consequence of the proposition, that a line drawn parallel to one side of a triangle divides the other sides into proportional segments.

The synthetical form of the preceding process differs from it much less on the paper than would be the case in the mind of a student, who had actually hit upon the solution in the progress of investigation. For, not being able to tell the various steps by which one of our readers would endeavour to arrive at the same conclusion, we are obliged to prompt him with a right guess, and thereby give him only a synthetical description of that which was in our minds an analytical process. It only remains, therefore, to make the demonstration synthetical in form, which, as will now be readily seen, will consist in stating the proposition to be proved, directing to draw CG parallel to DF, without giving any reason, and combining the steps of the preceding demonstration.

The geometrical analysis is generally ascribed to the school of Plato; but, in reality, as we have already observed, must be of a date as early as geometrical reasoning itself. The use of PORISMS, or problems [see also LOCI] admitting an indefinite number of solutions, the establishment of the properties of the CONIC SECTIONS, and the various efforts made for the DUPLICATION of the cube and the TRISECTION of the angle, all of which were the work of the school already mentioned, most certainly increased the power of the analyst, that is, made the means of discovery more obvious and more successful; but there is nothing in the methods which entitles them to the exclusive appellation of geometrical analysis.

The peculiar distinction between algebra and geometry is, that the analytical method is pursued in the former from the commencement. The solution of a problem consists in inquiring into the consequences of the solution *supposed to be found*, by introducing at every step some known truth, such as will produce a more simple consequence, and thus reasoning backwards, so to speak, until at last the answer itself is directly produced in numbers, which was before implicitly involved in the conditions of the problem. The methods are more general than in geometry, that is, a larger number of problems may be solved by each process. The same observations apply still more strongly to the higher parts of algebra, and the differential calculus.

The solution of equations of the first four degrees, and the approximation to that of all higher degrees, render the analytical solution of a vast number of common problems a matter of certainty. The solution of differential equations, where that can be done, is an additional step of even a more important character. Within the last century, mathematical analysis has made considerable approaches to a state which enables us to determine, almost immediately, whether a problem can be solved by such means as we possess, or not; no small advantage, when it is considered how much time was previously wasted in the attempt to attain results which have since been shown to be impossible.

ANALYSIS, CHEMICAL. [CHEMICAL ANALYSIS.]

ANALYSIS, EUDIOMETRIC. [GASOMETRIC ANALYSIS.]

ANAMERTA or ANAMIRTA, the name of a genus of plants belonging to the natural order *Menispermaceæ*, to which the plant yielding the Cocculus Indicus of commerce is now referred. It has the following characters: flowers diœcious, calyx of six sepals in a double series with two-close pressed bracteoles, corolla none; stamens on separate flowers united into a central column, dilated at the apex; anthers numerous, covering the whole globose apex of the column. The flowers with pistils are not known, but the fruit is a one- to three-celled drupe. The seed is globose, deeply excavated at the hilum, albumen fleshy, cotyledon very thin, diverging. The plant which yields the berries of commerce is the only species of this genus. It is a strong climbing shrub, and is met with on the coasts of Malabar and the Eastern Islands. It is called *Anamirta Cocculus;* it possesses a powerful bitter poisonous principle, and is used for external applications only.

ANAMIRTIC ACID. ($C_{35}H_{33}O_4$?) Obtained from the seeds of *Anamirta Cocculus*, but now believed to be identical with stearic acid. [STEARIC ACID.]

ANAMIRTIN ($C_{36}H_{24}O_4$.) A white crystalline body obtained by Francis from the seeds of the *Anamirta Cocculus*. When saponified by potash it is said to yield anamirtic acid.

ANAMORPHO'SIS (ἀνάμόρφωσις, a 'remodelling or change of form'), is such a representation of an object that, except when viewed from a particular point directly, or in a cylindrical mirror, or through a polyhedral lens, it will appear to be distorted, or disconnected, or to be a view of something very different from the original object. Such representations are only made for the amusement of young persons, and therefore a very brief explanation of them may suffice; but the art of forming them has been treated at length in the 'Thaumaturgus Opticus' of Niceron, and in the 'Perspectiva Horaria' of Maignan.

Distorted figures which are to appear, when viewed directly from a given point, in the just proportions which they have in an original drawing or print, may be easily traced in the following manner. Let the original be covered with a network of squares, and imagine it to stand vertically on paper laid on a table, the eye being in a given position in its front; then draw lines through the ground line, in the directions in which planes passing through the eye and the vertical lines drawn on in the original would cut the paper, and other lines parallel to the ground line at places where planes passing through the eye and the horizontal lines on the original would cut the paper. If within the trapezoidal areas thus formed the parts of the original figure which fall in the corresponding squares be drawn, the figure thus traced will be the distorted figure required; and, when viewed from the assumed place of the eye, it will evidently appear exactly as, to an eye in the same point, the original would appear if it were placed in a vertical position with the base on the line which was drawn to represent it; that is, it will appear to be an exact copy of the original.

A distorted representation of some object, which is to appear correct on being viewed from a given point, and by reflection from a cylindrical mirror whose curvature and position are also given, may be drawn on a plane by means of a perspective representation, as already described, or the squares drawn within a square circumscribing the original print or drawing. Thus a circular arc being drawn with a radius equal to that of the base of the cylinder, to intersect, between the eye and the ground line, all the oblique lines drawn in forming that representation; let lines be drawn from the intersections, making respectively equal angles with tangents to the circle, so as to represent the reflections of those oblique lines; and on the reflected lines set distances from the circumference equal to the distances of the parallel lines in the former representation from the same points in the circumference. Then curve lines connecting the points so determined will form, with the reflected lines, spaces within which the parts of the original figure are to be traced so as to correspond to those within the squares first drawn. This distorted tracing being laid horizontally on a table, and the mirror being set up vertically on the arc which represents its base, the reflected image will, to the eye, appear exactly similar to the original figure.

Distorted figures, which are to be seen corrected when viewed through a polyhedral lens or multiplying glass, may be traced mechanically thus:—let the multiplying glass be placed in a tube, like the eye-piece of a telescope, at a distance from the end to which the eye is to be applied rather greater than the focal length of the glass, and let a very small aperture be formed in the cover at that end: then, on placing a lamp or candle before the aperture, the rays of light passing through the faces of the lens will project, on a screen placed perpendicularly to its axis, at any convenient distance beyond the focus, a number of luminous spaces corresponding to the several faces of the lens, with intervals between them. In these luminous spaces, whose outlines should be traced with pencil before the light is removed, there must be drawn by hand parts of a landscape or figure, so that, on looking through the aperture, they shall seem to form a correct representation of the intended object.

The portions thus drawn, when viewed in any manner except through the aperture, will be unconnected; and the intervals may be filled up with any objects at pleasure, so that the whole may appear confused, or may represent something different from the original landscape or figure: then, on looking through the aperture, towards the screen, the intervals before mentioned, and the objects drawn on them, will be invisible; and there will appear only the representation of the object formed by the junction of the parts within the outlines first traced, that is, a correct copy of the original object.

ANAPÆST, a foot in Greek and Latin metre, consisting of two short syllables followed by a long. It was sometimes called Antidactylus, as being the opposite of the dactyle, which consists of a long syllable followed by two short. Assuming accent in English to be the same thing with quantity in Greek and Latin, the word *témporal* would be an example of a dactyle, and the word *superádd* of an anapæst. From the tendency of English enunciation to carry back the accent towards the beginning of polysyllables, there are not many single words which make anapæsts in our language. But the foot frequently results from the union of two or more words: as in *Dŏ yoŭ heār, Lĕt ălōne;* and sometimes it is found in part of a single word; as, for instance, in the three middle syllables of the word *anticipātion*. The predominance of dactyles in English, and of anapæsts in French, forms one of the most marked distinctions between the musical character of the one language, and that of the other.

ANAPÆSTIC VERSE, a species of verse composed of a succession of anapæsts. Among the Greeks the anapæstic verse was freely used both in tragedy and comedy. Some forms of it occur very often in Aristophanes. Both in tragedy and comedy, the anapæstic verse admits also dactyles and spondees. In English, only poems of the lighter sort have been usually written in anapæstic verse. Anstey's 'New Bath Guide' may be quoted as a well-known example. The line is often reduced to eleven syllables, by the retrenchment of the first, or the substitution at the beginning of an iambus instead of the anapæst. Thus, in the following lines from the work thus mentioned:

> "For I'm told the discourses of persons refin'd
> Are better than books for improving the mind;
> But a great deal of judgment's requir'd in the skimming
> The polite conversation of sensible women"

it will be observed, that the first foot of the second line consists only of one short or unaccented syllable followed by a long; and a similar retrenchment might be made of the commencing syllable of any of the others, without spoiling its prosody.

ANARCHY properly means the entire absence of political government; the condition of a society or collection of human beings inhabiting the same country, who are not subject to a common sovereign. Every society of persons living in a *state of nature* (as it is termed) is in a state of anarchy; whether that state of nature should exist in a society which has never known political rule, as a horde of savages, or should arise in a political society in consequence of resistance on the part of the subjects to the sovereign, by which the person or persons in whom the sovereignty is lodged are forcibly deprived of that power. Such intervals are commonly of short duration; but after most revolutions, by which a violent change of government has been effected, there has been a short period during which there was no person or body of persons who exercised the executive or legislative sovereignty, —that is to say, a period of anarchy.

Anarchy is sometimes used in a transferred or improper sense to signify the condition of a political society, in which, according to the writer or speaker, there has been an undue remissness or supineness of the sovereign, and especially of those who wield the executive sovereignty. In the former sense, anarchy means the state of a society in which there is *no* political government; in its second sense, it means the state of a political society in which there has been a *deficient* exercise of the sovereign power. As an insufficiency of government is likely to lead to no government at all, the term anarchy has, by a common exaggeration, been used to signify the small degree, where it properly means the entire absence. [SOVEREIGNTY.]

ANASTATIC PRINTING. In the year 1841, the proprietors of the 'Athenæum' received from a correspondent at Berlin a reprint of four pages of a number of that journal which had been published in London a few weeks earlier. The copy was so perfect a fac-simile, that had it not come to hand under peculiar circumstances, it would have been taken for two leaves out of a sheet actually printed in London; the observable difference was, that the impression was somewhat lighter, and the body of ink less in quantity than usual. In reply to further inquiries, the correspondent at Berlin could only discover that the secret was said to be in the hands of a person at Erfurt. He had seen a fac-simile of an Arabic MS. of the 13th century; and another fac-simile of a leaf of a book printed in 1483—both such close copies as hardly to be detected from the originals, and both taken without injury to the originals. It was also stated that a prospectus was issued at Berlin, of a pirated edition of the 'Athenæum, to be produced in a similar way, and sold at a low price.

In January 1845, the 'Athenæum' was enabled to announce that the inventor or discoverer of the method was a M. Baldermus, who had communicated the discovery to a person in London; and to convince the proprietors of that journal of the reality of the method, a page of 'L'Illustration,' French journal, was faithfully copied in a quarter of an hour. The method became known by the name of *Anastatic printing;* and many of the London journals directed attention to the subject. In the 'Art Union,' for February, 1845, pages 40 and 41 of the number were printed from zinc plates obtained by the Anastatic process. The compositors 'set-up' in the usual way, sufficient matter to fill two quarto pages of the work, leaving spaces for three wood-cuts, three drawings, and a few lines of writing in pen and ink, which were properly adjusted to the blanks left for them. All were alike copied or transferred to the zinc plates, and then printed from—several thousand copies being taken. The impressions were fainter and less distinct than those from the original types, but were unquestionably remarkable.

Professor Faraday explained the rationale of the Anastatic process in 1845, at the Royal Institution. The process depends on a few known properties of the articles employed. 1st. Water attracts water; oil attracts oil; but each repels the other. 2nd. Metals are much more easily wetted with oil than with water; but they will readily be moistened by a weak solution of gum. 3rd. The power of wetting metals with water is greatly increased by the addition of phosphatic acid. 4th. A part of the ink of any newly-printed book can be readily transferred by pressure to any smooth surface beneath; if, for example, a corner of a newspaper be fixed on a white sheet of paper, and then pressed or rubbed with a paper knife, the letters will be distinctly seen in reverse on the paper; and indeed every one knows that if a book be bound too soon after the printing, the pages become disfigured by the *setting off* or transfer of the ink upon the opposite pages. From these data the rules for the process are derived. The printed paper, whether letter-press or engraving, is first moistened with dilute acid, and then pressed with considerable force by a roller on a perfectly clean surface of zinc; by which means every part of the sheet of paper is brought into contact with the plate of zinc. The acid, with which the unprinted part of the paper is saturated, *etches* the metal, while the printed portion *sets off* on it, so that the zinc surface presents a reverse copy of the work. The zinc plate, thus prepared, is washed with a weak solution of gum in weak phosphatic acid; this liquid is attracted by the etched surface, which it freely wets, while it is repelled by the oil of the ink in which the writing or drawing on the plate is traced. A leathern roller, covered with ink, is then passed over the plate, when a converse effect ensues; the repulsion between the oil, ink, and watery surface over which the roller passes, prevents any soiling of the unfigured parts of the zinc plate; while the attraction between oil and oil causes the ink to be distributed over the printed portions. In this condition the anastatic plate is complete, and impressions are pulled from it by the common lithographic process. When it is required to apply the anastatic process to very old originals, which do not set off their ink on pressure, the page or print is first soaked in a solution of potash, and then in a solution of tartaric acid: by which is produced a perfect diffusion of minute crystals of bi-tartrate of potash through the texture of the unprinted part of the paper. As this salt resists oil, the ink-roller may now be passed over the surface without transferring any of its contents, except to the printed parts. The tartrate is then washed out of the paper, and the operation is proceeded with as before, commencing with the moistening by nitric acid.

When these interesting details became publicly known, it was soon ascertained that the so-called anastatic printing was little more than an extension of processes known long before in England. Mr. Jobbins, a lithographic printer, took copies of printed pages by a process analogous to that of anastatic printing, as far back as the year 1840. Mr. Cocks, of Falmouth, writing to the 'Mechanics Magazine,' said, "In the year 1836 I introduced a process for the transferring of copper-plate engravings (by the old masters), as well as letter-press printing, &c., to stone, zinc, tin, pewter, type-metal, fusible-metal, lead, copper, glass, &c., and had impressions taken from each; but the original subjects were destroyed by the chemical agents used. Since that time I have succeeded in transferring prints and letter-press without even soiling the originals, fixing the same on metal, wood, or paper, and printing from the form any number of copies. The process is so faithful in its operation, that the finest line of the etching needle is preserved."

In 1848 Mr. Strickland and Mr. Delamotte instituted experiments with a view to ascertain how far the anastatic process would be available as a substitute for lithography. They succeeded in transferring or printing from drawings made on paper with lithographic chalk; within an hour after the drawing was made, a perfect anastatic *facsimile* was produced, hardly to be distinguished from it. The chief difficulty here seems to be the production of a kind of paper which shall possess a surface similar to lithographic stone. A mode has been devised of imparting to India paper a clear sharp granular surface, well fitted for the purpose as far as regards surface; but it is almost too tender in substance. Mr. Strickland found that *metallic paper*, used for metallic pencils, had the required surface. For fine subjects copied in this way, it is essential that the lithographic chalk be of a hard quality, and cut to a fine point.

In 1853, a particular application of lithography was introduced into England from Germany, where it had been patented by M. Sigl. It was a process of machine-printing in lithography, for cheap commercial purposes rather than for matters of fine art. In preparing the plates, a mode of transfer was adopted somewhat analogous to that of anastatic printing. A reference to LITHOGRAPHY will, indeed, show that this analogy extends much farther.

An officer of the United States Survey department, devised a mode of transfer, nearly allied in character to the above, for the printing of maps and charts. An impression from an engraved copper-plate is taken with ordinary ink, on a peculiar kind of paper coated with a fatty substance; and it is then transferred to a lithographic stone, which can be prepared and used in the customary way.

Soon after the introduction of the anastatic process, much alarm was expressed in the commercial world lest it should facilitate the forgery of bank-notes, bank post-bills, cheques, bills of exchange, and other monetary documents. The uneasiness appeared to be not wholly groundless; but the interval between 1841 and 1859 has passed over without any serious realisation of the fears entertained. The transfer of impression is remarkable; but it could not escape the keen scrutiny of persons accustomed to watch for fraud in written or printed documents.

ANASTOM'OSIS, from ἀνὰ, *through*, and στόμα, *a mouth*, signifies the communication of blood-vessels with each other by the opening of the one into the other. The blood-vessels are the tubes by which the different parts of the body are supplied with nourishment. If the blood-vessels destined to nourish a part be obstructed so that it cannot receive a due supply of blood, that part must necessarily die, or, as it is technically termed, mortify. But the blood-vessels are soft compressible tubes, liable, by innumerable circumstances, to have their sides brought so closely into contact as to prevent the flow of a single particle of blood through them. In order to prevent the consequences that would result to the system from the operation of causes thus tending to impede the circulation, provision is made for the freest possible communication between the main trunks of the blood-vessels and their branches, and between one branch and another. All the arteries of the body spring from one great trunk (AORTA) which issues from the heart, and which passes from the heart through the chest, into the abdomen, where it divides into large branches which supply the lower extremities. In this course this vessel gives off innumerable branches, which supply different parts of the body, and these branches form innumerable unions with other branches which proceed from the main trunk of the artery. All the branches which form such communications are called *anastomosing* branches, and this union of branch with branch is termed *anastomosis*. Now so numerous are these anastomosing branches, and so competent are they to carry on the circulation, that if the main trunk of the aorta be tied in the abdomen, or even in the chest, the lower extremities will receive a sufficient supply of blood to maintain their vitality through these collateral or anastomosing branches. The knowledge of this fact enables the modern surgeon to perform with ease and safety operations which the surgeon of former times would have pronounced impossible. Anastomosis is of two kinds, that between large trunks, and that between small branches. When the communication is direct between two large trunks, there is no difficulty in conceiving that the circulation may readily go on though one of the trunks be obstructed, because the trunk which remains open may transmit a sufficient quantity of blood to nourish the part to which it is destined. But when a limb is supplied by one large artery only, and when that is obstructed, how does the limb receive a sufficient quantity of blood to support it? Suppose there is an obstacle to the free passage of the blood through its usual channel, namely, the main artery of the limb. What is the consequence?—the blood is driven in greater quantity, and with greater force into those branches which spring from the main artery above the seat of the obstruction. These branches, in consequence of receiving a greater influx of blood than usual, gradually enlarge in diameter, and transmit through them a proportionally larger quantity of blood. At the same time, the more minute branches, which anastomose with the branches given off below the obstruction, are in like manner dilated and admit a correspondingly free passage of blood to the inferior part of the limb. At first the circulation is in this manner carried on through a congeries of minute anastomising arteries, but in a short time a few of these channels become more enlarged than the rest: as these increase in size, the smaller vessels gradually collapse, and thus ultimately a few large communications constitute permanent channels through which the blood is transmitted to the parts which it is destined to supply. Such is the beautiful provision established in every part of the body to secure to it a due supply of blood, if any obstacle should obstruct the course of this vital fluid through its accustomed channel.

ANA'THEMA, a Greek word, properly signifying, a thing set apart and devoted. Among the Greeks a piece of armour or anything else which was offered to the gods, and placed in a temple, was called an ἀνάθημα (*anathēma*), or offering. Tripods, votive tablets with inscriptions, such as may be seen in the Elgin collection of the British Museum, belong to the class of *anathēmata*. But the dedication or setting apart might be to the powers of evil as well as to those of good, or, according to Pagan notions, to the infernal as well as to the celestial gods. Hence the word came, in one of its applications, to signify much the same thing with the word accursed. It is thus that it is principally used in the Old and New Testaments, where it appears, in 1 Corinthians xvi. 22, with the added form of the original maran-atha, said to mean in Syriac, 'the Lord will come,' and is supposed to allude to the third and principal excommunication among the Jews. In this sense the form *anáthema* (ἀνάθεμα) was employed, and not *anathēma*, though both are really the same word. In the decrees of popes and councils, also, a common form of expression is, whosoever shall do, or not do, or believe, or not believe, a particular act or dogma, 'let him be anathema,' that is, let him be held excommunicated, separated from the society of the faithful, and branded with the curse of the church. On the other hand, a heretic, when he renounced his errors and was received into the bosom of the church, was accustomed to declare his heresy 'anathema,' or a thing accursed. In English we more frequently use the term anathema in the sense of the curse or severe denunciation itself than for the object of the curse; as when we speak of the church directing its anathema against any particular opinion.

ANATOMY ACT. Before the passing of 2 & 3 Will. IV. c. 75, on the 1st of August, 1832, the medical profession was placed in a situation both anomalous and discreditable to the intelligence of the country. The law rendered it illegal for the medical practitioner or teacher of anatomy to possess any human body for the purposes of dissection, save that of murderers executed pursuant to the sentence of a court of justice, whilst it made him liable to punishment for ignorance of his profession; and while the charters of the medical colleges enforced the duty of teaching anatomy by dissection, the law rendered such a course impracticable. But as the interests of society require anatomy to be taught, the laws were violated, and a new class of offenders and new crimes sprung up as a consequence of legislation being inconsistent with social wants. By making anatomical dissection part of the penalty for crime, the strong prejudices which existed respecting dissection were magnified tenfold. This custom existed in England for about three centuries, having commenced early in the 16th century, when it was ordered that the bodies of four criminals should be assigned annually to the corporation of barber-surgeons. The 2 & 3 Will. IV. c. 75, repealed § 4, 9 Geo. IV. c. 31, which empowered the court, when it saw fit, to direct the body of a person convicted of murder to be dissected after execution. Bodies are now obtained for anatomical purposes under the following regulations, enacted in 2 & 3 Will. IV. c. 75, which is entitled 'An Act for regulating Schools of Anatomy.' The preamble of this Act recites that the legal supply of human bodies for anatomical examinations was insufficient, and that in order further to supply human bodies for such purposes various crimes were committed, and lately murder, for the sole object of selling the bodies of the persons so murdered. The Act then empowers the principal secretary of state, and the chief secretary for Ireland, to grant a licence to practise anatomy to any member or fellow of any college of physicians or surgeons, or to any graduate or licentiate in medicine, or to any person lawfully qualified to practise medicine, or to any professor or teacher of anatomy, medicine, or surgery; or to any student attending any school of anatomy, on application countersigned by two justices of the place where the applicant resides, certifying that to their knowledge or belief such person is about to carry on the practice of anatomy. Notice is to be given of the place where it is intended to examine bodies anatomically one week at least before the first receipt or possession of a body. The secretary of state appoints inspectors of places where anatomical examinations are carried on, and they make a quarterly return of every deceased person's body removed to each place in their district where anatomy is practised, distinguishing the sex, and the name and age. Executors and others (not being undertakers, &c.) may permit the body of a deceased person, lawfully in their possession, to undergo anatomical examination, unless, to the knowledge of such executors or others, such person shall have expressed his desire, either in writing or verbally, during the illness whereof he died, that his body might not undergo such examination; and unless the surviving husband or wife, or any known relative of the deceased person, shall require the body to be interred without. Although a person may have directed his body after death to be examined anatomically, yet if any surviving relative objects, the body is to be interred without undergoing such examination. When a body may be lawfully removed for anatomical examination, such removal is not to take place until forty-eight hours after death, nor until twenty-four hours' notice after death to the anatomical inspector of the district of the intended removal, such notice to be accompanied by a certificate of the cause of death, signed by the physician, surgeon, or apothecary who attended during the illness whereof the deceased person died; or if not so attended, the body is to be viewed by some physician, surgeon, or apothecary after death, and who shall not be concerned in examining the body after removal. Their certificate is to be delivered with the body to the party receiving the same for examination, who within twenty-four hours must transmit the certificate to the inspector of anatomy for the district, accompanied by a return stating at what day and hour, and from whom, the body was received, the date and place of death, the sex, and (as far as known) the name, age, and last abode of such person; and these particulars, with a copy of the certificate, are also to be entered in a book, which is to be produced whenever the inspector requires. The body on being removed is to be placed in a decent coffin or shell, and be removed therein; and the party receiving it is to provide for its interment after examination in consecrated ground, or in some public burial-ground of that religious persuasion to which the person whose body was removed belonged; and a certificate of the interment is to be transmitted to the inspector of anatomy for the district within six weeks after the body was received for examination. Offences against this Act may be punished with imprisonment for not less than three months, or a fine of not more than 50*l.*

The supply, under this Act, of the bodies of persons who die friendless in poorhouses and hospitals, and elsewhere, is said to be sufficient for the present wants of the teachers of anatomy; and the enormities which were formerly practised by 'resurrection-men' and 'burkers' have ceased.

ANCHOR. The anchor, which, under some form or other, must have been as ancient as ships of any magnitude, is mentioned by many Greek and Latin authors; by whom also its invention was ascribed to various persons. The first anchors were, most probably, what they now are among uncivilised nations, namely, large stones, or crooked pieces of wood loaded with heavy weights. The latter form is mostly used by the Chinese, and indeed upon our own coasts at the present day single heavy stones are used as anchors or "kitticks,' by fishermen. The first anchors had but one fluke; another was afterwards added: but the anchor was yet without a stock, as appears from ancient monuments, and must have been very incomplete. This addition may, therefore, be considered as the last step towards the present form. Each ship then had several anchors; the chief one was called *ἱερα*, or sacred, and reserved for the last extremity,—precisely as the largest and best is now used in emergencies under the name of "sheet anchor;" but the veneration paid to it has much declined since the custom of paying 5*l.* to the master on letting it go was discontinued in the navy. For the purposes of the present article, we shall notice first the mechanical action of an anchor; then the mode of its manufacture; and lastly, the changes recently introduced in its form.

The technical parts of an anchor, which must be borne in memory, are the following:—The *shank* is the main or central shaft; the *small* is the end of the shank near the top; the *throat* near the bottom; the *trend* two-thirds down the length of the shank; the *ring* is at the extreme upper end; the *stock* branches out immediately beneath the ring; the *arms* branch out at the other end of the shank; the *palms*, or *flukes*, are flattish portions at the ends of the arms; the *bill*, or *peak*, is the extreme end of each palm; and the *crown* is the part farthest from the ring.

It may suffice at present to state that the difference between *bower*, *sheet*, *stream*, *kedge*, and *spare* anchors, is rather one of size than of construction. Referring, therefore, to the annexed cut for an illustration of the several parts of an anchor, we proceed to show its mode of action.

A, the ring.

B E D, the shank.

B, the small.

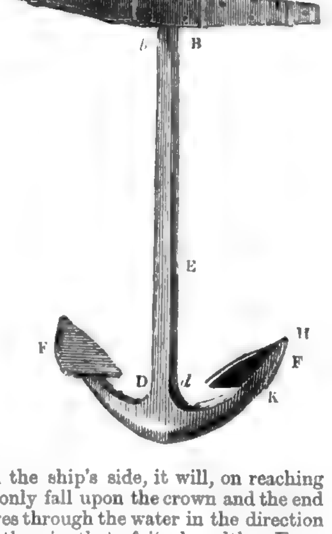
D, the throat.

E, the trend.

F D, H *d*, the arms.

F, the palm, or fluke.

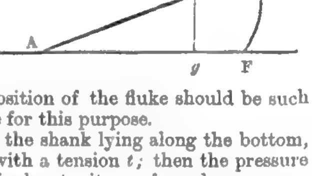
H, the bill or peak, or "pea."



When the anchor is let go from the ship's side, it will, on reaching the bottom of the sea, most commonly fall upon the crown and the end of the stock; because the stock moves through the water in the direction of its length with less resistance than in that of its breadth. From this position the anchor must be turned or canted over. The longer the stock, within the practical limits of stowage, the more certainly will the anchor turn properly; and, when hooked in the ground, the more powerfully will it resist any effort to overset it. Also, it is evident that the anchor will turn the more easily as the arm is shorter. In repairing old anchors, it is common to shorten the shank; in doing this, it is the custom also to shorten the stock in the same proportion. This, which is equivalent, in fact, to lengthening the arms, might, if carried to any extent, prevent the possibility of the anchor turning over, and therefore it appears that when the shank is shortened, the stock should remain unaltered. The amount of force required thus to overturn any given anchor might be found by calculation, or by actual trial; and it is remarked that the result of the former may be diminished by one-seventh when the anchor is under water.

The anchor being in the position of *fig.* 2, its weight, supposed to be collected at the centre of gravity, G (not including the stock), tends to force the fluke F into the ground; and as this pressure on F will evidently be greater, as the vertical line G g passes nearer to F c, this pressure is W. $\frac{A\,g}{A\,F}$ (W. = the weight, exclusive of the stock). As soon as the cable pulls from A, it causes the fluke to catch or hook deeper, that is, it forces the fluke down; and the position of the fluke should be such as to form the angle most favourable for this purpose.

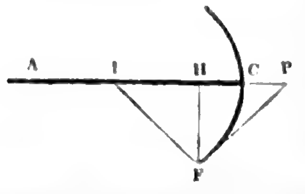
Fig. 2.



Suppose the arm C F imbedded, or the shank lying along the bottom, and the cable acting in the line C A with a tension t; then the pressure on the fluke taking place perpendicular to its surface, draw F I perpendicular to the fluke, and draw F P, tangent to the fluke, meeting

A C produced in P; then if P represent the tension t of the cable, I F will be the perpendicular re-action of the fluke, and P F the force which tends to drive it into the ground; draw F H perpendicular to C A, then H F is that part of P F which is perpendicular to the horizon, or is the effort of t to sink the fluke: let I P F $= a$, then F P $= t \cos a$, and F H $=$ F P $\sin a = t \cos a \sin a$, which is a maximum when $a = 45°$; or the fluke should be placed at 45° to the shank. Now, it is remarked by seamen, that when an anchor is once started, it is difficult and often impossible to get it to hold again, and as this case is the most urgent of all, it is apparently the one to which the position of the fluke should be calculated.

Fig. 3.



It would appear, since the weight of a large anchor bears a much higher ratio to any given tension of cable than the weight of a smaller one, that the solution of the problem ought to involve the weight of the anchor, which would give a different angle for anchors of different weights; but it appears from numerous experiments which Lieut. Rodgers has made on the qualities, as well as on the strength, of anchors, that an anchor, when dragged, always tends to rise out of the ground, thus following the direction in which the loosened soil affords a free passage;—since, therefore, it will not sink till it rests, and since its weight becomes less effective in pressing it farther the deeper it sinks, while the tension of the cable remains the same, it is thus constantly tending to the most favourable angle (when $= 45°$) till the arm is entirely buried.

It appears from *fig.* 2, that in shortening the shank, the fluke, making already in most anchors the angle with the shank, or F P I in *fig.* 3, too great, will become still more nearly perpendicular to the horizon. In many such cases the pull of the cable will produce scarcely any tendency whatever to sink the fluke; besides which it is to be observed that by lessening the horizontal distance A F, while F g remains the same, the pressure on the fluke is diminished, and thus on both accounts the qualities of the anchor impaired.

We now come to considerations relative to the strength of the anchor. It is obvious we have not the means of determining the amount of any of the forces concerned, but long experience has marked pretty nearly the limits beyond which the dimensions of anchors need not be carried. With these we can determine satisfactorily the preference which should be given to one form over another. The first strain that comes on the anchor when the cable is strained falls on the ring, which had been often broken or distorted, till its dimensions were of late years increased. This pull is conveyed along the shank to the lower arm, which it tends to break off at the greatest distance from the fluke, and therefore the thickness of the arm should increase towards the throat. The crown, which formerly was a circular arc, of late years formed an angle, till changed by Mr. Pering. The force to break the arm C F (*fig.* 3), is the re-action perpendicular to the fluke, or F I, against the tension of the cable. And the moment of this force to break the arm C F at C, is as the perpendicular from C on F I. If the arm F C be straightened into F P meeting A C in P, then the moment of the same force is as P F, which is considerably greater than before. It would be curious, therefore, to know what reason led to change from the curved to the angular form. In lifting or weighing the anchor, the cable acting perpendicularly to the end of the shank tends to break it, and hence the thickness of the shank should increase with its distance from the ring; also the breadth of the arms and the shank should be downwards. In order to obtain increase of length without either increase of weight or loss of strength, Lieut. Rodgers constructed his patent hollow-shanked anchor. The principle on which a hollow rod or bar is stronger than a solid one of equal sectional area is well known. Since the fluke from its breadth opposes greater resistance to being disturbed in weighing than the arm does, the axis of rotation will be towards the fluke, and accordingly the ground displaced by the angular motion of weighing being less than that displaced by fair pull,—and moreover the fulcrum or axis being near the throat in direct pull,—it seems that the force to lift an anchor out of the ground will be considerably less than the force sufficient by fair pull to bring the anchor home.

Before noticing the recent improvements in anchors, we will briefly detail the chief processes in making those of ordinary construction. Whether we view the forging of an anchor under the old state of things, or now that Nasmyth's steam-hammer works such wonders, it is a striking exhibition of industrial skill and labour. The shaft of a first-class anchor, nearly twenty feet long by ten or twelve inches thick, is too ponderous to be worked out of one piece of metal; and it has consequently to be built up of many pieces. Forty or fifty bars are sometimes laid together in a group, to be welded into one mass by powerful blows while at a white heat; but in modern times a smaller number of wider bars are more frequently used. The bundle of bars is brought to a highly-heated state, in a kind of oven formed wholly of coals, which completely surround the iron; but as the length of the shank is so great, only so much of it is heated at once as can be forged before it cools down too low. The fire is urged by ten or a dozen men; and when the mass is brought to a white heat, it is drawn out of the fiery furnace, swung round by means of the crane by which it has been suspended, and brought to bear on a large anvil. The men arrange themselves in a circle around the heated mass; and, guided by a foreman, they wield their ponderous hammers of sixteen or twenty pounds weight, and produce a rough music by their equal-timed blows.

But this was in the old times. If we now visit the government anchor smitheries, such as that in Devonport Dockyard, we find that steam has driven away something of the old picturesqueness—replacing it by a grandeur of its own. The anchor-shaft is no longer buried in a mere heap of blazing fuel, but is heated in a properly constructed furnace; the bellows are no longer worked by hand, but by the powerful blast of a steam-engine; the forgers need no longer to confine their operations to one small length, at a time, for a much greater length can now be managed before it cools down too low; and the circle of anchor-smiths less frequently wield their hammers, and expend their strength in blows which were once called powerful, but which have been superseded by something much more effective. Mr. Nasmyth's steam-hammer is a contrivance in which a powerful hammer or weight is allowed to fall by its own gravity, but is drawn up by the operation of steam-power; and this alternation of rising and falling occurs several times in a minute—much faster indeed than a man could wield a sledge-hammer. The white-hot anchor-shaft is placed upon an anvil immediately beneath the steam-hammer; and the blows which follow are so powerful and so quickly repeated, that the heated mass becomes forged in a wonderfully short space of time. Let the anchor-smiths group themselves as thickly as they may, and wield hammers the heaviest that human muscles can command—they cannot approach the amount of work which the steam-hammer effects. Even the *Hercules* which formed an intermediate stage between the sledge-hammer and the steam-hammer, and which consists of a heavy mass of iron worked by ropes, must yield in efficiency to Mr. Nasmyth's remarkable machine.

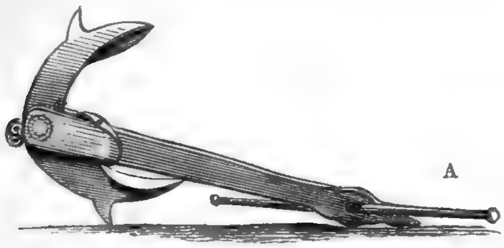
It would be impossible to notice all the improvements introduced or suggested in the form of anchors; but the chief novelties may consistently pass under review.

Mr. Pering introduced the plan of forming the shank of flat bars, of breadth equal to the depth of the shank. His greatest improvement was, however, that of forming the arms and part of the shank together—effected by splitting or dividing the bars, and throwing the ends back in opposite directions to form the arms; over the opening or angle thus formed is fixed a truss, and then to this are joined the flukes, and at the other end the remaining part of the shank.

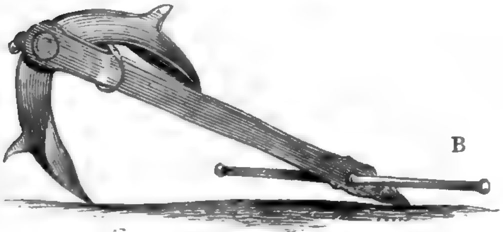
Lieutenant Rodgers introduced the hollow-shanked anchor; thus disposing the metal in the form which engineers know to be most profitable in proportion to its weight. The shank is, correctly speaking, not hollow in effect; for the square interior is filled up with a block of hard wood, to keep the iron bars or plates in their places; the principle, nevertheless, is that of a hollow shank, so far as strength is concerned. The shank is bound round with hoops at intervals.

In 1836 Mr. Meggitt patented an anchor in which the wide flukes or palms are dispensed with, the flukes being very little broader than the arms; while at the same time there is an increased width given to the crown by the addition of a triangular piece of iron. About the same period another form of anchor was introduced, in which the several parts were formed of distinct pieces of iron, so that it might be stowed away with great facility, or conveyed piecemeal by a boat which could not carry the whole anchor. The arms were formed of one piece, the shanks passing through the crown; the stock was also separate and secured to the shank when required; and the whole were so adjusted as to be put together in a short space of time.

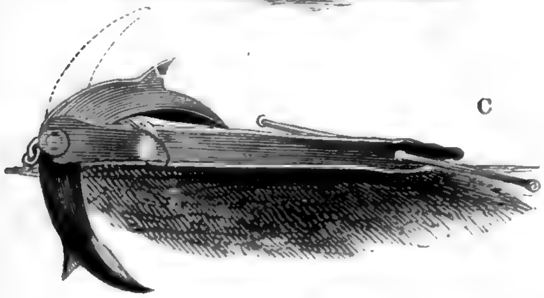
Mr. Porter's invention relating to anchors has, through various circumstances, led to very important results, and to a curious legal decision. The objects designed to be attained by this new construction are mainly the two following:—the avoidance of "fouling," by the cable passing over the exposed fluke of the anchor when the vessel is swinging in a tide-way; and the avoidance of injury to the vessel itself, in the event of falling upon her anchor. The peculiarity of the plan consists in giving to the arms and flukes a freedom of motion round a pivot or fulcrum at the end of the shank: thus departing at once from the rigidity usually observed in the construction of anchors. The arms and flukes are forged wholly independent of the shank, and have a hole drilled transversely through the centre, for the reception of the iron bolt which connects them with the shank. To give a familiar illustration, the joint may be described as of that kind which connects the wires of an umbrella with the ribs, so as to give a freedom of motion round the pin or bolt as an axis. When an anchor thus constructed is dropped from the vessel, it descends swiftly and strikes against the bottom of the sea with great momentum (estimated, with an anchor of ten hundredweight and a depth of twenty-four fathoms, at 45 tons). When the anchor rests fairly on the ground, its first position (A) is with the lower peak, or tip, in contact with the lower surface of the shank, the upper peak being as far as possible from the shank. Then the slightest movement of the cable suffices to disturb this position, and to bring the lower peak into a direction fitted to penetrate the ground (B). This libration continues until the upper peak touches the upper surface of the shank, and the lower peak is directed almost perpendicularly: a position very favourable for penetration, which then takes place. The shank and stock then lie flat on the ground (c); and the anchor, if pulled in the direction of the shank, has a tendency to fix itself more firmly in the ground, by keeping the



A



B



C

lower fluke almost perpendicular in the ground. Captain Denham, of the Marine Surveyor's Department at Fleetwood, gave a report of some experiments which he had tried in 1840 on the new swivel anchor, and states the following as the results to which he had arrived:—"It is almost impossible to foul it; it bites quickly into the most stubborn ground; it holds on to the shortest stay-peak; it cannot lodge on its stock end; it presents no upper fluke to injure the vessel herself, or others, in shoal water; it cannot injure vessels' bows when hanging acock-bill, as merchant-vessels find a convenient practice; it is not so likely to break off an arm, or part in the shank, as anchors with fixed flukes do, because the construction of these arms can be of continuous rod-iron, and the fulcrum of leverage is so much nearer the ring, owing to the pea of the upper fluke closing upon the shank; it is a most convenient anchor for stowing inboard on a voyage, as the flukes can be easily separated and passed into the hold; it can as easily be transported by two boats when one would be distressed by the whole weight; it produces the desired effect of ground-tackle at one-twentieth less weight." ('Unit. Serv. Journ.,' March 1840.)

Mr. Porter's anchor has been the basis on which improved forms have been introduced by Trotman, Honiball, and other inventors. Trotman's construction, patented in 1852, differs from Porter's chiefly in these points—that the palms are fixed intermediately on the breadth of the arm, instead of in front; and that the horn is of greater width than the arm, for a different shape is also given by Trotman to the upper part of the palm, in order that, as the tension of the cable buries the palm deeper into the ground, the upper flap of the palm being turned over so as to form the spur or horn, admits of the clay or sand, or mud being easily 'delivered' like the soil from a ploughshare. Hence it is often seen at anchorages which dry at low water, that Trotman's anchor buries itself totally some feet below the surface (a valuable consideration when a ship is riding heavily on a *lee-shore!*) while its shape insures ready extrication when the cable is hove full '*stay a peak:*' for its *ploughing qualification is available in any direction.* As regards *originality*, a notable legal decision was arrived at in 1855. Mr. Porter took out his patent in 1838; and an extension of the patent right was obtained in 1852; but this extension underwent a sudden check. During an action for infringement of patent, in 1855, it was proved that Porter's anchor was not a new one within the terms of the letters patent. Many years antecedent to 1838, Mr. James Logan had invented and made public the contrivance of a swivel anchor; he exhibited drawings and models; nay, he made such an anchor in 1826 for a steamer named the 'William Huskisson.' These facts were not known to Mr. Porter in 1838; but they vitiated his patent. Accordingly, in 1855, Mr. Pemberton Leigh, on the part of the Judicial Committee of the Privy Council, pronounced Porter's patent to be null and void, and the invention therefore open to the free use of any one.

In July, 1852, a trial of anchors was made at Sheerness, by order of the Admiralty. Those selected were to be bower anchors of 25 cwt.; and they were to be tested with regard to the following qualities;—"strength; holding, particularly when at a short stay, and being obliged to make sail; weight, and facility for stowing; quick holding; sweeping; tripping; fouling," &c. There were four modes of testing devised, in relation to the kind of ground chosen. The anchorsmiths of all nations were invited to compete, and several competitors appeared. The experiments occupied many days, and two or three of the anchors performed admirably. The most efficient appeared to be Porter's under the improved form introduced by Trotman.

Many patents for anchors have been obtained within the last few years—such as Firmin's in 1854; Scott's in 1855, and Hunter's in 1856; but they related chiefly to slight modifications of constructions already in use.

The number of anchors carried at both the bows and stern of a ship have been finally reduced to four principal, and these all at the bows. The anchors supplied to men-of-war are the best and small 'bowers,' the 'sheet,' and the 'spare:' these are of the largest size; to which are added, the 'stream' and the 'kedge,' which are used for particular or for temporary purposes, and are usually carried 'in board.' Since there is but small difference in the form of anchors of different weights, the stream of a large vessel serves for the bower of a smaller. Various rules have been given for the dimensions of anchors. The rough rule in the navy is, 1 cwt. to a gun; thus, an 80-gun ship will have an anchor of 80 cwt.; and a merchantman of 200 tons having an anchor 10 cwt., 5 cwt. is added afterwards for every 100 tons: thus 300 tons would give 15 cwt., and so on. The principal dimensions of the anchors in the navy may be stated shortly thus: calling the shank 10, the arm is about 3, the breadth and depth of the palm about half this, the thickness or depth at the small, ·42, at the throat ·6, which are nearly the dimensions of the arms also, and the breadths about $\frac{2}{3}$ of these, the edges being rounded. The weight of an anchor of 10 feet in length is, according to Pering, about 11·4 cwt., and since, if the forms of all anchors were alike, the weights would be as the cubes of the lengths, the weight of any anchor might be found (nearly) by multiplying the cube of its length by ·0114. The recent improvements in anchors are however likely to derange the old rules in respect both to the dimensions and weights of the several parts.

The largest anchors ever yet employed were those adopted by Mr. Brunel in the launching of the 'Great Eastern,' or 'Leviathan,' in the winter of 1857-8. They were required, for the enormous strain incident to that operation, to bear a breaking test of 110 cwt. each; and the chain cables for them, by Messrs. Brown and Lenox, were the largest ever made.

In the technical employment of anchors on board ship, an anchor is said to be 'foul' when the cable is any way entangled with it; to 'come home,' when the ship drags it; to be 'a-wash,' when the stock is hove up to the surface of the water; to be 'acock-bill' when hanging vertically; and to be 'stay a peak' when just ready to lift from the ground.

A'NCHORET, sometimes written, and more correctly, Anachoret, a Greek word (ἀναχωρητὴς), signifying a person who has retired from the world. Under Christianity they sprung up about the middle of the 3rd century in Egypt and Syria, where many believers went to hide themselves in caves and solitary wilds, from the fury of the persecution which arose under the Emperor Decius. Paul, commonly called the hermit, has the credit of having been the first regular anchoret. A distinction, however, came afterwards to be drawn between anchorets and hermits: the former name being given only to those who rigidly confined themselves to their caves or cells; and the latter to those who, although they had broken off all commerce with the world, still wandered about at large in the wilds to which they had retired. Both descriptions of recluse were entirely distinguished from the Cœnobites, or those living in communities. Many of the anchorets were laymen; and there were also female as well as male anchorets. From nearly the commencement of the 7th century, the Church assumed a jurisdiction over anchorets; and persons were not allowed to enter upon the mode of life in question, except by permission of their ecclesiastical superiors, and after an appointed ceremony had been performed, at which the bishop presided. Churches and religious houses in the middle ages would sometimes keep an anchoret shut up in a cell, which was usually attached to the choir of the church. Such an attraction brought great crowds of the devout and the curious to the holy place, which benefited much by their offerings. It was eventually found necessary, in our own as well as in other countries, to lay down certain regulations with a view of discouraging the adoption of this solitary life. The most singular species of anchorets recorded in the history of the Church, is that which arose in Syria in the 5th century, and of which Simeon Stylites was the founder. This zealot and his followers, instead of resorting, according to the customary fashion, to caves, elevated themselves into the air, on lofty pillars of stone, on the tops of which they passed their lives. They have hence received the names of pillar saints, holy birds, and aërial martyrs.

ANCHUSIC ACID ($C_{35}H_{20}O_8$?).—(*Anchusin.*)—A resinoid colouring matter obtained from Alkanet root (*Anchusa Tinctoria*). It is insoluble in water, but soluble in alcohol, ether, and oils, to which it imparts a fine carmine red colour. It is hence used for colouring hair-oil. Its alcoholic solution is bleached by exposure to light.

ANCHUSIN. [Anchusic Acid].

ANCHYLO'SIS, a Greek word (ἀγκύλωσις), signifying *a bending*. If the Greek orthography were strictly followed, the word would be written *ankylosis*.

An essential part of the apparatus of locomotion in animals consists of the structure termed a joint. [Joint.] Joints are so constructed as to produce various kinds and degrees of motion, in the execution of which it is necessary that the different parts constituting the joint should be in close contact with each other. Organised living surfaces, in close contact with each other, have a tendency to grow together; but such a union would at once destroy the action of a joint, and a specific apparatus is provided for the express purpose of preventing this event. What are termed articular surfaces, that is, the surfaces of joints, are covered with a thin and delicate membrane which secretes a peculiar fluid of an unctuous or oily nature, termed *synovia*. This synovia, the oil of joints, is in general effectual in keeping separate and distinct the different parts of the joint, however closely and for however long a time they may be in contact with each other; nevertheless, it does occasionally happen that a firm and complete union takes place between the different articular surfaces: when this occurs, it constitutes what is technically termed anchylosis, or, in common language, a stiff joint. An anchylosis, or a stiff joint, consists then of the immoveable union of two bones naturally connected together in such a manner as to form a moveable joint. All the moveable bones forming joints may become consolidated together, or anchylosed; and cases are on record of a general anchylosis of all the bones of the human body. Whatever keeps a joint motionless for a long time together may give rise to anchylosis. Hence it is apt to occur after the fracture of a bone in the neighbourhood of a joint; because it is necessary to the cure of the fracture that the limb should be fixed in one position, while the inflammation occasioned by the violence that produces the fracture often spreads to the joint, and it is one of the ordinary effects of inflammation to agglutinate and consolidate the parts inflamed. Hence inflammation, sprains, dislocation, shocks occasioned by leaping or falling on the feet from great heights, ulcers, are the common causes of anchylosis. But anchylosis cannot always be considered in the light of a disease; at any rate, it is sometimes the happy termination of a formidable malady. The natural cure of many painful and dangerous diseases of the joints is the formation of an anchylosis. When an anchylosis is forming, and is clearly inevitable, and is indeed a thing to be desired, the position in which the limb is kept, or the position in which the bones are allowed to unite, is a matter of great importance to the future comfort of the individual. When, for example, from injury done to the hand, the joints of the fingers are undergoing the process of anchylosis, it is very important to keep the fingers bent, because, if they anchylose in that position, the hand will be more useful than it could be were the fingers permanently extended. On the contrary, when there is danger of anchylosis of the knee-joint, the limb should be kept as straight as possible, because, if the leg be extended, the limb will be more useful than if it were permanently bent. On the other hand, when anchylosis of the elbow-joint cannot be prevented, the limb should be kept bent.

The term anchylosis is also employed to denote a natural union of bones. Thus, bones, or parts of bones, which are separate in the early stages of their growth, and afterwards become united, are said to be anchylosed. Also in the case of animals belonging to different divisions of the animal kingdom, bones which remain separate in one class through life, are found united in another class, and anchylosis is said to have taken place.

ANCIENT, ANCIENTS. The term *ancient*, which we derive from the French word *ancien*, has the primary meaning of "very old," as when we say "an ancient building," "an ancient family," implying only that many generations have passed since they first came into existence. But it is also used in a more limited sense, with reference to a certain period in the existence of the human race: as when we speak of ancient, as distinguished from modern, history; of the ancient classics, ancient literature, and generally, of the *ancients*. The boundary line between ancient and modern in this latter sense is not very accurately drawn; but according to the common acceptation of the terms, the period of the ancients seems to be closed by the final and complete overthrow of the Western Roman empire. With reference to the nations over which that empire extended, the distinction is not altogether arbitrary, or without an intelligible reason. The overthrow of the Roman empire marks the commencement of a new order of things, when we begin to discover the rudiments of those powerful independent nations, of those various languages and peculiar institutions, which so remarkably distinguish a large portion of what is called modern Europe, from Europe under Roman dominion. There is of course a short interval, which may be considered as doubtful ground, for the possession of which the terms ancient and modern will always be allowed to contend.

It is plain that the reason here given for the commonly received distinction is applicable only to the West and South of Europe; yet the same distinguishing terms are familiarly used, and in many cases the same date arbitrarily assumed with reference to the rest of the world. This practice is attended with many difficulties, and produces no little confusion. The Eastern Roman empire, for instance, survived the Western by many centuries; nor can any good reason be given why the subjects of Justinian and his predecessors should be classed among the ancients, and those of his successors among the moderns. If the question were asked, where should a Greek author in a late period of the Eastern empire be placed, we could not call him either an ancient or modern Greek writer without giving cause for considerable misapprehension. The use of the term mediæval may, however, to a certain extent remove the difficulty—at least in many cases. In the case of the Oriental nations, the terms ancient and modern are still applied, and often perhaps with no very distinct notion of their import, even by those who employ them. We hear commonly of ancient and modern Persia, ancient and modern India. Now, in the case of the Persian empire, in seeking for a date, we might choose between the conquests of Alexander the Great, the irruption of the Parthians, the restoration, as it is called, of the old Persian dynasty, and its subjugation by the Mohammedans. Any one of these events, and especially the last, would furnish perhaps better ground for the distinction of ancient and modern Persia, than anything which occurred at the time of the overthrow of the Roman empire.

It might be expected that the convenience of having at hand such terms as ancient and modern would often lead to some abuse, and this is particularly observable in the vague reference so frequently made to "the ancients." There is no definition which excludes from their number any who lived from the time of Noah down to the last Roman emperor; and it is obvious, that there is not much which can be safely predicated of a class so large and comprehensive; yet we often hear of what "the ancients" said, and did, and thought. Allusion is made to the military tactics or the philosophy of the ancients: comparisons are instituted between the literature of the ancients and moderns; and we are told of the sentiments on certain subjects entertained by the heathen ancients. The truth is that, by "the ancients," we must understand, on many of these occasions, Greeks or Romans at certain periods of their national history; and even thus limited, there are few assertions which will hold good of "the ancients" generally. For the most part, perhaps, the looseness of the expression is corrected and limited by the subject or the context; but it is also true, that real misapprehension has arisen from the practice of throwing together and confounding the most dissimilar things by the help of this comprehensive term.

This is not the place to enter on the consideration of ancient and modern history; but there is an evil in some measure connected with the use of these terms, which it may be worth while to notice. It is to be feared that the common division of the subject of history into two parts, ancient and modern, too often conveys the notion of an actual separation which does not exist. The young student pictures to himself a great gulf between them. When busy with the ancient part of the subject, he imagines himself to be conversing with beings of a different nature from himself. He believes the narrative, but is affected by it much as he would be by a work of fiction. When he has crossed the gulf, and passed from the obscure regions of ancient history into the stronger realities of modern times, he converses freely with beings of the same flesh and blood with himself. It is not requisite to enumerate all the bad effects which must arise from this impression. It is evil enough that the student must necessarily overlook the important fact, that the subjects of what are called ancient and modern history are so far one and indivisible, that a comprehensive view of the ancient part is necessary for the profitable study of the modern.

ANCIENT DEMESNE. [Manor; Socage.]

ANCIENT LIGHTS. [Lights.]

ANDAN'TE, in music, is the third in order of the five classes into which musical movement is divided [Allegro], and the medium between the extremes of slow and quick.

The music of Corelli, Handel, and their contemporaries, was generally much slower than that which prevails at present, and Andante was then used to denote a moderate degree of quickness: now it indicates a steady, calm movement, rather inclining to slowness than the reverse. It also enjoins a more than ordinary attention to the measure, to the equality of time given to each bar. This term is also used substantively: thus we say, 'an Andante of Haydn,' &c

ANDANTI'NO, in music, is the diminutive of 'andante.' It affords a curious example of the vagueness of musical terms, that musicians are not agreed whether this diminutive ought to mean 'less slow,' or 'less quick.' When the word andante is used, as by the old masters, to denote a degree of quickness, its diminutive abates its motion: when employed to indicate a movement rather slow than quick, as in the present day, the diminutive increases its motion. For want of adverting to this fact, much misapprehension and some disputes have arisen. It, however, seems to be agreed, that andantino now shall signify a movement quicker than andante—that it shall be the medium between the latter and allegretto.

ANDRO'MEDA, a constellation, so called by the Greeks from Andromeda, the mythological daughter of Cepheus and Cassiopeia, who was bound to a rock and thus exposed to a sea-monster, from whom she was delivered by Perseus. This constellation occupies a considerable region of the heavens below Cassiopeia, by which it may be thus found. A line drawn through the brightest star of the five in Cassiopeia, marked β, and the pole star, passes through a star of the first magnitude in the head of Andromeda, marked α, and called Alpherat. A line drawn through ϵ Cassiopeiæ, at the other corner, and the pole star, passes through Almach in the foot of Andromeda, marked γ, while in the line between the two stars thus found, lies Mirach, marked β, in the girdle of Andromeda.

The following is an enumeration of the principal stars in this constellation, classified according to their magnitudes :

Magnitude.	Number of Stars.	Magnitude.	Number of Stars.
1st	1	4th	6
2nd	1	5th	8
3rd	2	6th	45

Hence the total number of the stars in this constellation which are visible to the naked eye amounts to 63.

The following are the designations of the various stars in Andromeda, down to the 4th magnitude inclusive :

Character.	No. in Catalogue of Flamsteed.	No. in Catalogue of British Association.	Magnitude.
α	21	4	1
π	29	155	4
ϵ	30	164	4
δ	31	166	3
ζ	34	215	4
ν	35	227	4
μ	37	252	4
β	43	334	2
	51	487	4
γ	57	628	3

ANEMO'METER (from ἄνεμος, the wind, and μετρέω, to measure), is an instrument for measuring the force of the wind, by finding what mechanical effect the wind to be measured will produce upon the apparatus. The first anemometer seems to have been invented by Dr. Croune, in 1667, but this did not answer its purpose well, and a better instrument was devised in the last century by Wolfius, which is described by him in his 'Elementa Matheseos,' vol. ii. p. 319 (Geneva edition, 1746). It consists of four sails, similar to those of a windmill, but smaller, turning on an axis. On the axis is a perpetual screw, which turns a vertical cog-wheel round a second axis, placed transversely to the former. To the second axis is attached a bar, on which a weight is fixed, so that the sails cannot turn without moving round the bar in a vertical circle. When the wind acts upon the sails the bar rises, and this continues until the increased leverage of the weight furnishes a counterpoise to the moving force of the wind. The number of degrees the bar moves through to produce this effect is measured on a dial, the hand of which turns on the axis of the cog-wheel.

Another form of anemometer was invented by Leslie, depending for its action upon the principle, that the cooling power of a current of air varies as its velocity. Another instrument depended on the evaporation of water, which, for any time, is proportional to the velocity of the wind. In all these forms, however, the force is measured either by the compression of a spring, or by the raising of some weight to a height varying with the force to be measured. The former method, though more convenient, is, owing to the diminution in elasticity by frequent compression, liable to give varying results.

The principle of Dr. Lind's anemometer is as follows :—A, a curved tube of glass, as represented in *figure* 1, is partially filled with water. The bore of the tube is diminished at the bottom, as a check on the oscillations to which, the water is subject from sudden variations in the force of the wind. The wind acts upon the open end A, and depresses the water to B, until the column of water b C, the difference between the levels B and C, is a counterpoise to the force of the wind on B. This difference can be ascertained by the graduated scale. Hence, when the area of the bore at B is known, and the height of b C observed, the column of water is found the weight of which is equivalent to the force of the wind. The velocity may thence be found by observing (AERODYNAMICS) that the velocities are nearly as the square roots of the resistances, and that the moving force of a wind of 20 feet per second on a square foot is 12 ounces.

Fig. 1.

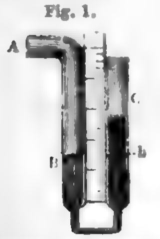
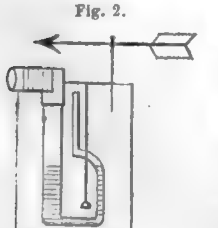


Fig. 2.



Lind's anemometer has been improved by Sir W. Snow Harris, who has reduced one of the limbs to the diameter of one-fourth of the tube which is open to the wind, and by making the first part of the scale horizontal the delicacy of the instrument has been much increased. He has also provided it with a plumb line, and with a light vane to facilitate the operation of observing. (See *fig.* 2.) Sir John Herschel, in the 'Manual of Scientific Inquiry,' recommends that in using this instrument in cold climates, a saturated brine which does not freeze should be substituted for the water; its specific gravity is 1·244, so that the force given by the table must be multiplied by this factor.

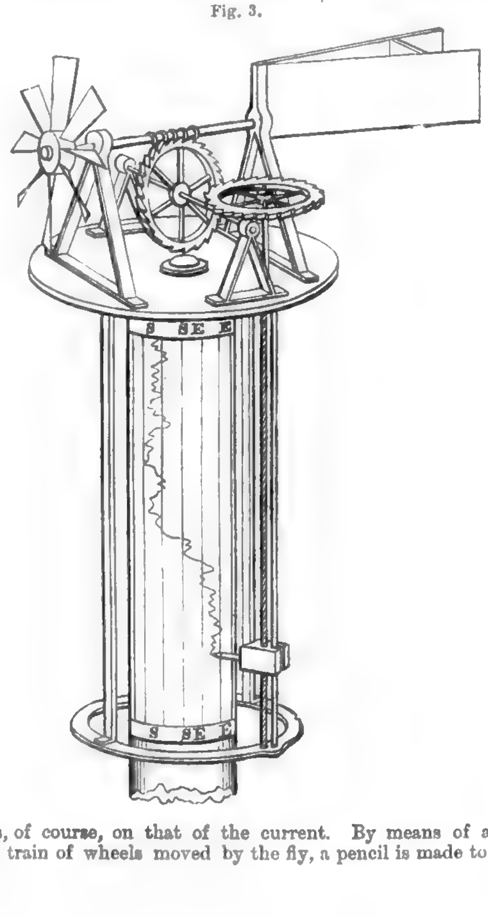
The following table, calculated by Dr. Hutton, and given in his 'Mathematical Dictionary,' is based upon some experiments made with Dr. Lind's anemometer, at Woolwich; it may be used with that instrument, and indicates what velocity of wind corresponds to various differences between the levels of the liquid, and the consequent force of the wind. Thus, when the column of liquid is 9 inches, the velocity is 108 miles per hour, and the pressure on the square foot is 43·9 lbs., producing a most violent hurricane; so that in the greatest storms the difference between the atmospheric pressures on the windward and leeward sides of any object does not amount to $\frac{1}{50}$th of the pressure on the leeward side, which, we know, is capable of supporting a column of water 32 feet, or of mercury 30 inches.

Difference of Levels in inches.	Force of Wind in pounds.	Velocity per hour in miles.
$\frac{1}{4}$	1·3	18.0
$\frac{1}{2}$	2·6	25.6
1	5·2	36·0
2	10·4	50·8
3	15·6	62·0
4	20·8	76·0
5	26·0	80·4
6	31·3	88·0
7	36·5	95·2
8	41·7	101·6
9	46·9	108·0
10	52·1	113·6
11	57·3	119·2
12	62·5	124·0

In Regnier's anemometer, a bar, carrying a flat wooden surface at right angles to it, protrudes from a box, through a hole in the front of which it slides. This bar is met by a spring, which resists its further entry, until force is applied against the wooden surface. In the interior of the box, the under side of the bar carries rackwork, which plays on a cog wheel, the axis of which, passing through a side of the box, carries a hand round a dial-plate. The flat surface of wood is presented to the wind, which presses upon it and forces back the bar, carrying the cog wheel and hand through an angle, greater or less, according to the greater or less impulse of the wind.

Various other contrivances have been proposed, the most important of which are by Dr. Whewell and Mr. Osler. In Whewell's anemometer (*fig.* 3) a windmill fly is, by the action of a vane, constantly presented to the wind, and the velocity of the revolutions of the fly

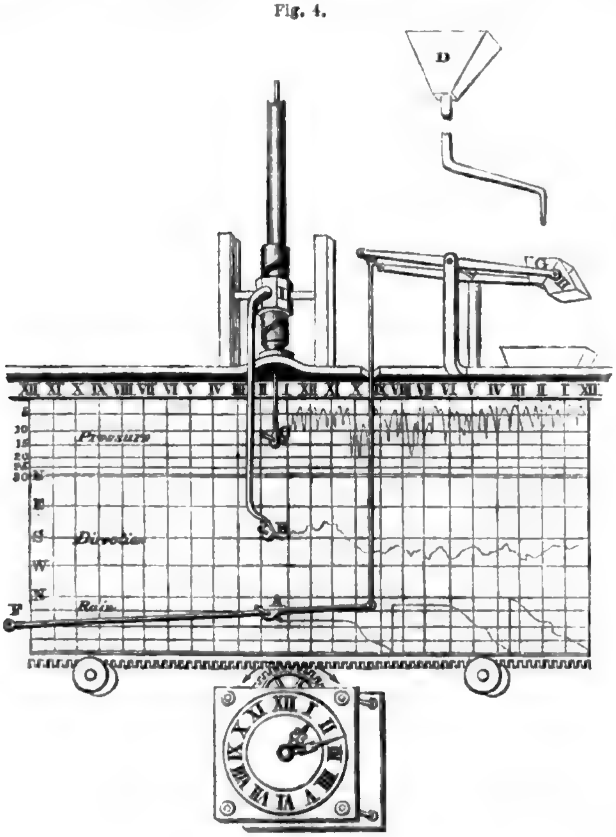
Fig. 3.



depends, of course, on that of the current. By means of an intermediate train of wheels moved by the fly, a pencil is made to descend over a fixed cylinder, producing thereon a trace of variable length, according as the wind varies in velocity. The surface of the fixed cylinder is divided into sixteen or thirty-two equal parts by means of vertical lines, the spaces between which correspond with the points of the compass, and between or upon these divisions the pencil is moved about by means of the vane, and the trace that it leaves shows the *direction* of the wind. The pencil, however, has two motions, one from above, downwards (10,000 revolutions of the fly causing the pencil to descend $\frac{1}{20}$ of an inch), and this motion increases as the wind blows more strongly, and by the extent of its depression registers the whole *amount* of wind that has been blowing. The other motion depends on changes of the quarter from which the wind blows; the pencil and its frame are carried round by the vane, so as to register the *direction* of the wind. Thus, if the fly revolve in the simple proportion of the velocity of the wind, the trace marked by the pencil describes a space proportional to that which a particle of air would describe in a given direction in a given time, taking into account the strength of the wind and the time for which it blows. The constant *wavering* of the wind causes the pencil to describe, not a single line, but an irregular broad path, something like the shadings in the coast of a map. The middle of this line will give the mean direction of the wind, while its length will be in proportion to the product of the velocity of the wind and the length of time during which it blows in each direction, which product is called its *integral force*.

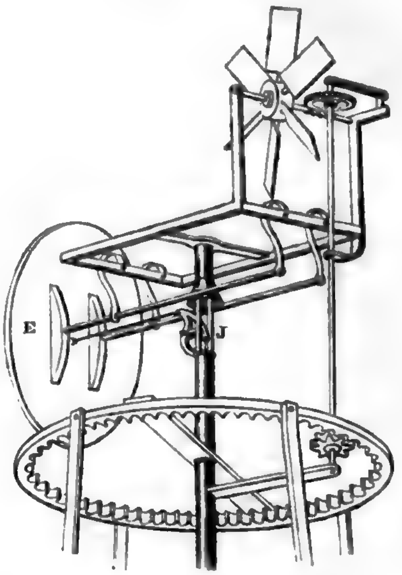
A great objection to the above form of anemometer is the amount of friction involved in the method of converting the rapid motion of the fly into a slow descending motion, and in the mode by which the pencil is made to move against the fixed cylinder. Osler's anemometer has some advantages over Whewell's. This instrument traces the direction of the wind and its pressure on a given area, together with the amount of rain, on a register sheet divided into twenty-four portions, corresponding with the twenty-four hours of the day. The action of this instrument will be understood by referring to *fig.* 4,

Fig. 4.



which represents the parts adjoining the register-paper. The central portion of this paper has a series of lines corresponding with the cardinal points of the compass, for indicating the *direction* of the wind. The upper part of the paper has a series of lines corresponding with the *pressure* in pounds on the square foot, while the lower part of the paper has a series of lines corresponding with given quantities of *rain*. There is also a series of twenty-four vertical lines, corresponding with the twenty-four hours of the day, so that a new register-paper, being properly placed on a board, is carried along upon friction-rollers, by means of a clock, behind the three pencils A, B, C, which may be regarded as the indexes of the machine. The pencil B, which marks the direction, is operated on by means of a set of vanes (*fig.* 5), turning vertically in a plane at right angles to that of the pressure-plate (E, *fig.* 5), and driving a cog-wheel, which rolling on a fixed cogged circle, turns the rest of the apparatus round, so as to present the edges of the

Fig. 5.



sails to the current when it is no longer turned by it either way: under these circumstances, the pressure-plate is placed at right angles to the vanes, and is acted on with full effect by the wind. As the vane or cap turns in the direction of the wind, a spiral worm on the shaft near its lower end raises or lowers the fixed nut I, from which springs the arm which carries the pencil B; this pencil traces a mark on one of the long lines of the register when the wind is blowing from one of the cardinal points, or between those lines, if it be blowing from intermediate points. The pressure-plate E is made to face the wind by means of the vane or cap. It is suspended by means of four springs, which yield to gentle winds, while a stronger spring receives the more violent pressure of a high wind. The motion of the plate is transmitted to the register-paper by means of a wire connected by the bell-crank J with another wire, which descends through the hollow upright shaft, and is kept stretched by a spiral spring. This wire carries the upper pencil C, which of course descends lower in proportion as the pressure-plate E is pushed back, and returns to the top of the paper when the pressure ceases. In this way, the distance to which the pencil is depressed shows, by means of a number of irregular parallel lines, the pressure of the wind in pounds on the area of one square foot, or its velocity in miles per hour. For registering the rain, the pencil A is attached to a lever A F, *fig.* 4, which is moved by the following contrivance: A rain-receiver, D, is placed on the roof of the house, and the water which pours into it is conducted into one of the two divisions of a gauge, G H, balanced on an axis and supported by a second balance: as the water accumulates in G (for example), the second balance begins to descend, and thus raises the upright rod to which the lever F A is attached, when the pencil, being raised with it, makes a mark on the paper, which represents the quantity of water collected in the gauge. When this quantity is equal to a certain depth of rain or to a certain number of cubic inches on a square foot, the gauge becomes upset by the weight of water, the water is thrown out, and the other compartment, H, is brought under the pipe; the effect of which motion is to send the pencil to the bottom of the paper, and it only begins to rise again when more rain is collected. Of course, the heavier the rain, the sharper will be the angles formed by the trace of the paper; whereas, if the rain be gentle, the elevating or diagonal lines will be drawn out to a considerable length; and lastly, if there be no rain, the pencil will trace a horizontal line, such as is represented in *fig.* 4, from VI. to VIII½, and from X½ to I.

Thus it will be seen, that as the register-paper is being constantly moved forwards by the action of a clock, the three pencils mark the direction and pressure of the wind, together with the amount of rain. The register-paper may be ruled for twenty-four hours, or for a week, and it may be placed vertically, as at the Royal Exchange, London, or laid horizontally on a table, as at the Meteorological Observatory at Greenwich, where the register, being on a larger scale, is changed every day. Mr. Osler has further improved his anemometer in the following manner: A sheet of plain paper, placed in the instrument under a registering pencil, is moved forward by rotating hemispherical fans, at the rate of one inch for every two miles of air that passes; this same pencil, having a lateral motion given to it by a vane, records the point of the compass from which the wind blows; and a clock-hammer descending every hour, strikes its mark on the margin of the paper to express the time. Thus in a single line are given, 1st, the length of the current; 2nd, the direction of the current; 3rd, the time occupied in passing a given station marked hourly, or at any shorter interval that may be desired.

The Rev. W. Foster, of Sturbington, near Portsmouth, has contrived an ingenious anemometer, which is fully described in Sir W. Snow Harris's 'Report on the Working of Whewell's and Osler's Anemometers at Plymouth during the years 1841,-42,-43,' presented to the British Association for the Advancement of Science in 1844, to which we are indebted for some of the preceding details. Foster's anemometer consists of a cross horizontal fly three feet in diameter, with four vanes each six inches square, and so contrived as to revolve in one direction only. The revolution of this fly imparts motion to a vertical shaft, at the lower end of which is an endless screw, which is connected with a train of wheels to a disc, twenty-two inches in diameter, which is caused to revolve slowly in a horizontal plane, and this disc thus registers the revolutions of the fly, which may be in any convenient proportion to those of the disc.

By means of a second vane and a vane-rod a second disc, nine inches in diameter, is made to revolve. There is also a rain-receiver on the roof, and a pipe by which the rain descends into a balanced gauge, the reciprocating motion of which causes an axis to work in a toothed wheel under the disc, through a space proportional to the quantity of rain delivered at each tip of the gauge. There is also a rod set on friction-rollers, and furnished with a rack adapted to the tooth of a horizontal rod projecting from the centre of a clock. There are twenty-four teeth in the rack, so that the rod is moved hourly one division, by which motion three pencils are hourly moved upon the respective discs, so that traces are obtained of the direction and velocity of the wind, and of the rain for every hour.

We give the following table as a specimen of the interesting results of the operation of this instrument. It shows the total and mean hourly velocity of each wind in miles.

Points of Compass.	Total Velocity in miles per hour.	Number of hours of each wind.	Mean hourly Velocity in miles.
N.	432	42	10·3
N.N.E.	3828	354	10·6
N.E.	4468	317	14.2
E.N.E.	2491	147	17·0
E.	948	75	12·6
E.S.E.	854	68	12·5
S.E.	699	81	8·6
S.S.E.	1125	77	14·6
S.	1811	136	13·3
S.S.W.	2787	149	18·7
S.W.	5773	265	21·8
W.S.W.	10,227	609	17·0
W.	6836	383	17·0
W.N.W.	16,301	877	18·5
N.W.	6695	412	16·2
N.N.W.	3011	298	10·1

Professor John Phillips had, in the Great Exhibition of 1851, an anemometer for collieries, hospitals, &c., for ascertaining the velocity of the current in the ventilation of such places. The pressure is received on a semicircular disc of cardboard, suspended by the diameter and measured on a graduated arc. By tables calculated from the equation, $\text{vel.} = M\sqrt{\frac{\sin.\,\theta}{\cos.^2\theta}}$, the velocity is obtained in terms of the angle. M. de Hannault also exhibited a small travelling anemometer, consisting of a series of fans which, by a simple contrivance, could be stopped or set in motion almost momentarily. Its chief object was to determine the horizontal velocity of the air in a given time.

In the anemometer erected at Kew Observatory Dr. Robinson's method is adopted, namely, that of measuring the velocity of the wind by the rotation of a system of hemispherical cups, the direction being indicated by a double-wheel fan, like the directing vane at the back of a windmill. A stout tubular support carries the whole of the external part of the instrument, including the measurer of velocity, the direction vane, and a rain gauge. All the rotatory parts of the anemometer run upon friction-balls. The shaft of the apparatus for measuring the movement of the wind by means of a diminishing train of wheels, is made to turn a cylinder upon which is wrapped a sheet of paper of the kind used for metallic memorandum-books, which paper receives a trace from a brass style. The sheet of paper is divided into two sections, upon one of which is recorded the motion of the wind, and upon the other the direction. As the cylinder is being turned by the action of the wind, a clock carries a pencil along the cylinder at the uniform rate of twelve inches in twenty-four hours. To the lower end of the direction-shaft is attached a spiral of such a figure that equal angles correspond to equal increments of radius; the edge of this spiral consists of a thin slip of brass, which touches the paper and records the direction of the wind on a rectilinear scale. When the sheet of paper is taken off the cylinder after the lapse of twenty-four hours, the motion of the wind and the direction are both found projected in rectangular co-ordinates. This self-registering apparatus was designed and constructed by Mr. R. Beckley, assistant in the observatory.

In a letter to the writer of this article Mr. Beckley remarks :—"The principal improvement I think, consists in the method of mounting, by the application of the hollow shaft to the direction vanes; as in all cases where the cups have been used the velocity and direction of the wind have been two distinct erections, whereas all that is necessary in my case is a base to bolt the column upon. I also economise space within the building. The method of registration consists in using metallic paper, upon which brass becomes a pencil; the form of which is a very thin-threaded screw, whose pitch, in the case of the velocity-pencil, is equal to a scale of fifty miles upon the paper. By this means I get a very open scale in a small space. The pitch of the direction-screw is equal to any openness of scale that is desirable. By using this form of pencil I overcome the difficulty attending the old method, namely, the pencil shifting off the scale, to obviate which, it was usual to have three sets of scales upon the paper; but even then, should the wind go twice round in the same direction, it ceased to indicate, whereas in my arrangement it must at all times register."

With respect to anemometric observations at sea, Mr. Welsh, Director of the Kew Observatory, gives the following method of making allowance for the effect of the ship's motion upon the observed velocity and direction of the wind :—"By means of a portable Robinson's anemometer, provided with a means of observing the total number of turns made by the rotating part in any given time, observe the *apparent* velocity of the wind, and record it in knots per hour. By an anemoscope of any kind register the *apparent* direction of the wind. From the log-book take the rate and direction of the ship's motion. On a slate or other similar surface scratch a permanent compass circle: set off from the centre of the circle, on the radius of the direction of the ship's head, by any convenient scale, the number of knots per hour the ship is going; from this point draw a pencil line parallel to the direction of the wind as observed by the anemoscope (that is, the *apparent* direction *to* which the wind is *going*); set off on this line the number of knots per hour as shown by the anemometer; draw a line from the centre of the circle to this last point. The length of this line by the scale adopted, gives the *true* velocity of the wind, and its direction (carried backwards) shows the point *from* which the wind is *coming*. A parallel ruler divided on the edge is all that is required besides the slate. It would be easy enough to contrive some mechanism to save the trouble of drawing lines, but it would not, I believe, be any real simplification, and would increase the expense. The train of indicating wheels might be so arranged that they at once indicate knots per hour, without reference to tables, and can be readily set to zero for a fresh observation." ('British Association Report,' 1856.) Professor C. Piazzi Smyth, from a series of observations communicated to him by Captain H. Toynbee, concluded that the only unexceptionable station for anemometrical observations at sea was the mast-head. He had therefore contrived an apparatus for measuring the direction and the velocity of the wind, arranged with a view to such a position, and also with a view to observe accurately the mean effects, and this by a summation of every individual gust, even the lightest. For the most accurate plan of securing data, he had arranged a method of electric registration, which was carried on in the cabins below, while the anemometers were measuring the wind aloft. ('British Association Report,' 1855.)

For the method of discussing the results obtained by means of anemometers, see AËRO-DYNAMICS.

ANEMONIC ACID. A name given to two distinct acids derived from the *Anemone Pulsatilla*, *A. Pratensis*, and *A. Nemorosa*. One of these acids has the formula $C_{30}H_{14}O_{14}$. The formula of the other is doubtful. Neither acid possesses any especial interest.

ANEMONIN ($C_{30}H_{12}O_{12}$?). A white crystalline body found in the water distilled from the *Anemone Pulsatilla*, *A. Pratensis*, and *A. Nemorosa*. It is poisonous, and slightly irritating to the skin. Alkalies transform it into anemonic acid.

ANE'MOSCOPE, an instrument for determining the direction of the wind; usually constructed by connecting with the spindle of a weathercock the hand of a dial on which the points of the compass are marked. [ANEMOMETER.]

ANEROID BAROMETER. [BAROMETER.]

ANE'THUM GRAVEOLENS (DILL)—*Medical Properties of.* This is an umbelliferous plant, native of the south of Europe, Astrakhan, Egypt, and the Cape of Good Hope: it has either migrated or been introduced into Egypt and the Cape. It is also cultivated in England. It was in high repute among the ancients, both as a medicinal and a savoury herb, being mentioned by Hippocrates and Dioscorides (ἄνηθον of the latter); also in the Bible (Matt. xxiii. 23), where, however, it is translated anise. The fruit is the part which is officinal. This consists of a diachenium formed of two flattened mericarps, on the back of which is one, and on the commissure two vittæ, containing the volatile oil, on the presence and quantity of which the peculiar odour and virtues of the fruit depend. The quantity of oil varies much according to the degree of ripeness, the age, and, above all, the place of growth of the fruit. Fruits too ripe, or very long kept, yield less than those gathered before perfect maturity, or very fresh ones. Those raised in England are inferior to those from the south of Europe; the clearer and drier atmosphere of the latter favouring the elaboration of volatile oils. To obtain it, the bruised fruit is submitted to distillation with water: 2 cwt. of good fruits yield 8 lbs. 5 oz. of oil. (Pereira.) The colour is pale yellow; the specific gravity 0·881; the odour peculiar, penetrating, and much disliked by some—hence, the French name of the plant, *Fenouil puant*. The taste is hot, and rather sweetish. It requires 1440 parts of water to dissolve one part of oil. It is very soluble in alcohol and ether. Hence, to form the *aqua anethi* (dill-water), the instructions of the pharmacopœia are rarely complied with, but a portion of the oil is previously dissolved in alcohol and then with sugar diffused through distilled water, by which means a more potent agent is obtained. The oil is sometimes administered by dropping it on sugar, and so forming an oleo-saccharum.

Dill is a carminative agent of considerable power, and in most frequent use, particularly to allay the spasmodic affections of the bowels of infants, and to assist the expulsion of flatus. This practice, though attended with temporary benefit, is in the end hurtful. A much more rational plan is for the nurse who suckles the child to be most careful in her diet, to retire to rest early, and to discharge faithfully all the duties which devolve upon her as a mother. She may take the dill, when troubled with indigestion and flatus, with more safety than the infant, and also with more advantage, as, by promoting the digestion, it augments the quantity of the milk and improves its quality. Like those of several other umbelliferous plants, the seeds are fatal to birds, such as chaffinches.

Dill-water is often made the vehicle of purgative or other medicines to prevent griping. One of the best laxatives for infants is made with equal parts of dill-water and compound decoction of aloes, to which a few drops of aromatic spirit of ammonia may be added. This is much more appropriate than the domestic doses of magnesia and rhubarb, so often given to infants, and which Dr. Reid declared to be the cause of death in one-half the children which died in London under two years of age. The insoluble nature of the woody fibre of rhubarb renders it very irritating to the sensitive stomachs of infants, to whom nothing solid should ever be given. The evils of magnesia are manifold.

A'NEURISM is a Greek word (ἀνευρυσμός), literally signifying 'a widening or extension.' It is now used to signify a tumour, consisting of a preternatural enlargement of an artery. The artery is the only seat of this disease; and any artery of the body may be the subject of it, but it is much more common in some arteries than in others. The corresponding disease in a vein is called a varix. [VARIX.]

An artery is composed of three membranes, which are firmly united, and form the walls of a strong elastic and extensible tube. These membranes are called tunics or coats. In the healthy state of the artery these tunics yield only to a certain extent to the impulse of the blood, so that the tube possesses only a certain diameter; but in a state of disease the impulse of the blood distends these tunics to a preternatural extent, causing that part of the artery which is diseased to swell out into a tumour or bag. The distension of the coats of the artery progressively increasing, they are at last capable of no further stretching, and consequently are torn asunder and burst. But the inner and middle coats of the artery are not as extensible as the external coat; the two former coats are therefore ruptured a considerable time before the latter gives way, in which case the only proper coat of the artery forming the wall of the aneurismal tumour is the external. This coat in its turn getting progressively thinner and thinner as the dilatation goes on, at length bursts like the former; the blood escapes, and life is suddenly extinguished. But sometimes the tumour does not burst even after the rupture of the external coat of the artery; for there is placed around the artery a dense and strong membranous sheath, consisting of what is termed cellular membrane, which sheath is far more extensible than any of the coats of the artery, and it is found that sometimes the aneurismal sac, or the bag-like tumour which the dilated artery forms, consists only of this condensed cellular membrane; all the proper coats of the artery having been rent and destroyed by the progressively distending force. Thus an aneurism may consist simply of the dilatation of the coats of an artery without the rupture of any; or of the dilatation of some with the rupture of others; or of the rupture of all; the bag of the tumour being formed solely by the cellular sheath of the artery.

When the coats of the artery have burst, and this portion of the tube is dilated into a sac, it is evident that this sac is beyond the direct current of the circulation, and that the larger the bag, the farther its contents will be from the influence of the direct current of the blood. The consequence is, that the blood contained in the aneurismal sac undergoes a peculiar change, a modification of the process of coagulation [BLOOD, NAT. HIST. DIV.]; the thinner part of the blood being removed, while a portion of the thicker part, or the fibrin, remains. In this manner there is left upon the internal surface of the sac a stratum of the thicker or fibrous part of the blood. Successive depositions are made of this fibrous part of the blood by which the cavity of the tumour is gradually diminished. At length the sac becomes entirely filled with this substance, which forms for it a firm plug. The deposition of this fibrin is not confined to the aneurismal sac, but is continued into the artery itself, both above and below its dilatation, until it reaches the next important ramification which is given off from the artery, where it stops. In this manner the circulation through the aneurismal portion of the vessel is prevented; the blood is determined into other channels; this portion of the vessel, being no longer of any service in carrying on the circulation, is blocked up, and in this manner is effected a spontaneous cure of the disease.

But this beautiful curative process, though it occasionally happen, is not the usual course. When the external coat or the cellular sheath of the artery are stretched beyond a certain point, it would seem that its vitality is diminished; at length a part of it mortifies or dies; an eschar is formed; the eschar sloughs away; an opening is thus formed in the tumour; the blood rushes out, and the patient dies. This is the mode in which the aneurismal sac bursts when the aneurism is situated on the external part of the body. But if the aneurism be internal the process is different; the tumour becoming thinner and thinner by successive distension, bursts suddenly by a crack or fissure, through which the blood is discharged.

The first symptom which denotes the formation of an aneurism, is the perception of an unusual throbbing in the diseased artery. If the situation of the artery be such that it can be seen or felt, a small tumour is manifest. This tumour, when carefully observed, is found to have a pulsatory motion, this motion, as well as the tumour itself, disappearing when the part is compressed, but instantly reappearing on the removal of the pressure. Commonly, the tumour is without pain, and without any discoloration of the skin. The magnitude of the tumour, whatever its size when first discovered, is steadily progressive; in proportion as it grows larger, the pulsatory motion diminishes, and when it has attained a very considerable size the pulsation is no longer perceptible. The tumour continually enlarging, produces a variety of effects on the parts with which it comes in contact. Some it pushes aside, others it carries with it, and others it destroys. The adjacent muscles, for example, whether they are situated directly over the aneurism, or are at one side of it, are usually stretched, displaced, dwindled, and sometimes entirely confounded with the contiguous parts. The nerves, too, are frequently pushed out of their natural situation; or, if they adhere to the sides of the sac, as they often do, they are necessarily stretched as the tumour enlarges, and this distension of the nervous cords sometimes occasions intense pain. The cartilages and bones, pressed upon by the advancing tumour, gradually disappear, and at length are so completely destroyed that not the slightest vestige of them remains. In general, as long as the tumour is small, it is unattended with pain; but the changes which it produces in other parts, such as the stretching of the nerves and the absorption of the bones, is sometimes attended with intolerable pain, capable of being mitigated by no means hitherto discovered. Death at last puts an end to the pain and the patient together by the bursting of the sac, the approach of the fatal event being clearly indicated by the increasing thinness, softness, and darkness of the tumour.

The importance, in practice, of discriminating between this most dangerous disease and all other tumours is manifest; but the distinction is not always easy, or at any rate is not always made. Many a death has happened in consequence of incisions having been made into aneurisms which were mistaken for abscesses.

There is something in the structure of the larger arteries which predisposes to this disease. Their coats are thinner in relation to the magnitude of the column of blood with which they are filled than the coats of the smaller arteries. The internal are much more subject to aneurism than the external arteries. The curvatures of the arteries are another predisposing cause. The period of life at which aneurism is most frequent is between the ages of thirty and fifty. Sir Astley Cooper, however, states that he has seen the disease in a child only eleven years old, and that he has operated for it with success in a man of eighty-five. It is much more common among males than females. Out of sixty-three cases of this disease, fifty-six were males and only seven females. Aneurism so often follows a sudden violent shock, sustained either by the whole body or by a limb, and more especially by the sudden violent extension of a limb, as apparently to justify the common opinion that external violence is among the most frequent exciting causes of the malady.

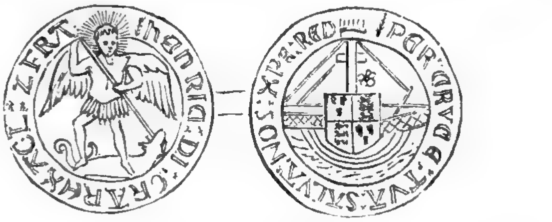
Excepting in the exceedingly rare case in which a spontaneous cure is effected, this disease, when left to itself, uniformly proves fatal by the ultimate rupture of the tumour, in consequence of which the patient expires either instantaneously, from the great and sudden loss of blood, or by degrees, from repeated losses of it.

The cure of aneurism consists in the obliteration of the preternatural cavity of the artery. The obliteration of this cavity is the sole object of the operation which is found to be the only sure and effectual mode of curing the disease. This operation consists in cutting down upon the artery and passing a ligature around it above its dilatation. The immediate effect of the ligature, of course, is to stop the flow of blood into the sac; its ultimate effect is to excite inflammation in the coats of the vessel, by which its sides, brought into close contact by the ligature, permanently adhere together, thus inducing an obliteration of the cavity of the vessel. The success of the operation depends entirely on the completeness of the adhesion of the sides of the vessel, and the consequent obliteration of its cavity. But this adhesion will not take place unless the portion of the artery to which the ligature is applied be in a sound state. If it be diseased, as it almost always is, near the seat of the aneurism, when the process is completed by which the ligature is removed [INFLAMMATION], hæmorrhage takes place, and the patient dies just as if the aneurism had been left to itself. For a long time, surgeons were in the habit of applying the ligature as close as possible to the seat of the aneurism; they laid open the aneurismal sac in its whole extent, and scooped out the blood contained in it. The consequence was that a large deep-seated sore, consisting of parts in an unhealthy state, was formed; and it was necessary to the cure that this sore should suppurate, granulate, and heal,—a process which the constitution was frequently unable to support. Moreover, there was a constant danger that the patient would perish from hæmorrhage, through the want of adhesion of the sides of the artery. The profound knowledge of healthy and of diseased structure, and of the laws of the animal economy by which both are regulated, which John Hunter had acquired from anatomy, suggested to this eminent man a mode of operating, the effect of which, in preserving human life, has placed him high in the rank of the benefactors of his race. This consummate anatomist saw that the reason why death so often followed the common operation, was because a process essential to its success was prevented by the diseased condition of the artery. He observed that while the vessel close to the aneurism was always diseased, at some distance from the aneurism it was in a sound state: it occurred to him, that if the ligature were applied to this distant part, that is, to a sound instead of a diseased portion of the artery, the process necessary to the success of the operation would not be counteracted. But to this there was one capital objection, namely, that it would often be necessary to apply the ligature around the main trunk of an artery, before it gives off its branches, in consequence of which the parts below the ligature would be deprived of their supply of blood, and must therefore mortify. He was well acquainted with the facts of the anastomosis of the blood-vessels. [ANASTOMOSIS.] Reflecting on the number and freedom of the communications of the arterial tubes, he conceived it possible that a limb might receive a sufficient supply of blood to maintain its vitality through the medium of its collateral branches only. For an aneurism in the ham, he therefore boldly cut down upon the main trunk of the artery which supplies the lower extremity, and applied a ligature around it, where it is seated near the middle of the thigh, in the confident expectation that though he thus deprived the limb of the supply of blood which it received through its direct channel, it would not perish. His knowledge of the processes of the animal economy led him to expect that the force of the circulation being thus taken off from the anueurismal sac, the progress of the disease would be stopped; that the sac itself, with all its contents, would be absorbed; that by this means the whole tumour would be spontaneously removed, and that an opening into it would be unnecessary. The most complete success followed this noble experiment; and the sensations which this philosopher experienced on witnessing the event constituted an appropriate reward for the application of profound knowledge to the mitigation of human sufferings. After Hunter followed Abernethy, who treading in the footsteps of his master, for an aneurism of the femoral, placed a ligature around the external iliac artery; lately the internal iliac itself has been taken up, and surgeons have tied arteries of such importance, that they have been themselves astonished at the extent of their success.

Within the last few years the method of curing aneurism by pressure has been revived, and it has been so successful and free from dangerous results that the majority of surgeons have recourse to this method before hazarding the operation of tying the artery. The pressure is applied to the artery at the most accessible point above the aneurism, and in such a manner, as to prevent excessive pain, excoriation, or ulceration of the skin. In order to effect this, compresses of various kinds have been employed—that invented by Dr. Carte is regarded as the most efficient. This operation requires time, and the patient is kept quiet, and submitted to such a course of treatment as is likely to assist generally in obtaining the desired result. Although treatment by pressure has always been occasionally employed, this treatment in modern times was not adopted successfully till 1825, when a successful case occurred in the practice of Mr. Todd, of Dublin. In 1846, twenty-nine cases of femoral and popliteal aneurism had been thus treated, and twenty-five had been cured. Since that time a large number of cases have been treated, both in this country and the United States of America, and the result has been such that no surgeon would now feel himself justified in tying the artery without first having recourse to the method of treatment by pressure, in those cases in which it can be had recourse to.

In some aneurisms, neither operation nor pressure can be applied. In these cases, everything must be done to diminish the current of blood through the aneurismal sac, and facilitate a natural cure. Unfortunately, such cures are rare, but they are frequent enough to warrant the medical practitioner in employing such a course of treatment as is dictated by the nature of the case.

ANGEL (COIN). Dr. Johnson defines it as "a piece of money anciently coined and impressed with an angel, in memory of the observation of Pope Gregory, that the pagan Angle, or English, were so beautiful, that, if they were Christians, they would be Angeli, or Angels." But we must remark that Pope Gregory's observation was made in the 7th century, and the coin called the angel was not struck in England till the middle of the 15th century. The angel was originally a gold coin of France, where it was first coined, at least by that name, in 1340. (See Ducange *voce* Moneta, and Le Blanc, 'Traité Hist. de Monnoyes de France,' 4to Amst. 1692, p. 207.) In France, where it was soon followed by the half and quarter angel, it was always of fine gold, but not always of the same weight. It appears to have been introduced, with its minor divisions, into England by Edward IV., in 1465 (see Leake, pp. 150—164), and was continued as a coin by King Henry VI., when he returned to the throne. We give a representation of the angel of Henry VI. When first introduced, the angel was rated



Angel Coin of Henry VI.

in value at 6*s.* 8*d.*, and being of the same value as the noble, was sometimes called the noble angel. This value was continued at Henry VIII.'s first coinage of gold. In the coinage of that king's latter time, the value was raised to 8*s.*, and so continued through the reign of Edward VI. Queen Mary's angel went for 10*s.*, which value continued to the end of the reign of Charles I., the last of our kings who coined the angel. So base was Henry VIII.'s gold coinage of this money that Stow, in his 'History of London,' says, "I have seen 21*s.* given for an old angel, to gild withal." Queen Elizabeth (according to Nicolson's 'Historical Library,' p. 267, from Fynes Moryson's 'Itin.,' part i. lib. 3, cap. 6), in the forty-third year of her reign (1600—1601), contracted, not only for the coining of angels, and their usual divisions, but for pieces of an angel-and-a-half and three-angels, of the finest angel gold; but it is presumed that the contract for these larger pieces was never completed, as no such coins have ever been seen by our collectors. The usual device on the obverse of the angel was the figure St. Michael standing upon the dragon, and piercing him through the mouth with a spear, the upper end of which terminated in a cross, or cross-crosslet. The reverse of the earlier ones had a ship, with a large cross for a mast, with the royal arms in front. The angels of James I. and Charles I. have the mast of the ship with a main-top, and no cross. The obverse had the king's titles surrounding the device. The reverse, from Edward IV. to Edward VI., bore the inscription 'PER CRVCEM TVAM SALVA NOS CHRISTE REDEMPTOR.' The reverses of the angels of Philip and Mary, Elizabeth, and James I., bore, partly at length and partly abridged, the sentence, 'A DOMINO FACTVM EST ISTVD ET EST MIRABILE [IN OCVLIS NOSTRIS.'] Charles I.'s angel had on the reverse, AMOR POPVLI PRÆSIDIVM REGIS. Folkes (pl. xiii. of his 'Gold Coins') has engraved a piece in silver, struck from the reverse only of a die, intended for an angel by King Charles II., but never coined; with the same inscription on the reverse as his father's angel. The only distinction by which the angels of Henry VI. are known from those of Henry VII. is that in the former the archangel Michael stands with his left foot upon the dragon; in the latter, the angel stands with both feet upon the dragon. In the collection of Lord Pembroke there is a six-angel piece; but it is not certain that it was intended for a coin. The angelets of Edward IV., and to Henry VIII., have on the reverse, O CRVX AVE SPES VNICA. The angelets of Edward VI. have the same inscription on the reverse as the angel.

ANGELIC ACID ($C_{10}H_8O_4$). *Sumbulic acid.*—Found in the roots of several species of Angelica, and obtained also by the action of hydrate of potash upon essence of camomile. It crystallises in large striated colourless prisms, which are anhydrous; they possess a peculiar aromatic odour, and an acid taste. Angelic acid fuses at 113° Fahr. and boils at 374°, distilling without decomposition. It is easily soluble in alcohol, ether, oil of turpentine, and fixed oils. Heated with caustic potash it yields acetate and propionate of potash, evolving hydrogen.

$$\underbrace{C_{10}H_8O_4}_{\text{Angelic acid.}} + 4HO = \underbrace{C_4H_4O_4}_{\text{Acetic acid.}} + \underbrace{C_6H_6O_4}_{\text{Propionic acid.}} + H_2$$

Angelic acid is monobasic, and forms an extensive series of salts which are generally very soluble in water and in alcohol. It also unites with oxide of ethyl, forming angelic ether.

ANGELIC ETHER. [ANGELIC ACID.]

ANGELICINE, a non-azotised vegetable substance found in Angelica root (*Angelica Archangelica*).

ANGER (according to Aristotle, 'Rhetor.' b. ii., c. 2.) *is a desire of revenge, accompanied with pain, on account of an apparent slight improperly offered to a person or some one connected with him.* From this definition it appears, first, that in order to excite the passion of anger it is necessary that a slight should be offered; and secondly, that the slight produces a desire of revenge, which is painful until it is either gratified or assuaged. A slight is an act or forbearance by which a man appears to indicate his opinion that another person is not worthy of notice; and it may be shown both in active and passive conduct; actively, as when a person insults, reviles, ridicules and banters, or annoys, vexes, and teases another: passively, as when a person omits the marks of attention and respect which an inferior owes to a superior, or an equal to an equal, or when he treats another with contempt. In the cases of abuse, insult, and unseemly or misplaced ridicule, as well as where there is a scornful indifference or want of respectful behaviour, the pain is caused by the undue assumption by which an equal appears to make himself a superior, and an inferior an equal. Hence it is (as an ancient historian has remarked) that men care more for insult than injury; as the one seems to be the aggression of an equal, for his own profit; the other to be the insolence of a superior, arising from spite or mere wantonness. On a similar reason was founded the advice of Bernadotte to Louis XVIII., that France was to be governed with an *iron hand*, and a *velvet glove*: a remark capable of a much wider extension. In the cases of annoyance and vexation, the pain of the person angered is caused by the feeling that the object of the other party is purely to give pain, without any advantage accruing to himself.

The pain excited by the slight is instantly followed by a desire of *revenge*. The desire of revenge is not a general desire that ill may come to the person offering the slight, but a desire of personally paining him, so that he may know by whom the pain is inflicted, and the person angered may have the gratification of being himself the executioner of his own retribution. The satisfaction of the desire of vengeance is always pleasurable, and in brutal and uncultivated minds is attended with all the marks of the most triumphant exultation. So strong indeed is the temptation of gratifying this craving after retaliation, when the means of indulging it are in our power, and so great the difficulty of foregoing the pleasure which it affords, that Shakspere enumerates among the rare instances of female perfection—

> "She who being angered, her revenge being nigh,
> Bids her wrong stop, and her displeasure fly."

No angry person, however, would feel his desire of revenge satisfied by learning that the object of his anger has suffered some grievous calamity, as that he has lost a near relation or a large sum of money; he wishes that the pain should be inflicted *in return* for the slight shown to him, and by *his own* agency. Anger, therefore, is different from hatred; the one is a passion which is commonly extinguished by the lapse of time, even if the desire of vengeance is not satisfied; the other is a settled habit of the mind which never varies: the one is attended with pain, the other is without pain. Anger is always personal, and is felt only towards individuals: hatred is often general, and embraces not only individuals, but whole classes, as murderers, tyrants, heretics, &c. There are even *national* hatreds, and misanthropy is a hatred of the *whole human race*. Anger is often satisfied with a slight infliction of pain, whereas hatred desires nothing less than the extinction of the persons hated; hence pity is consistent with anger, but never with hatred. Anger seeks to inflict pain; hatred desires to do harm. Anger requires a personal retaliation, hatred is pleased that harm should come to the person hated, from whatever quarter, and by whatever means. (See Aristot. 'Rhet.,' b. 2. c. 4.)

As anger is a bad passion, the object of which is the infliction of pain, it ought to be restrained; and one of the most important parts of moral discipline is the proper regulation of the desire of revenge which characterises it. The proper government of this passion consists not in altogether suppressing it, which is indeed impossible, as every person must feel pained at an undeserved slight, but in repressing the desire of vengeance to which that pain gives rise. It is a rule, to which every exception should be questioned with the utmost jealousy, that in a political society all vengeance for vengeance sake is immoral. This, however, does not prevent a person from showing *his displeasure* at an improper slight: so that the reproof be given without animosity, and arise from a desire of preventing future affronts or vexation, not of satiating a thirst for revenge.

Although anger is a bad passion, and in a state of civil society its effects are much oftener hurtful than beneficial, its *use* (or, as it is sometimes said, its *final cause*) is not the less obvious. In a state of nature, before the institution of government, if instead of men being prompted by the constant and violent influence of a passion to retaliate harm for harm, the retribution of wrongs had been left to the irregular operation of cool reason, it may be doubted whether the collision of interest and the mutual resistance which arose from each man being the avenger of his own cause, and which were the origin of political government, would ever have existed. Hence revenge (as Lord Bacon has said) is a sort of wild justice; that is, in a society where there is no administration of law, it takes the place of legal justice: and it is better that wrongs should be avenged than that they should be done with entire impunity. In the barbarous states of society which have prevailed at different times in Arabia, Greece, Germany, Scotland, and other countries, the imperfect security of person which existed was owing chiefly to the duty of revenge imposed by traditionary feelings and opinions on the family of a murdered person. But when the exercise of sovereign political power is once firmly established, together with an efficient administration of law by regular judicatories, the use of revenge, as an instrument for the suppression of wrongs, has ceased, and it must give place to a far better substitute. The good, says the French proverb, is the enemy of the better; and on this principle, a political society, both in its legal and moral code, must discard that instrument to which it may, indeed, in great measure, owe its *existence*, but which is incompatible with its *continuance* in a state of happiness and tranquillity. The private retaliation of wrongs is the scaffolding by means of which the structure of civil society was erected, but which disfigures its beauty and impairs its utility when completed. [PUNISHMENT.]

ANGI'NA PE'CTORIS, literally, "a contraction or tightening of the chest," a disease so named from the anguish felt in the chest. This disease is characterised by a sudden attack of severe pain in the lower part of the chest, commonly inclining to the left side; the pain is sometimes so severe, that the patient feels as though he must die: the pain generally extends to the left arm, and occasionally also to the right: it is often attended with a sensation of fainting or of suffocation, and with palpitation of the heart; but frequently these latter symptoms are absent; the pulse is commonly quick, weak, irregular, or intermittent, though sometimes it is little affected; the countenance is commonly pallid, and the expression anxious and depressed. This attack comes on in paroxysms, which last from a few minutes to half an hour and more. There is no regular interval between the paroxysms, and no distinct warning of their return. They usually come quite suddenly, from slight causes, and often when no cause can be assigned. The health at first is tolerably good during the intervals, but in the progress of the disease a great variety of uneasy sensations distress the patient even when the paroxysm is absent, chiefly those which indicate a disordered state of the digestive and respiratory organs.

Much investigation has been instituted to ascertain the seat and nature of this disease; and although physicians are not yet unanimous in their opinion in regard to either, yet sufficient evidence has been accumulated to determine both with a high degree of probability. It seems upon the whole to be established that it is primitively a nervous affection, and that the nerves in fault are those which supply the lungs and heart,—the lungs, in consequence of the disease of its nerves, being unable perfectly to decarbonise the blood, and the heart, in consequence of the disease of its nerves, not being duly nourished, and consequently not being able to carry on the circulation with the requisite energy and regularity. On inspection of the organs after death of those who perish by this disease, in the immense majority of cases appreciable disease is discoverable both in the lungs and in the heart, but more especially in the latter. The most frequent morbid appearances in the heart are ossification of the coronary arteries (the nutrient arteries of the organ); ossification of the valves of the heart; preternatural accumulation of fat on its external surface; enlargement of its cavities; and, above all, change of structure in its muscular substance, which becomes pallid, soft, flabby, thin, and easily torn. This change in the muscular substance of the heart is by far the most constant morbid appearance; but even this, as well as the other organic changes, must be considered as the effect rather than the cause of the disease, in whatever degree these organic changes may be the cause of death.

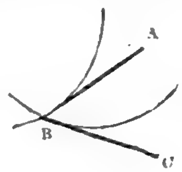
Angina pectoris is most frequent at the meridian of life and beyond it; it may occur in adolescence, but it is very rare at that period. It is much more frequent in the male than in the female. Out of one hundred cases, seventy were upwards of fifty years of age, and seventy-nine were males. It is remarkably under the influence of mental causes, if it be not in the first instance induced by them. When it has once occurred, a paroxysm is readily produced by any emotion, whether of a pleasurable or a painful nature, but more especially by the latter. Anxiety of mind, any depressing passion, or anger, places a person subject to this disease in the most imminent danger. Many persons have died suddenly, instantaneously, under the influence of such emotions. There is conceived to be a close connection between this disease and gout. Without doubt it is very often found in persons who are subject to gout, and the less the gout affects the extremities, in its regular and decided form, the more frequently and severely such persons suffer from angina pectoris.

It is of the nature of this disease to proceed progressively from bad to worse. At first it is a temporary evil of short duration, recurring perhaps only at distant intervals; but if it be neglected, the intervals become shorter and shorter, and the paroxysms more and more severe. Complete success often attends the early, active, and judicious treatment of it. This, therefore, is eminently one of those diseases, the first accession of which should excite serious alarm, and induce every one to adopt without delay, and with the greatest regularity, the means best fitted to prevent the recurrence of it.

Those means are, in the paroxysm, absolute rest. The paroxysm often comes on in walking or during some bodily exertion: the patient has the feeling that the continuance of such exertion would prove instantaneously fatal; and it is really highly dangerous. Unless in very severe cases, the paroxysm usually goes off spontaneously, in a few minutes, on sitting perfectly still, or, which is often better, on lying down. If the pain do not quickly subside, vigorous friction with a stimulating liniment should be applied over the whole chest, and the patient should instantly take some warm antispasmodic and stimulant medicine, such as two ounces of the camphor julep, with a dram of ether or of the aromatic spirit of ammonia. But much more active measures may be necessary; and this is a disease so serious in its nature, and requiring so much delicacy and skill in the management of it, that the patient ought to place himself under the best medical guidance he can procure as quickly as possible. It is during the interval that the most effectual treatment must be employed. It is impossible to discuss here the remedies which the physician should resort to, the reasons which should determine his choice, and the different states which should modify the treatment in adaptation to individual cases. But it is very important to state, that angina pectoris is one of those diseases in which the concurrence of the patient with the efforts of the physician is indispensable. Unless the patient resolve and firmly adhere to his resolution strictly to conform to the plan prescribed in diet, in exercise, in every locomotive movement, in sleep, temperature, and medicine, but above all in the regulation of the mind, the physician can do but very little for him.

ANGLE OF CONTINGENCE, or CONTACT, the opening made by a curve and its tangent. [CURVATURE.]

ANGLE (CURVILINEAR), the rectilinear angle made by the tangents of two curves at the point where they meet, as A B C.



ANGLE (HORARY), the angle formed with the meridian of any place by a great circle, which passes through a star and the pole.

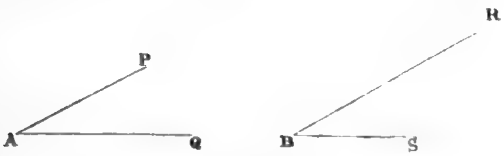
ANGLE OF INCIDENCE, REFLECTION, REFRACTION, ELONGATION, ELEVATION, THE VERTICAL.—See these several terms.

ANGLE, PLANE, SPHERICAL, SOLID, PARALLACTIC.—See these terms.

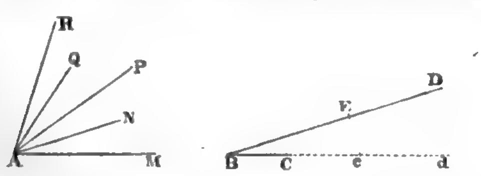
ANGLE OF POSITION, usually the curvilinear angle made by two great circles drawn through a star to the poles of the ecliptic and equator. It may be used to signify the angle made by lines drawn from any point under consideration to any two points which are used in determining the *position* of others.

ANGLE (RECTILINEAR), from the Latin word *angulus*, of the same signification. The notion (for it can hardly be called definition) is, the *opening* made by two straight lines which cut one another. The term *inclination* is also used synonymously with angle; thus, the angle or opening of two lines is called their inclination to one another.

To investigate a more precise definition for this word, we must recollect that any species of relation is entitled to the term *magnitude*, and becomes the object of arithmetic or geometry, so soon as it can be shown that the notion implied in one or other of the words equal, greater, or less, is always derivable from the consideration of two such relations. Take the two angles or openings made at the points A and B by the straight lines A P and A Q at A, and by B R and B S at B, and transfer the first figure to the second, so that the point A shall fall upon B, and the straight line A Q upon B S; or rather, let as much of A Q as is equal to B S fall upon B S, and let the remainder of A Q form a continuation of B S: also let A P and B R be made to lie

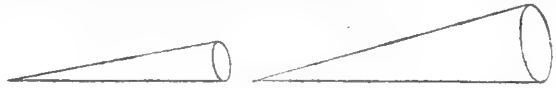


upon the same side of B S. We have now no longer any control over the position of A P with respect to A Q, since the first figure is not to undergo any change except that of simple removal into another position. If, after A Q has been placed upon B S, A P then fall upon B R, the two openings or angles at A and B are the same. If A P, in its new position, fall between B S and B R, the opening or angle at A is less than that at B; and if A P fall further from B S than B R does, the angle at A is greater than that at B. The angle at A is called the angle P A Q, and that at B, the angle R B S. Hence the notion of one angle being twice or three times, &c., as great as another may be fixed. For example,



the angle M A P being made up of the two M A N and N A P, each of which is equal to the angle D B C, is twice D B C; the angle Q A M is three times D B C; R A M is four times D B C; and so on. Similarly, the angle D B C is one-half of P A M, one-third of Q A M, &c. The angle made by two lines does not depend upon the length of these lines; if a part D E be cut off from B D, the angle is not altered, that is, the angle E B C is the same as D B C. If B e and B d be respectively equal to B E and B D, and if B C e d turn round B, the same *quantity of turning* which brings B e into the position B E, will bring B d into that of B D.

When we cast our eyes on two angles, the sides containing which are nearly equal in both, we judge of their comparative magnitude by the spaces which are included between the lines. But this is is not a notion capable of being rendered rigorous, because one boundary of the space is indefinite. Nevertheless we may correct this method of judging, and produce a precise idea of an angle, *if* we admit the propriety of comparing with one another spaces which are absolutely infinite in extent. The longer the lines are, the more nearly is the preceding notion absolutely correct, because the space at and near the



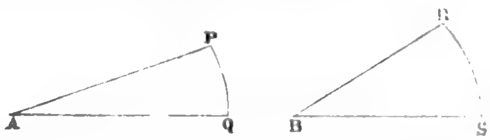
mouth of the angle, which for want of a definite boundary is doubtful as to whether it is or is not to be considered a part of the angular opening, becomes less and less with respect to that about which there is no doubt. If then we suppose the lines which contain the angle to be produced without end, the infinite spaces so imagined will be correctly in the same proportion to one another as the angles. The objection to introducing this into geometry is the real or supposed want of rigour in the comparison of unbounded spaces. [INFINITE.] It must be remarked, however, that the disputed theory of parallels follows immediately and rigorously from the preceding (see 'Library of Useful Knowledge,' Study of Mathematics, pp. 77, 78; and Lacroix, 'Elémens de Géométrie,' p. 23, note), and it is therefore in the choice of every person to decide for himself whether he will *add* the words in italics to the first of the two following axioms, and *prove* the second, or *omit* the words in italics, and *assume* the second.

1. Two spaces, *whether of finite or infinite extent*, are equal when the one can be placed upon the other, so that the two shall coincide in all their parts.

2. Through a given point, not more than one parallel can be drawn to a given straight line.

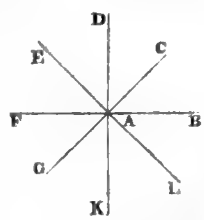
In order to bound the preceding spaces, and compare angles by means of spaces or lines, it is necessary to draw arcs of circles having equal radii through the two points.

Let P Q and R S be arcs of circles having the equal radii A Q, B S.



Then the angles P A Q and R B S are in the same proportion as the spaces (called *sectors*) P A Q, and R B S, and also as the lengths of the arcs P Q and R S. This proposition, which is Euclid, vi. 33, is not so far from first principles as its position would appear to indicate. For the fifth book, on proportion, is entirely independent of, and might be considered as antecedent to, the first four books: if this were supposed, the preceding proposition might be easily made to follow book i. 23, or even i. 8. We might even place it immediately after the doctrine of proportion, by a proof founded on simple superposition, provided we assume (what is tacitly assumed in various parts of the first book of the elements, i. 4, for example) that an angle may be conceived equal to another angle before we know how to construct equal angles.

If a line setting out from A B be conceived to revolve round the point A, it will in every position form two openings or angles with its original position A B. For example, in the position A C, A B and A C will form the smaller angle B A C, and the larger angle made up of the angles C A F, F A K, and K A B. Only the former of these is usually considered in geometry, but the latter is frequently used in analysis. When half a revolution has been made, and A B has come to A F, at first sight we might say there was no angle formed; but on looking at the preceding position A E, we see that the opening of B A and A F is greater than that of B A and A E. The half of this opening B A F, that is, B A D, is called a right angle. A whole revolution makes A B pass through four right angles, and, in analysis, if we wish to point out that the line A C is supposed to have made a complete revolution, and to have come into the position B A C for the second time, the angle made with A B is said to be



4 right angles + B A C

An *angle* is the opening of two lines; *rectilinear*, of two straight lines; *curvilinear*, of two curves; *mixtilinear*, of a straight line and a curve. But, in truth, angle always means rectilinear angle; and when a curve enters, its tangent is the straight line which is used in determining the angle.

A *right* angle is half the opening of a straight line and its continuation;

an *acute* angle is that which is less than a right angle; an *obtuse* angle is that which lies between one and two right angles. *Complemental* angles are two which together make a right angle; *supplemental* angles are two which together make two right angles. Two lines which meet and make a pair of angles, one less than two right angles, are called *salient;* the other greater than two right angles, are called *re-entrant*, or *re-entering*. None but salient angles are mentioned by Euclid. For salient and re-entering (which are borrowed from fortification), *direct* and *retroflected* have sometimes been used.

The angles which two lines make with the same part of a third, on opposite sides of it, are called *alternate*. Two lines which cross one another make two pair of *vertically opposite* angles. The angles made by adjacent sides of a figure are called *internal;* those made by any sides with adjacent sides produced are *external*. When the angular point is the centre or on the circumference of a circle, the *angle* is said to be *at* the centre, or *at* the circumference. Beginners often confound the angle with the angular point.

The angle of *contingence* or of *contact* is an old notion of the opening made by two curves, or a curve and a line, which touch. In modern mathematics, when a curve is supposed to be composed of infinitely small rectilinear elements, the infinitely small acute angle made by one element with the production of the next does duty for this old angle of contingence.

A *spherical* angle is made by two circles (usually great circles) of a sphere. When the circles meet at the pole of the equator, and one of them is the meridian, the angle is an *horary* or *hour-angle;* and when neither is the meridian, the angle is frequently called *horary*. The *angle of position* of a star is that made by the circles drawn to it from the poles of the equator and ecliptic. The angle of *elevation* is the angle made by a line drawn from the eye to any object with the horizontal line which is in the same vertical plane as the first line; but when the object is below the horizon, the term is angle of *depression*. When lines are drawn from two points to a third, those two points, and also the line joining them, are said to *subtend* the angle which is made at the third point. The angle which two objects subtend at the eye is their angle of *elongation*. The *angle of the vertical* is a name given to the angle which a line drawn to the spectator's zenith makes with his radius of the earth produced: it is taken as nothing when the earth is supposed to be a perfect sphere. Angular terms, such as right ascension, longitude, &c., with which the word angle is not usually coupled, are not considered here. The *parallactic* angle is simply the PARALLAX.

When one line falls upon another, the angle of *incidence* is the acute angle which the incident line makes with the perpendicular to the other. When the incident line is thrown off again on the same side as that from which it came, the acute angle made with the perpendicular is called the angle of *reflexion;* when on the opposite side, the angle of *refraction*. These terms are nearly confined to optics.

A *dihedral* angle is the opening made by two planes. It is measured by a rectilinear angle, namely, that made by two lines drawn in the two planes perpendicular to their common intersection. But the rectilinear measure is not the same thing as the dihedral angle, though the two are often confounded. We might just as well say that the pressure of the air is the same thing as the number of inches in the barometrical column of mercury.

A *solid* angle is said to exist when three or more straight lines, not in the same plane, meet at a point. It is a complex idea, and the best notion of it as a magnitude is derived from considering it as measured by the area of the spherical triangle which subtends it.

For the most important properties of angles see TRIANGLE; PARALLEL; POLYGON; TRIGONOMETRY.

The methods of measuring an angle, of which we think it necessary to take notice, are three in number. The first is the one universally employed in *theoretical* investigations, and is as follows:—in the last figure but one, the number which expresses what proportion the arc P Q is of the radius, is the number chosen to represent the angle. It is shown in geometry that if any number of arcs be drawn with the centre A, subtending the same angle P A Q, what part soever any one of them is of its radius, the same part is any other of *its* radius; that is, whatever circle may be chosen, the preceding measure gives the same number for the same angle. For example, if the arc P Q be equal to the radius, the angle P A Q is the angle 1. If P Q be two-thirds of the radius, the angle P A Q is the angle $\frac{2}{3}$. The unit of this measure is therefore the angle whose arc is equal in length to its radius. It is customary to say that an angle or arc (for the terms are frequently confounded) thus measured, is given in parts of the radius; but this expression does not convey much meaning, and we cannot propose any better, unless it might be judged proper to say it is measured in *theoretical* units, meaning thereby, in the units which are always employed in pure theory; or in *arcual* units, derived from use of the arc. The *theoretical* or *arcual* unit would then be the angle subtended by the arc which is equal to its radius.

The semi-circumference of a circle contains its radius,

3·14159, 26535, 89793, 23846

times, very nearly. This is then the number of theoretical units contained in two right angles. The right angle is therefore

1·57079, 63267, 94896, 61923,

and the following are the angles of one degree, one minute, and one second, to which we shall presently come:

·01745, 32925, 19943, 29577 degree
·00029, 08882, 08665, 72160 minute
·00000, 48481, 36811, 09536 second.

In the second measure, in which angles are said to be measured in *space* (the word space being here opposed to *time*, as we shall see, and not to *length*), the whole angle traced out in one revolution, equal to four right angles, is divided into 360 equal parts, each of which is called one *degree*, and marked thus, 1°. Each degree is divided into 60 equal parts, each called one *minute* (1′), and each minute into 60 equal parts, each called one *second* (1″). Formerly, the second was divided into 60 equal parts called *thirds*, and so on; but it is now usual to use the tenths, hundredths, &c., of seconds. The present table therefore stands thus:

A whole revolution = 360° = 21,600′ = 1296,000″
A right angle = 90° = 5,400′ = 324,000″

Degrees.	Minutes.	Seconds.
1	60	3600
	1	60

To convert an angle from *theoretical units* into *degrees, &c., of space*, observe that the last-mentioned unit is

206264″·806247096355 in seconds
3437′·746770784939 in minutes
57°·295779513082 in degrees

and multiply the number which expresses the angle in theoretical units by the one among the preceding numbers which has the same denomination as that to which the angle is to be reduced. As many decimals may be taken as shall be considered necessary. The following table however will be found more convenient:

	Degrees.	Minutes.	Seconds.
1	·05729578	·03437747	·020626481
2	·11459156	·06875494	·041252961
3	·17188734	·10313240	·061879442
4	·22918312	·13750987	·082505922
5	·28647890	·17188734	·103132403
6	·34377468	·20626481	·123758884
7	·40107046	·24064227	·144385364
8	·45836624	·27501974	·165011845
9	·51566202	·30939721	·185638325

EXAMPLE. What number of minutes and decimals of minutes does the angle contain which expressed in theoretical units is 1·7906?

From the minutes' column take out the rows opposite to 1, 7, 9, and 6; write them so that the first figure of each shall fall under its corresponding figure in 1·7906, and add, but take only so many out of each row as will serve to fill up the places under the first row, increasing the last figure of each broken row by 1, when the first neglected figure is 5 or upwards:

1·7906
―――――
03437747
2406423
309397
2063
―――――
06155630

Place the decimal point *three* places off the unit's column for *degrees*, *five* for *minutes*, and *seven* for *seconds*. This gives 6155′·630, since the present calculation is made for minutes. Further to illustrate the placing of the decimal point, let the angle theoretically expressed be ·096, to be turned into degrees and decimals of degrees, and afterwards to seconds and decimals of seconds:

0· 096
51566202
3437747
―――――
0 055003949

Bring down the preliminary cyphers, and *then* cut off three places, which gives 5°·5003949. Again for the seconds:

0· 096
185638325
12375888
―――――
0 0198014213

Cut off *seven* places, which gives 19801″·4213.

Given an arc of a circle and the radius to determine the degrees, minutes, or seconds in the angle at the centre; divide the arc by the radius, and proceed with the quotient as above.

For the converse problem, given the degrees, minutes, and seconds in an angle, to express the same in theoretical units, the following table is given :—

	Degrees.	Minutes.	Seconds.
1	·01745329	·00029089	·00000485
2	·03490659	·00058178	·00000970
3	·05235988	·00087266	·00001454
4	·06981317	·00116355	·00001939
5	·08726646	·00145444	·00002424
6	·10471976	·00174533	·00002909
7	·12217305	·00203622	·00003393
8	·13962634	·00232710	·00003879
9	·15707963	·00261799	·00004363

EXAMPLE.—It is required to express in theoretical units the angle 89° 52′ 34″. Take out the row corresponding to each figure from the column having the same denomination, taking seven places only for a unit's figure, and the whole eight places for the tens, increasing the last figure when necessary, as before: add and make seven decimal places.

For 80°	1·3962634
.. 9°	·1570796
.. 50′	0·0145444
.. 2′	·0005818
.. 30″	0·0001454
.. 4″	·0000194
	1·5686340

and the answer is 1·5686340.

Given any angle and a radius, required the circular arc subtended by that angle; proceed as above, and then multiply by the radius. Thus, to a radius of 100 feet, the arc which subtends an angle of 89° 52′ 34″ is

$$1 \cdot 5686340 \times 100 \text{ or } 156 \cdot 86340 \text{ feet.}$$

In the attempt to effect a universal change of weights and measures, which followed the French Revolution, the circle was divided into 400 degrees, each degree into 100 minutes, each minute into 100 seconds, and so on. This innovation obtained only a partial introduction, and is now almost entirely abandoned. When used, it is customary in this country to distinguish the French degrees by the name of GRADES, and to denote one grade by 1°, or $1^{gr.}$ The convenience of this method, from its close affinity with the decimal system, is certainly great: for example, grades and decimals of grades, such as $12^{gr.}$ 1329 are converted into grades, minutes, and seconds, by mere separation of the figures: thus, $12^{gr.}$ 13′ 29″.

It is not necessary to give complete tables of reduction from the new French to the ancient system, as they would so seldom be useful; the following is all that is necessary :—

1^{gr} is 0°·9 or 54′ or 3240″
1′ „ 0 ·009 „ 0′·54 „ 32″·4
1″ „ 0 ·00009 „ 0′·0054 „ 0″·324

The third method of measuring angles, in which they are said to be measured in *time*, is confined to astronomy, and is derived from the complete apparent revolution of the heavens which takes place in 24 hours. That is, if a line revolve round a point at the rate of a whole revolution in 24 hours, or a right angle in 6 hours, the times of moving through different angles are made the measures of their comparative magnitudes. Thus 4^h 32^m 60^s is the angle moved through in 4 hours, 32 minutes, and 60 seconds. The following tables are useful in turning angles measured in degrees, &c., of space into the corresponding measures in time, and the converse:

TIME INTO SPACE.					SPACE INTO TIME.				
Hours.	°	Min. / Sec.	° / ′	′ / ″	° / ′	h. / m.	m. / s.	″	s.
1	15	1	0	15	1	0	4	1	0·067
2	30	2	0	30	2	0	8	2	0·133
3	45	3	0	45	3	0	12	3	0·200
4	60	4	1	0	4	0	16	4	0·267
5	75	5	1	15	5	0	20	5	0·333
6	90	6	1	30	6	0	24	6	0·400
7	105	7	1	45	7	0	28	7	0·467
8	120	8	2	0	8	0	32	8	0·533
9	135	9	2	15	9	0	36	9	0·600
10	150	10	2	30	10	0	40	10	0·667
11	165	20	5	0	20	1	20	20	1·333
12	180	30	7	30	30	2	0	30	2·000
13	195	40	10	0	40	2	40	40	2·667
&c.	&c.	50	12	30	50	3	20	50	3·333
					60	4	0		
					70	4	40		
					80	5	20		
					90	6	0		
					100	6	40		
					200	13	20		
					300	20	0		

In these tables, where there are two headings, either the upper or under of both must be used. The following are examples:

To turn 18^h 11^m $35^s·3$ into degrees, &c., of space. From the first table:

10^h	is	150° 0′ 0″
8^h	„	120 0 0
10^m	„	2 30 0
1^m	„	15 0
30^s	„	7 30
5	„	1 15
$0^s·3$	„	4·5
18^h 11^m $35^s·3$	is	272°· 53′ 49″·5

To turn 97° 54′ 23″ into hours, &c. From the second table,

90°	is	6^h 0^m 0^s
7°	„	28 0
50′	„	3 20
4′	„	16
20″	„	1·333
3″	„	0·200
97° 54′ 23″	is	6^h 31^m $37^s·533$

In astronomy 30° is sometimes called a sign, in allusion to the arc of the ecliptic, through which one of the signs of the zodiac extends: Thus $2^{s·}$ 3° 4′ 12″ means 63° 4′ 12″.

The *angle* is distinguished from all other magnitudes whatsoever in a very remarkable way. It is the only magnitude which is a function of a number, and of which a number is a function. Let any one single magnitude, not angle, say a length, be presented: without reference to other magnitude, it is impossible to assign a number with which that length is necessarily connected, so that by merely giving the length, the number is deducible. But an angle, when given, determines ratios of lines, and so determines number. To one angle there is but one ratio of arc to radius, one sine, one cosine, &c., and all these are numbers. Consequently, a relation may exist between *one* angle and numbers; but the idea of a relation between one length and numbers is absurd.

ANGLE, TRISECTION OF. [TRISECTION.]

ANHYDRIDES, or ANHYDROUS ACIDS. A class of chemical compounds of great theoretical interest. They are represented both amongst organic and inorganic bodies, but it is especially the organic anhydrides discovered by Gerhardt, which, in conjunction with Williamson's compound ethers, have exercised so profound an influence upon the development of theoretical chemistry. The anhydrides bear the same relation to the hydrated acids as the ethers bear to the alcohols, and they may be regarded as formed from the hydrated acids, by the substitution in the latter, of a second equivalent of a negative radical for the remaining single equivalent of hydrogen, a transformation which will be more readily understood by reference to the following comparison:

Vinic alcohol.	Vinic ether.
$\left.\begin{matrix}(C_4H_5)\\ H\end{matrix}\right\}O_2$	$\left.\begin{matrix}(C_4H_5)\\ (C_4H_5)\end{matrix}\right\}O_2$
Acetic acid.	Acetic anhydride.
$\left.\begin{matrix}(C_4H_3O_2)\\ H\end{matrix}\right\}O_2$	$\left.\begin{matrix}(C_4H_3O_2)\\ (C_4H_3O_2)\end{matrix}\right\}O_2$

The organic anhydrides are best obtained by acting upon the potash salt of an organic acid by the chloride of a negative radical. Thus acetic anhydride is produced by distilling a mixture of solid and dry acetate of potash with chloride of othyl. The following equation represents the nature of the reaction:

$$\underset{\text{Acetate of potash.}}{\left.\begin{matrix}(C_4H_3O_2)\\ K\end{matrix}\right\}O_2} + \underset{\text{Cloride of othyl.}}{\left.\begin{matrix}(C_4H_3O_2)\\ Cl\end{matrix}\right\}} = \underset{\text{Anhydrous acetic acid.}}{\left.\begin{matrix}(C_4H_3O_2)\\ (C_4H_3O_2)\end{matrix}\right\}O_2} + \underset{\text{Chloride of potassium.}}{\left.\begin{matrix}K\\ Cl\end{matrix}\right\}}$$

The anhydrides are neutral bodies, generally liquid, although some are solid. In contact with water they are gradually re-converted into hydrated acids. Acted upon by ammonia they give either neutral amides or ammoniacal salts of amidated acids. The anhydrides may either contain two equivalents of the same negative radical, as acetic anhydride, or they may be formed by the juxtaposition of two different negative radicals as, for instance, aceto-benzoic anhydride, which contains both othyl ($C_4H_3O_2$) and benzoyl ($C_{14}H_5O_2$).

The organic anhydrides may be divided into two classes, namely, 1st, The anhydrides of monobasic acids; and 2nd, the anhydrides of bibasic acids. A third class would be formed by the anhydrides of the tribasic acids, but no organic compound of this class has yet been formed. The following is a list of the principal anhydrides hitherto obtained:

I. ANHYDRIDES OF MONOBASIC ACIDS.

Acetic anhydride	$\left.\begin{matrix}C_4H_3O_2\\ C_4H_3O_2\end{matrix}\right\}O_2$
Butyric	$\left.\begin{matrix}C_8H_7O_2\\ C_8H_7O_2\end{matrix}\right\}O_2$
Valeric	$\left.\begin{matrix}C_{10}H_9O_2\\ C_{10}H_9O_2\end{matrix}\right\}O_2$

Pelargonic	$\left.\begin{matrix}C_{18}H_{17}O_3\\C_{18}H_{17}O_3\end{matrix}\right\}O_2$
Angelic	$\left.\begin{matrix}C_{10}H_7O_3\\C_{10}H_7O_3\end{matrix}\right\}O_2$
Benzoic	$\left.\begin{matrix}C_{14}H_5O_3\\C_{14}H_5O_3\end{matrix}\right\}O_2$
Cuminic	$\left.\begin{matrix}C_{20}H_{11}O_3\\C_{20}H_{11}O_3\end{matrix}\right\}O_2$
Cinnamic	$\left.\begin{matrix}C_{18}H_7O_3\\C_{18}H_7O_3\end{matrix}\right\}O_2$
Salycilic	$\left.\begin{matrix}C_{14}H_5O_3\\C_{14}H_5O_3\end{matrix}\right\}O_2$
Aceto-benzoic	$\left.\begin{matrix}C_4H_3O_3\\C_{14}H_5O_3\end{matrix}\right\}O_2$
Cumino-œnanthylic	$\left.\begin{matrix}C_{20}H_{11}O_3\\C_{20}H_{11}O_3\end{matrix}\right\}O_2$
Valeroangelic	$\left.\begin{matrix}C_{10}H_9O_3\\C_{10}H_7O_3\end{matrix}\right\}O_2$

II. Anhydrides of Bibasic Acids.

Succinic anhydride	$\left.\begin{matrix}C_4H_2O_2\\C_4H_2O_2\end{matrix}\right\}O_2$
Lactic	$\left.\begin{matrix}C_6H_5O_2\\C_6H_5O_2\end{matrix}\right\}O_2$
Phtalic	$\left.\begin{matrix}C_8H_2O_2\\C_8H_2O_2\end{matrix}\right\}O_2$
Camphoric	$\left.\begin{matrix}C_{10}H_7O_2\\C_{10}H_7O_2\end{matrix}\right\}O_2$
Fumaric, or Maleic	$\left.\begin{matrix}C_4H\ O_2\\C_4H\ O_2\end{matrix}\right\}O_2$
Tartaric	$\left.\begin{matrix}C_4H_2O_4\\C_4H_2O_4\end{matrix}\right\}O_2$
Pyrocitric	$\left.\begin{matrix}C_5H_2O_2\\C_5H_2O_2\end{matrix}\right\}O_2$

ANHYDROUS ACETIC ACID. [Anhydrides.]

ANHYDROUS ACIDS. [Anhydrides.]

ANHYDROUS ANGELIC ACID. [Anhydrides.]

ANHYDROUS ACETO-BENZOIC ACID. [Anhydrides.]

ANILES. A name applied to certain organic chemical compounds, forming a sub-class of amides. They contain one equivalent of aniline, *plus* one equivalent of a bibasic acid, *minus* four equivalents of water. [Anilides.]

ANILIC ACID, *Indigotic acid, Nitro-salicylic acid* ($C_{14}H_5(NO_4)O_6$ + 2aq.). This acid is one of the numerous substances formed by the decomposition of indigo. It is procured by the long continued action of weak nitric acid on that substance. It is also formed by treating salicylic acid with fuming nitric acid. It is identical with nitro-salicylic acid. Anilic acid is a solid, fusible, and volatile substance, forming fine yellowish-white prisms, which shrink in drying. It combines with bases forming anilates. The anilate of the oxide of methyl may be obtained by the action of nitric acid on the oil of gaultheria, which is a salicylate of the oxide of methyl.

The solution of anilic acid is coloured blood red by persalts of iron. Concentrated nitric acid converts it into picric acid.

ANILIDATED ACIDS. [Anilides.]

ANILIDES. A sub-class of amides, which might also be termed *phenyl* amides, formed with aniline instead of ammonia. Gerhardt gives the following classification of the anilides:

Anilides corresponding to neutral salts.	*Anilides:* 1 atom aniline + 1 atom of a monobasic acid — 2HO.
	Dianilides: 2 atoms analine + 1 atom of a bibasic acid — 4HO.
Anilides corresponding to acid salts.	*Anilidated Acids:* 1 atom aniline + 1 atom of bibasic acid — 2 HO.
	Aniles: 1 atom aniline + 1 atom of a bibasic acid — 4HO.

ANILINE ($C_{12}H_7N$)—*Kyanol, Crystalline, Phenylamine, Phenamide, Benzidam.* Hofmann has demonstrated that the base obtained by Unverdorben, under the name of *crystalline*, from the products of the distillation of animal matter or coal tar, is identical with aniline. The same distinguished chemist has added largely to our knowledge of this substance. He has shown that *Isatine*, which is oxidised blue indigo, when treated with potash, yields aniline, and that chlorisatine and bromisatine, when treated in the same way, yield products of the type of aniline, in which hydrogen is replaced by chlorine, bromine, or both. Aniline assumes a deep violet colour when brought into contact with chloride of lime. It is remarkable for its power of entering into combination with other substances. Hofmann has obtained it from other substances besides isatine. When anthranilic acid is treated with powdered glass, it is resolved into carbonic acid and aniline. It may, however, be best prepared by the reduction of nitrobenzol by means of acetic acid and iron filings.

Salicylamide and *Nitrotoluole* both yield this substance when exposed to heat with the bases lime, or baryta. The first yields little, but the last compound is entirely resolved into aniline and carbonic acid. The following is a list of substances which are formed by the simple substitution of other elements for atoms of hydrogen in the aniline base:—

Aniline	$C_{12}H_7N$
Chloraniline	$C_{12}H_6ClN$
Dichloraniline	$C_{12}H_5Cl_2N$
Trichloraniline	$C_{12}H_4Cl_3N$
Bromaniline	$C_{12}H_6BrN$
Dibromaniline	$C_{12}H_5Br_2N$
Tribromaniline	$C_{12}H_4Br_3N$
Chlorodibromaniline	$C_{12}H_4ClBr_2N$
Nitraniline	$C_{12}H_6(NO_4)N$
Nitrodibromaniline	$C_{12}H_4Br_2(NO_4)N$
Ethylphenylamine	$C_{12}H_6(C_4H_5)N$
Diethylphenylamine	$C_{12}H_5(C_4H_5)_2N$

Chemically, these compounds are of the highest interest. In the case of bromaniline, and chloraniline, chlorine and bromine are substituted for hydrogen, and this was one of the first instances known of the substitution of other elements for hydrogen in a basic compound, although many instances have since occurred. It will also be observed from these compounds that aniline has a close resemblance to ammonia. This is seen also in the fact, that just as ammonia forms the compounds carbamide and oxamide, so aniline will yield under the same circumstances *carbanilide* and *oxanilide*. It also forms acid anilides, as carbanilic acid, analogous to carbamic acid. Hofmann has also made the discovery that just as cyanate of ammonia passes into urea, and the cyanate of methylamine into *methylo-urea*, so cyanate of aniline passes spontaneously into *anilo-urea*. In fact, the more recent researches of Wurtz and Hofmann have clearly established this close relationship between aniline and ammonia. For a full account of the chemistry of this highly interesting compound the reader should consult the papers of Dr. Hofmann, in the 'Philosophical Transactions,' and the 'Journal of the Chemical Society.' [Organic Bases.]

ANILOCYANIC ACID. *Carbanile, Cyanate of Phenyl* ($C_{14}H_5NO_2$). A liquid organic body obtained by the distillation of oxamelanile.

ANIMAL FOOD, PRESERVATION OF. [Antiseptics.]

ANIMAL MAGNETISM. [Mesmerism.]

ANIMAL STRENGTH. Information on this branch of mechanical philosophy will always be received with interest so long as it shall be found necessary to employ men or animals, either in conveying burdens or in giving motion to machinery, since by it the employer is enabled to ascertain what is the greatest quantity of useful work which may be obtained from such agents without subjecting them to a degree of fatigue which might in time prove injurious to their health or bodily powers.

As early as the year 1680, Borelli published a treatise, entitled 'De Motu Animalium;' and since that time the determination of numerical expressions for the amount of human and animal labour has occupied the attention of many distinguished mathematicians and experimentalists. It has been said that the strengths of different animals of the same species, or of the same animal at different times, are in a *triplicate* proportion of the quantities of their blood; the whole strength of an animal being the force of all the muscles taken together, which are directly nourished by the blood. If, however, the blood be so altered as to increase or diminish the strength, it amounts to the same as if the blood were in a natural state, but its quantity increased or diminished in the same proportion. M. de la Hire remarked that the strength of an ordinary man in walking, is only 27 lbs., but that this would be much greater, if he walked backwards. A horse draws, he says, horizontally, as much as seven men, that is, 189 lbs. But to none is this subject so much indebted as to Coulomb. The dynamical unit employed by Coulomb is one kilogramme (= 2·2055 pounds avoirdupois), which is supposed to be transported to a distance equal to one kilometre (= 0·6214 mile), and his expression for strength is the product of the number of kilogrammes in a burden by the number of kilometres in the distance in which the burden is conveyed during one working day of eight hours. For convenience, however, the unit of weight in this article, is one pound avoirdupois, and the unit of distance is one mile; so that the expression for strength is the product of the number of pounds by the number of miles to which they may be conveyed in one such day.

With respect to men, Coulomb found that when a man travels unloaded on level ground he can walk 31 miles daily. Now, assuming the weight of a man to be 160 lbs., we have 160 × 31 or 4960 for the measure of his strength or the quantity of action, which is, consequently, equivalent to that of a machine capable of carrying 4960 lbs. to a distance of one mile, or one pound to a distance of 4960 miles in one day.

He found also, from a mean of the work done by the porters of Paris, that with a burden equal to 128 lbs. a man can walk 9·72 miles in a day, from which it follows (the weight of a man being 160 lbs.) that the quantity of action is (160 + 128) × 9·72, or 2799. If the weight of the man be not included, the quantity of action is 128 × 9·72, or 1244; and this is to be considered as the useful effect. Subtracting 2799 from 4960, we have 2161 for the measure of the action, lost in consequence of the burden; but the useful effect, which in the first case was nothing, is in the second expressed by 1244.

By means of a formula, which was given by Euler, with the data afforded by these experiments, it is found that 272 lbs. constitute the greatest burden which a man of average strength can support, and under which he cannot move. It is found, moreover, that the useful effect is at a maximum when a man is loaded with 121 lbs.: under this burden he can walk 10½ miles, nearly, in a day; and consequently the greatest useful effect is expressed by 1250.

Coulomb further determined, that when a man ascends a convenient flight of steps unloaded, the vertical heights of all the ascents during one day being added together, were equal to 1·82 mile; the quantity of action may therefore be expressed by 160 × 1·82 or 291, as if the action were equivalent to that of a machine which could raise 291 lbs. to the height of 1 mile vertically, or one pound to the height of 291 miles during a day. When loaded with 150 lbs. the vertical height ascended was 0·494 mile: the whole quantity of action is, therefore, in this case (160 + 150) × 0·494, or 153, while the useful effect is 150 × 0·494, or 74; that is, 74 lbs. raised 1 mile vertically.

It is remarkable that, from the result of Coulomb's experiments on the power of men ascending steps, both the greatest weight which a man can carry without moving, and the weight which he should bear to render his useful effect a maximum, are nearly the same in this case as they were found to be from experiments made with burdens carried on level ground.

Coulomb has also made experiments to determine the quantity of action in the case which most generally occurs when heavy goods are carried in towns, viz. that in which a porter, having delivered his burden, returns unloaded for another; and his conclusion is, that, in order to produce the most useful effect in this case, the greatest burden which a man should carry on level ground is 135 lbs., and with this he should walk seven miles. The quantity of useful action is therefore 135 × 7, or 945.

It is said that a London porter can carry 200 lbs. on his shoulders at the rate of three miles per hour; but this action can only be continued during a short time.

The following statements of the strength of men are taken from Hachette's 'Traité des Machines,' and from other sources; the numerical values being reduced so as to express the number of pounds carried by a man one mile per day of eight hours:—

Drawing a vessel on a canal	753459
Conveying a load (110 lbs.) in a wheelbarrow (1·018 mile per hour)	896
Drawing a small waggon on four wheels over rather unequal ground	857
Pulling horizontally, the weight being raised by a rope passing over a pulley	378
Rowing in a boat	374
Thrusting horizontally, as at a capstan	368
Turning a winch and axle	159
Digging with a spade	85·3
A soldier marching (12·43 miles) with his arms, &c. (60 lbs.) daily	745

With respect to the horse, the most useful way of employing his strength is to make him draw loads in a cart or waggon; but, even for such work, the estimates which have been made of the quantity of action performed daily are various.

According to Tredgold a horse can draw 125 lbs. at the rate of 2½ miles per hour, which, for one day, would give 125 × 2½ × 8, or 2500. But Messrs. Boulton and Watt ascertained from trials, purposely made, that a strong horse can draw 125 lbs. at the rate of 3 miles per hour; and the measure of the power of such a horse is 3000, which expresses a number of pounds drawn one mile in a day. If this be multiplied by the number of feet in a mile, and the product be divided by the number of minutes in eight hours, the result (= 33000) denotes a weight in pounds drawn one foot per minute during the eight hours; and that result is now universally adopted as a measure of the power of a horse.

The useful effect of a horse when walking in a circle, as in some mills, is considered as equivalent to .	800
A horse carrying a soldier with arms, &c. (= 200 lbs.), can go 25 miles in a day, which gives	5000
An African dromedary carrying only his rider (160 lbs.) can go between seven and eight miles per hour during nine or ten hours, which gives 160 × 7½ × 9½, or	11400
An Asiatic camel will carry burdens weighing from 500 to 800 lbs. (suppose 600) at the rate of two and a half miles per hour. This, for a day of eight hours, gives 600 × 2½ × 8, or	12000

The velocity of a horse in walking is estimated at 5½ feet per second, or 3¾ miles per hour; in trotting 12 feet per second, or 8⅓ miles per hour; and in galloping 18 feet per second, or 12¼ miles per hour.

The following remarks are taken from Major Griffiths's 'Artillerists' Manual':—The average weight of artillery horses is 10 cwt. 2 qrs. The most useful mode of applying a horse's power is in draught, and the worst is in carrying a load. This is owing to the structure of the animal. It has been found that three men carrying each 100 lbs. will ascend a hill with greater rapidity than one horse carrying 300 lbs. When a horse has a large draught in a waggon, however, it is found useful to load his back to a certain extent; this prevents him from inclining so much forward, as he would otherwise do, and consequently frees him from the fatigue of great muscular action. The best disposition of the traces in draught is when they are perpendicular to the collar; when the horse stands at ease, the traces are then inclined to the horizon, at an angle of about 15°; but when he leans forward to draw, the traces should then become nearly parallel to the road. The most proper inclination, however, is determined from the relation which subsists between the friction and the pressure in every particular case. When a horse is employed in moving a machine, by travelling in a circular path, the diameter ought not to be less than 25 or 30 feet, and in most cases 40 feet should be preferred; at all events, it must not be less than 18 feet.

The following table shows the *maximum quantity of labour* which a horse of average strength is capable of performing at different velocities, on canals, railways, and roads, but in comparing this table with practice at the higher velocities, it is found necessary to add one-third more than the *useful effect* for the total mass moved. Whatever the difficulties of a road may be, ten horses are as many as can be harnessed with effect to one carriage.

Velocities per hour.	Day's work.	Force of Traction.	Useful effect per day for 1 Mile in distance on a Canal.	Railway.	Level Road.
Miles.	Hours.	lbs.	Tons.	Tons.	Tons.
2½	11·5	83⅓	520	115	14
3	8		243	92	12
3½	5·9		153	82	10
4	4·5		102	72	9
5	2·9		52	57	7·2
6	2		30	48	6
7	1·5		19	41	5·1
8	1·8		12·8	36	4·5
9	·9		9	32	4
10	·75		6·6	28·8	3·6

The following is the result of experiments with a light four-wheeled cart, weighing, with its load, 1000 lbs., drawn on different sorts of roads (12½ lbs. being deducted from the force of traction, for the friction at the axles, which were of wood):—

	Force of traction.
Turnpike road, hard and dry	18
" " dirty	26½
" " new gravelled	130⅓
Loose sandy road	191½

NOTE.—An ox can draw about 4 cwt., and a pair of oxen 9 cwt. on a level road.

ANIMAL SUBSTANCES. Among the important and indispensable materials of manufactures, are those which are derived from the animal kingdom. Few persons are aware, unless actually engaged in manufacturing operations, how numerous and varied these materials are. The bounty of nature has placed at the disposal of man so large a number of substances, derived from so large a number of animals, that there is scarcely an article in daily use but can exhibit an application of some such substance, either in its formation or its decoration. The exterior and the interior, the solids and the liquids—all parts of some animals, and numerous parts of many, admit of being thus industriously applied.

In the classified list of objects drawn up for the Commissioners of the Great Exhibition of 1851, the principal materials of manufactures and the arts derived from the animal kingdom were enumerated, and an attempt was made to arrange them into some convenient systematic form. In the first place, the whole series was divided into three sections, namely; 1st, Animal substances used as food; 2nd, Animal substances used for medicinal purposes; and 3rd, Animal substances used in manufactures.

Almost every part of almost every species of animal serves as food to some variety or other of the human race. The flesh, the eggs of birds, and the milk of mammalia, are obviously the chief forms in which animal food is presented; but there are many other forms to which more or less of preparative process has been applied; such as preserved meats for long voyages; portable soups; concentrated nutriments; consolidated milk; dried gelatine, albumen, and isinglass; caviare and trepang; sharks' fins; nests of the Java swallow; honey, &c.

The animal substances used in the medicinal art are exceedingly numerous. Among them are cod-liver and other animal oils; unguents of spermaceti, lard, oil, and various combinations of the three; musk, castoreum, civet, and ambergris; phosphorus and ammonia, from bones and hartshorn; crabs' eyes (the calcareous concretions formed in the craw-fish), and cuttle-bone; cantharides, and their essence cantharadine; iodine, obtained from marine zoophytes and sponge, &c.

But the animal substances used in manufacturing processes, though perhaps not equalling in quantity those consumed as food, are far more varied in quality and texture. They are so numerous that the Commissioners found it convenient to separate this section into five divisions, namely; Animal substances employed, 1st, for textile fabrics and clothing; 2nd, for domestic or ornamental purposes; 3rd, for serving as agents in the manufacture of other articles; 4th, for the production of chemical substances; and 5th, for pigments and dyes. Under the first division come wool, hair, hair bands and ropes; bristles and whalebone; silk from the silkworm, the pinna, and other insects; feathers, down, and fur; skins, hides, and leather; elytra or beetle wings, for ornaments of dress, &c. Under the second division are included bone, horn, hoofs, ivory, tortoise-shell, shagreen, parchment, vellum, quills, pearls, seed pearls, mother o' pearl, buffalo shells, Bombay shells, black shells, white-edge shells, yellow-edge shells, flat shells, green-snail shells, coral; together with a large number of softer substances, such as sponge, catgut, gold-beaters' skin, bladders, spermaceti, wax, lard, tallows, oils, &c. Under the third division come glue, isinglass, gelatine, bone-black, ivory black, animal charcoal, &c. Under the fourth division are included bones and other substances from which phosphorus, ammonia, cyanides, &c. are procured. Under the fifth division are enumerated cochineal and carmine; dyes from the galls of aphides; gall-stone pigment from ox-gall; lac, in its various forms of stick-lac, seed-lac, lump-lac, shell-lac, lac-lake, and lac-dye; sepia, from the cuttle fish; essence d'orient, obtained from the scales of the bleak, and used in the manufacture of artificial pearls, &c.

Notices of the more important of the above-named substances will be found under their proper headings.

ANIMÉ. A gum resin, of which two kinds are known; the American, which is said to be obtained from incisions in the *Hymenæa Courbaril*, and the Oriental. The American animé is pale yellow to dusky brown, has an agreeable odour, and a specific gravity of 1·03. It contains 2·4 per cent. of a volatile oil. The oriental variety has a yellow or reddish yellow colour, and a specific gravity of 1·0272. Both varieties are employed for scenting pastilles.

ANISAMIC ACID ($C_{16}H_9NO_6$). A colourless crystalline acid, obtained by adding sulphide of ammonium to nitranisic acid.

ANISAMIDE [$NH_2(C_{16}H_7O_4)$]. A crystalline substance, obtained by the action of chloride of anisyl upon ammonia. [AMIDES.]

ANISANILIDE [$NH(C_{16}H_7O_4)(C_{12}H_5)$]—*Phenylanisamide.* A crystalline body, formed by acting upon aniline with chloride of anisyl. [ANISIC ACID.]

ANISHYDRAMIDE (*Hydride of Azoanisyl*) ($C_{48}H_{24}N_2O_6$). A crystalline product of the action of ammonia on hydride of anisyl.

$$\underbrace{3C_{16}H_8O_4}_{\text{Hydride of Anisyl.}} + \underbrace{2NH_3}_{\text{Ammonia.}} = \underbrace{C_{48}H_{24}N_2O_6}_{\text{Anishydramide.}} + 6HO$$

Anishydramide crystallises in brilliant prisms, fusible, and soluble in hot alcohol and ether.

ANISIC ACID—*Draconic Acid* ($C_{16}H_8O_6$). Obtained by M. Cahours by boiling oil of anise with nitric acid of specific gravity 1·2. A yellow resinous mass (nitraniside) first separates, and then crystals of anisic acid are deposited as the liquid cools. Anisic acid is almost tasteless, scarcely soluble in cold, but easily soluble in hot water, in alcohol, and in ether. It fuses at 347°, and may be sublimed unaltered. Distilled with pentachloride of phosphorus, it yields *chloride of anisyl* ($C_{16}H_7O_4Cl$). It also unites with oxide of ethyl, forming *anisic ether* ($C_{16}H_7(C_4H_5)O_6$).

ANISIC ETHER. [ANISIC ACID.]

ANISIDINE—*Methyl-phenidine* ($C_{14}H_9NO_2$). An oily solid, formed by the action of sulphide of ammonium upon nitrophenate of methyl.

ANISINE ($C_{48}H_{24}N_2O_6$). An organic base, formed by the isomeric transformation which hydride of azoanisyl suffers when maintained at a temperature of 330° F. for several hours. It crystallises in colourless prisms possessing a strong alkaline reaction; is soluble in alcohol, and slightly so in boiling water. It forms crystallisable salts with acids.

ANISÖIN. A substance obtained by acting on the oil of anise by sulphuric acid or the chlorides of tin and antimony. It is analogous to benzoin.

ANISOL—*Phenate of Methyl* $\left(\begin{matrix}C_{12}H_5\\C_2H_3\end{matrix}\right\}O_2\Big)$. Prepared by distilling anisic acid with an excess of caustic baryta. It is a colourless, very mobile liquid of an aromatic odour. It boils at 306° F.

ANISYL ($C_{16}H_7O_4$). The hypothetical radical of anisic acid. It may be regarded as methyl-salicyl, thus:—

Salicyl	$C_{14}H_5O_4$
Anisyl	$C_{14}H_4(C_2H_3)O_4$.

ANKER, a measure of wine and spirits, particularly of the latter, formerly in use, containing 10 old wine gallons, or 8⅓ imperial gallons, that is, 2310·62 cubic inches. This measure is also in use in various parts of Europe, and varies according to the following table:—

Place.	Anker in old wine gallons.	Anker in imperial gallons.
Amsterdam	10·250	8·542
Berlin	9·894	8·245
Copenhagen	9·950	8·292
Danzig	9·900	8·250
Hamburg	9·563	7·969
Oldenburg	10·988	9·157
Pernau	10·233	8·528
Revel	11·172	9·310
Riga	10·333	8·611
Russia	9·738	8·115
Rotterdam	9·998	8·332
Rostock	9·562	7·968
Stettin	13·700	11·417
Sweden	10·372	8·643

ANNALS, in Latin *Annales*, is derived from 'annus,' a year. Cicero, in his second book, On an Orator ('De Oratore,' chap. xiii.), informs us that from the commencement of the Roman state down to the time of Publius Mucius, it was the custom for the Pontifex Maximus, or high priest, annually to commit to writing the transactions of the past year, and to exhibit the account publicly on a tablet (*in albo*) at his house, where it might be read by the people. Mucius was Pontifex Maximus in the beginning of the 7th century from the foundation of Rome. These are the registers, Cicero adds, which we now call the 'Annales Maximi,' the great annals. It is probable that these annals are the same which are frequently referred to by Livy under the title of the 'Commentarii Pontificum,' and by Dionysius under that of the *ἱέραι δέλτοι*, or 'Sacred Tablets.' Cicero, both in the passage just quoted, and in another in his first book On Laws ('De Legibus,') speaks of them as being extremely brief and meagre documents. It may, however, be inferred from what he says, that parts of them at least were still in existence in his time, and some might be of considerable antiquity. Livy only says that *most* of the contents of the Pontiffs' Commentaries were lost at the burning of the city after its capture by the Gauls. It is evident, however, that they were not in Livy's time to be found in a perfect state even from the date of that event (A.U. 363); for he is often in doubt as to the succession of magistrates in subsequent periods, which it is scarcely to be supposed he could have been, if a complete series of these annals had been preserved.

The word annals, however, was also used by the Romans in a general sense; and it has been much disputed among the critics what was the true distinction between annals and history. Cicero, in the passage in his work 'De Oratore,' says, that the first narrators of public events, both among the Greeks and Romans, followed the same mode of writing with that in the 'Annales Maximi;' which he further describes as consisting in a mere statement of facts briefly and without ornament. In his work 'De Legibus' he characterises history as something quite distinct from this, and of which there was as yet no example in the Latin language. It belongs, he says, to the highest class of oratorical composition.

This question has been considerably perplexed by the division which is commonly made of the historical works of Tacitus, into books of annals, and books called histories. As what are called his 'Annals' are occupied with events which happened before he was born, while in his 'History' he relates those of his own time, some critics have laid it down as the distinction between history and annals, that the former is a narration of what the writer has himself seen, or at least been contemporary with, and the latter of transactions which had preceded his own day. Aulus Gellius ('Noctes Atticæ,' v. 18) has stated this doctrine, which, after his manner, he has endeavoured to support by a reference to the etymology of the word history, from the Greek *ἱστορέω*, properly to inquire in person.

It must be evident that this is quite an unfounded notion. Without attempting to define at present what history properly is, which will be more conveniently done under the word itself, we may venture to assume, that it does not mean merely memoirs of events by contemporaries. And it is equally clear that there is nothing in the term annals which should make it exclusively applicable to accounts of past ages. We doubt if Tacitus himself ever gave the name of histories to any of his writings. If he gave either work a title at all, more probably he gave to both that of annals only. We rather think it will be found, that wherever he mentions his historical writings, he refers to them by this name. It is, at any rate, by no means certain that the common division either originated with him, or was even recognised by others of his own age.

Tacitus has himself in one passage intimated distinctly what he himself understood annals to be, as distinguished from history. In his 'Annals' (commonly so called), lib. iv. cap. 71, he states his reason for not giving the continuation and conclusion of a particular narrative which he had commenced, to be simply the necessity under which he had laid himself by the form of composition he had adopted of relating events strictly in the order of time, and always finishing those of one year before entering upon those of another. The substance of his remark is, that "the nature of his work required him to give each particular under the year in which it actually happened." This, then, was what Tacitus conceived to be the task which he had undertaken as a writer of annals, "to keep everything to its year." Had he been writing a history (and in the instance quoted above, he insinuates he had the inclination, if not the ability, for once to act the historian), he would have considered himself at liberty to pursue the narrative he was engaged with to its close, not stopping until he had related the winding up of the whole. But remembering that he professed to be no more than an annalist, he restrains himself, and feels it to be his business to keep to the events of the year.

It is of no consequence that on some other occasions Tacitus may have deviated somewhat from the strict line which he thus lays down for himself—that he may have for a moment dropped the annalist and assumed the historian. If it should even be contended that his narrative does not in general exhibit a more slavish submission to the mere succession of years than others that have been dignified with the name of historians, that is still of no consequence. He may have satisfied himself with the more humble name of an annalist, when he had a right to the prouder one of an historian; or the other works referred to may be wrongly designated histories. It may be, for instance, that he himself is as much an historian in what are called his 'Annals' as he is in what is called his 'History.' In that case all we can say is, upon any interpretation of the words that may be advanced (except indeed the foolish one proposed by Aulus Gellius), that one of the titles is wrong.

In lib. iii. cap. 65 of his 'Annals,' Tacitus tells us that it formed no part of the plan of his 'Annals' to give at full length the sentiments and opinions of individuals, except they were signally characterised either by some honourable or disgraceful traits. In chap. 22 of the treatise on Oratory, attributed to Tacitus, the author expresses his opinion of the general character of the style of ancient annals; and ('Annal.' xiii. 31) he carefully marks the distinction between events fit to be incorporated into annals and those which were only adapted to the Acta Diurna. [ACTA DIURNA.]

The distinction we have stated between history-writing and annal-writing seems to be the one that has been commonly adopted. An account of events digested into so many successive years is usually entitled, not a history, but annals. The 'Ecclesiastical Annals' of Baronius, and the 'Annals of Scotland,' by Sir David Dalrymple (Lord Hailes), are well-known examples. In such works so completely is the succession of years considered to be the governing principle of the narrative, that that succession is sometimes preserved unbroken even when the events themselves would not have required that it should, the year being formally enumerated although there is nothing to be told under it. The year is at least always stated with equal formality whether there be many events or hardly any to be related as having happened in it. In this respect annals differ from a catalogue of events with their dates, as, for instance, the 'Parian Chronicle.' The object of the latter is to intimate in what year certain events happened; of the former, what events happened in each year. The history of the Peloponnesian war by Thucydides has the character of annals. The events are arranged distinctly under each year, which is further divided into summers and winters. All political reflections are, for the most part, placed in the mouths of the various commanders on each side.

In the 'Rheinisches Museum für Philologie,' &c., ii. jahrg. 2 heft. pp. 293, &c., there is a disquisition by Niebuhr on the distinction between History and Annals, in which he limits the latter nearly as has been done above. But the greater part of the paper is taken up in endeavouring to account for the definition given by Aulus Gellius, which is illustrated in a manner perhaps more fanciful and ingenious than convincing. There is a translation of it in the Sixth Number (for May, 1833) of the 'Cambridge Philological Museum.'

It scarcely need be noticed that the term annals is popularly used in a very loose sense for a record of events in whatever form it may be written—as when Gray speaks of

"The short and simple annals of the poor."

In the Romish Church a mass said for any person every day during a whole year was anciently called an annal; and sometimes the same word was applied to a mass said on a particular day of every year.

(Du Cange, *Glossarium ad Scriptores Mediæ et Infimæ Latinitatis.*)

ANNA'TES, from *annus*, a year, a sum paid by the person presented to a Church living, being the estimated value of the living for a year. It is what is otherwise called *Primitiæ*, or First Fruits. [FIRST FRUITS.] The amount in each cure was formerly regulated, in England, by a valuation of benefices, made by Walter, bishop of Norwich, under the direction of Pope Innocent IV., in 1254, in the reign of Henry III. A new valuation was made in 1292, in the reign of Edward I.; and a third in 1535, in the reign of Henry VIII., according to which (commonly called the Liber Regis, or King's Book) the clergy are at present rated. These fines, before the Reformation, went to the bishop or to the pope: on the supremacy being transferred to the crown, they went along with it. In the reign of Queen Anne they were given up to form a fund for the augmentation of poor livings; hence called Queen Anne's Bounty. The administration of this fund is now regulated by 1 & 2 Vict. c. 20. In Ireland, until the 3 & 4 Will. IV. c. 47 (An Act to alter and amend the Laws relating to the Temporalities of the Church in Ireland), the first fruits were applied in the first instance to the repair of churches, and to the augmentation of poor livings after that object had been satisfied. By that statute the demand of first fruits is abolished (§ 13), and in lieu of it, all ecclesiastical incomes above a certain amount are to pay yearly a tax regulated by their value. In Scotland, by the Act of Parliament, 1672, c. 13, the executors of every holder of a spiritual benefice are allowed the first half-year's stipend after that to which the incumbent was entitled at the time of his death; and this is called the Ann, or Annat. As it belongs to the executors of the clergyman, and not to himself, it can neither be assigned by him during his life, nor seized in payment of his debts. (Ersk. 'Inst.,' ii. 10, 66.)

ANNEALING. There are certain substances, more especially glass and some of the metals, which on sudden cooling after having been melted, acquire great brittleness, and in the case of glass, a disposition to fly to pieces by moderate changes of temperature, or slight external force. This is remedied by annealing, which, with respect to glass, consists in heating it, below the point at which it softens, in what are termed *annealing ovens*, the glass being gradually removed from the hotter to the cooler parts of the furnace. The brittleness of glass has been attributed to the disturbance, attendant upon the hasty cooling, in the regular arrangement of its particles. [GLASS.]

The metals also suffer remarkable changes as to their hardness, toughness and brittleness; this is especially the case with iron after it has been converted into steel. The alteration of structure which they undergo is not thoroughly understood; it is, however, certain that some malleable metals which crystallise on cooling, are brittle in their crystalline state, and that this structure is altered, and they are rendered tough by heating and rolling. This is remarkably the case with zinc, which is incapable of extension under the hammer, except in a slight degree, without cracking; but when it has been passed through the rollers, at a moderate increase of temperature, it becomes almost as flexible and as tough as copper. This change must be derived from some alteration of structure, and fresh arrangement of the particles, which must be considered as owing to a process, if not identical with annealing, yet bearing a strong analogy to it. [BRASS; STEEL.]

ANNIHILATOR, FIRE. In addition to the machines noticed under FIRE ENGINE and FIRE ESCAPE, another protection from fire has been introduced by Mr. Phillips, under the name of the *Fire Annihilator.* Mr. Phillips took out his patent in 1849. The materials employed consist of sugar and chlorate of potash, mixed and boiled together into a homogeneous mass. This is placed in a perforated cylinder, within a second perforated cylinder, contained in a third but air-tight cylinder; and the whole put into an outer case. Water is placed in the space between the bottoms of the third cylinder and outer casing; a vertical pipe opens from this space to the space between the second and third cylinders. By the action of the heated water, aided by a mechanical contrivance, a particular gas or vapour is generated from the chlorate, and is allowed to escape through an opening at the top of the case. It is this gas which is intended to act so remarkably upon a burning mass as to extinguish flame.

With this apparatus Mr. Phillips has made many experiments which have attracted a good deal of public attention. A display was made at Vauxhall Gas Works, in October, 1849; model houses and shops, filled with combustibles, were set on fire, with a view of showing how rapidly the annihilator could extinguish the flames. The machine is placed where it can be influenced by the heat of the conflagration; and the resulting gas has a remarkable effect in extinguishing flame; but it does *not* extinguish red heat unaccompanied by flame. Experiments were made in the early part of 1850 at Trentham Park, at the Paddington Railway Station, and at the West India Docks; but the annihilator on these occasions scarcely merited the good opinion of its admirers. Shortly after this, the Board of Ordnance permitted a brick building to be constructed in Woolwich Marsh, and made to represent as nearly as practicable (without incurring too much expense) a three storied house, which was then filled with cheap furniture; and a similar experiment was conducted here.

The truth seems to be (so far as has yet been shown), that in close rooms, or confined spaces generally, the liberated gases of the annihilator may be serviceably used to extinguish flame; but that where there is plenty of access for external air, the action of the machine becomes impaired. So far as the mere setting to work is concerned, it is easy and simple; but an experience of ten years (1849 to 1859) has not tended far towards the establishment of the fire-annihilator in practical use.

ANNIVE'RSARY, the yearly return of any remarkable day, called, in old English, by the expressive term year-day.

Anniversary days are festivals celebrated by the Romish church in honour of the saints, one or two of whom are assigned to every day in the year. In the Church of England the only anniversaries are the solemn ones of the birth and death of our Saviour, but there are special services for some of the saints. There are also some few fairs held on saints' days, but without any present recognition of the saints, and with scarcely a remembrance of them. The birth-day of the reigning monarch is very generally celebrated by holidays and rejoicings; the anniversary of the Gunpowder Plot has been rescued from oblivion by the love of school-boys for fire-works and the pageant of Guy Fawkes; the oaken bough still preserves the remembrance of the restoration of the Stuarts; and Valentine yet makes a considerable contribution to the post-office revenue.

Literary and scientific associations generally celebrate the anniversary of their original institution, and social parties are held in domestic life on the birth-days of heads of families.

ANNUITY, a term derived from the Latin *annus*, a year; signifying, in its most general sense, any fixed sum of money which is payable either yearly or in given portions at stated periods of the year. Thus, the lease of a house, which lets for 50*l.* a year, and which has 17 years to run, is to the owner an annuity of 50*l.* for 17 years. In an ordinary use of the term, it signifies a sum of money payable to an individual yearly, during life. In the former case, it is called, in technical language, an *annuity certain*, and in the latter, a *life annuity*.

It is evident that every beneficial interest which is either to continue for ever, or to stop at the end of a given time, such as a freehold, a lease, a debt to be paid in yearly instalments, &c., is contained under the general head of an *annuity certain;* while every such interest which terminates with the lives of any one or more individuals, all that in law is called a *life estate*, and all salaries, as well as what are most commonly known by the name of life annuities, fall under the latter term. Closely connected with this part of the subject are COPYHOLDS (which see), in which an estate is held during certain lives, but in which there is a power of renewing any life when it drops, that is, substituting another life in place of the former, on payment of a fine—REVERSIONS, or the interest which the next proprietor has in any estate, &c., after the death of the present—and *life-insurance* [INSURANCE], in which the question is, what annuity must A. pay to B. during his life, in order that B. may pay a given sum to A.'s executors at his death.

If money could not be improved at interest, the value of an annuity certain would simply be the yearly sum multiplied by the number of years it is to continue to be paid. Thus a lease for three years of a house which is worth 100*l.* a year, might either be bought by paying the rent yearly, or by paying 300*l.* at once. A life annuity, in such a case, will be worth an annuity certain, continued for the average number of years lived by individuals of the same age as the one to whom the annuity is granted. But if compound interest be supposed, which is always the case in real transactions of this kind, the landlord, in the case of the annuity certain just alluded to, must only receive such a sum as, when put out to interest, with 100*l.* subtracted every year for rent, will just be exhausted at the end of three years. To exemplify this, let us suppose that money can be improved at 4 per cent. In Table I., in the column headed 4 p. c. (4 per cent.) we find 2·775 opposite to 3 in the first column, by which is meant that the present value of an annuity of *one pound* to last three years is 2·775*l.*, or $2\frac{775}{1000}$*l.* The present value of an annuity of 100*l.* under the same circumstances is, therefore, 277·5*l.*, or 277*l.* 10*s.* This is the value of a lease for three years corresponding to a yearly rent of 100*l.* The landlord who receives this, and puts it out at 4 per cent., will, at the end of one year, have 288*l.* 12*s.* From this he subtracts 100*l.* for the rent which has become due, and puts out the remainder 188*l.* 12*s.* again at 4 per cent. At the end of a year this has increased to 196*l.* 2*s.* 10¾*d.*, from which 100*l.* is again subtracted for rent. The remainder, 96*l.* 2*s.* 10¾*d.*, again put out at interest, becomes at the end of the year 99*l.* 19*s.* 9*d.*, within three pence of the last year's rent. This little difference arises from the imperfection of the Table, which extends to three decimal places only.

TABLE I.—PRESENT VALUE OF AN ANNUITY OF ONE POUND.

No. of Years.	3 p. c.	3½ p. c.	4 p. c.	5 p. c.
1	·971	·966	·962	·952
2	1·913	1·900	1·886	1·859
3	2·829	2·802	2·775	2·723
4	3·717	3·673	3·630	3·546
5	4·580	4·515	4·452	4·329
6	5·417	5·329	5·242	5·076
7	6·230	6·115	6·002	5·786
8	7·020	6·874	6·733	6·463
9	7·786	7·608	7·435	7·108
10	8·530	8·317	8·111	7·722
15	11·938	11·517	11·118	10·380
20	14·877	14·212	13·590	12·462
25	17·413	16.482	15·622	14·094
30	19·600	18·392	17·292	15·372
40	23·115	21·355	19·793	17·159
50	25·730	23·456	21·482	18·256
60	27·676	24·945	22·623	18·929
70	29·123	26·000	23·395	19·343
For ever	33·333	28·571	25·000	20·000

To find the present value of an annuity of 1*l.* per annum continued for 10 years, interest being at 5 per cent., look in the column headed 5 p. c., and there, opposite to 10 in the first column, will be found the value of 7·722*l.*, or 7*l.* 14*s.* 6½*d.* This would be commonly said to be 7·722 *years' purchase* of the annuity. Decimals of a pound may be reduced to shillings and pence, and the converse, by the following Table:—

TABLES II. AND III.—FOR REDUCING DECIMALS OF A POUND TO SHILLINGS AND PENCE, AND THE CONVERSE.

Dec.	s.	Dec.	s.	d.	Dec.	d.
·1	2	·01	0	2½	·001	0¼
·2	4	·02	0	5	·002	0½
·3	6	·03	0	7¼	·003	0¾
·4	8	·04	0	9½	·004	1
·5	10	·05	1	0	·005	1¼
·6	12	·06	1	2½	·006	1½
·7	14	·07	1	5	·007	1¾
·8	16	·08	1	7¼	·008	2
·9	18	·09	1	9½	·009	2¼

s.	Dec.	d.	Dec.	f.	Dec.
1	·05	1	·004	¼	·001
2	·1	2	·008	½	·002
3	·15	3	·013	¾	·003
4	·2	4	·017		
5	·25	5	·021		
6	·3	6	·025		
7	·35	7	·029		
8	·4	8	·033		
9	·45	9	·037		
10	·5	10	·042		
		11	·046		

For example, what is ·665*l.* in shillings and pence?

TABLE II.	·6	is	£0	12	0
	·06	„		1	2½
	·005	„			1¼
	·665		£0	13	3¾

Again, what is 17*s.* 10¾*d.* in decimals of a pound?

TABLE III.	£0	10	0	is	·5
		7	0	„	·35
			10	„	·042
			¾	„	·003
	£0	17	10¾		·895

These conversions are not made with perfect exactness, as only three decimal places are taken. The error will never be more than one farthing.

To use Table I. where the number of years is not in the table, but is intermediate between two of those in the table, such a mean must be taken between the annuities belonging to the nearest years above and below the given year, as the given year is between those two years. This will give the result with sufficient nearness. We must observe, that no tables which we have room to give are sufficient for more than a first guess, so to speak, at the value required, such as may enable any one who is master of common arithmetic, not to form a decisive opinion on the case before him, but to judge whether it is worth his while to make a more exact enquiry, either by taking professional advice, or consulting larger tables. As an example of the case mentioned, suppose we ask for the value of an annuity of 1*l.* continued for 12 years, interest being at 4 per cent. We find in Table I., column 4 per cent.—

For	10	years	8·111
„	15	„	11·118
	Difference		3·007

Since 5 years adds 3·007 to the value of the annuity, every year will add about one-fifth part of this, or ·601, and two years will add about 1·202. This, added to 8·111, gives 9·313. The real value is more near to 9·385, and the error of our table is ·07 out of 9·313, or about the 133rd part of the whole. The higher we go in the table, the less proportion of the whole will this error be.

The last line in Table I. gives the value of the annuity of 1*l.* continued for ever: for example, at 5 per cent., the value of 1*l.* for ever, or, as it is called, a *perpetuity* of 1*l.*, is 20*l.* This is the sum which at 5 per cent. yields 1*l.* a year in interest only, without diminution of the principal. We see that an annuity for a long term of years differs very little in present value from the same continued for ever: for example, 1*l.* continued for 70 years at 4 per cent. is worth 23·395*l.*, while the perpetuity at the same rate is worth only 25*l.* Hence the present value of an annuity which is not to begin to be paid till 70 years have elapsed, but is afterwards to be continued for ever, is 1·605 at 4 per cent.: which sum improved during the 70 years, would yield the 25*l.* necessary to pay the annuity for all years succeeding.

TABLE IV.—AMOUNT OF AN ANNUITY OF ONE POUND.

Y.	3 p. c.	3½ p. c.	4 p. c.	5 p. c.
1	1·000	1·000	1·000	1·000
2	2·030	2·035	2·040	2·050
3	3·091	3·106	3·122	3·153
4	4·184	4·215	4·246	4·310
5	5·309	5·362	5·416	5·526
6	6·468	6·550	6·633	6·802
7	7·662	7·779	7·898	8·142
8	8·892	9·052	9·214	9·549
9	10·159	10·368	10·583	11·027
10	11·464	11·731	12·006	12·578
15	18·599	19·296	20·024	21·579
20	26·870	28·280	29·778	33·066
25	36·459	38·950	41·646	47·727
30	47·575	51·623	56·085	66·439
40	75·401	84·550	95·026	120·800
50	112·797	130·998	152·667	209·348
60	163·053	196·517	237·991	353·584
70	230·594	288·938	364·290	588·529

In this Table we see what would be possessed by the receiver of an annuity at the end of his term, if he put each year's annuity out at interest as soon as he received it. For example, an annuity of 1*l.*, in 40 years, at 5 per cent., amounts to 120·8*l.*, which includes 40*l.* received altogether at the end of the different years, and 80·8*l.*, the compound interest arising from the first year's annuity, which has been 39 years at interest, the second year's annuity, which has been 38 years at interest, and so on, down to the last year's annuity, which has only just been received. When the annuity is payable half-yearly, or quarterly, its present value is somewhat greater than that given in the preceding Table. For the annuitant, receiving certain portions of his annuity sooner than in the case of yearly payments, gains an additional portion of interest. Since 4 per cent. is 2 per cent. half-yearly and 1 per cent. quarterly, and since every term contains twice as many half-years as years, and four times as many quarters, it is evident that an annuity of 100*l.* a-year, payable half-yearly, at 4 per cent., for 10 years, is the same in present value as one of 50*l.* per annum, payable *yearly*, at 2 per cent., for 20 years. Again, 100*l.* a-year, payable quarterly for 10 years, money being at 4 per cent., is equivalent to an annuity of 25*l.*, payable yearly for 40 years, money being at 1 per cent.

The principles on which the calculation of life annuities depends will be more fully explained in the articles PROBABILITY and MORTALITY. Let us suppose 100 persons, all of the same age, buy a life annuity at the same office. Let us also suppose it has been found out, that of 100 persons at that age, 10 die in the first year on the average, 10 more in the second year, and so on. If, then, it can be relied upon that 100 persons will die nearly in the same manner as the average of mankind, or at least, that in such a number the longevity of some will be compensated by the unexpected death of others, the fair estimation of the value of a life annuity to be granted to each may be made as follows. To make the question more distinct, let us suppose the bargain to be made on the 1st of January, 1859, so that payment of the annuities is due to the survivors on new-year's day of each year. Moreover, let each year's annuity be made the subject of a separate contract. The first question is, what ought each individual to pay in order that he may receive the annuity of 1*l.*, if he survives, in 1860? By the general law of mortality, we suppose that only 90 will remain to claim, who will, therefore, receive 90*l.*, among them, the remaining 10 having died in the interval. It is sufficient, therefore, to meet the claims of 1860, that the whole 100 pay among them, January 1, 1859, such a sum as will, when put out at interest, (suppose 4 per cent.,) amount to 90*l.* on January 1, 1860. This sum is 86·654*l.*, and its hundredth part is ·86654*l.*, which is, therefore, what each should pay to entitle himself to receive the annuity in 1860. There will be only 80 to claim in 1861, and, therefore, the whole 100 must among them pay as much as will, put out at 4 per cent. for 2 years, amount to 80*l.* This sum is 73·968*l.*, and its hundredth part is ·73968*l.*, which is, therefore, what each must pay, in order to receive the annuity, if he lives, in 1861. The remaining years are treated in the same way, and the sum of the shares of each individual for the different years is the present value of an annuity for his life. We must observe, that in the term *value of an annuity*, it is always implied that the first annuity becomes payable at the expiration of a year after the payment of the purchase money.

The value of a life annuity depends, therefore, upon the manner in which it is presumed a large number of persons similarly situated with the buyer, would die off successively. Various tables of these *decrements of life*, as they are called, have been constructed, from observations made among different classes of lives. Some make the mortality greater than others; and of course, Tables, which give a large mortality, give the value of the annuity smaller than those which suppose men to live longer. Those who buy annuities would, therefore, be glad to be rated according to tables of high mortality or low expectation of life; while those who sell them would prefer receiving the price indicated by tables which give a lower rate of mortality. In insurances the reverse is the case: the shorter the time which a man is supposed to live, the more must he pay the office, that the latter may at his death have accumulated wherewithal to pay his executors. We now give in Table V., the values of annuities according to three of the most celebrated Tables.

TABLE V.—PRESENT VALUE OR PURCHASE-MONEY OF A LIFE ANNUITY.

	Northampton.			Carlisle.			Gov. M.	Gov. F.
Age.	3 p. c.	4 p. c.	5 p. c.	3 p. c.	4 p. c.	5 p. c.	4 p. c.	4 p. c.
0	12·3	10·3	8·9	17·3	14·3	12·1		
5	20·5	17·2	14·8	23·7	19·6	16·6	19·3	20·0
10	20·7	17·5	15·1	23·5	19·6	16·7	18·8	19·7
15	19·7	16·8	14·6	22·6	19·0	16·2	18·0	19·1
20	18·6	16·0	14·0	21·7	18·4	15·8	17·3	18·6
25	17·8	15·4	13·6	20·7	17·6	15·3	16·9	18·1
30	16·9	14·8	13·1	19·6	16·9	14·7	16·4	17·5
35	15·9	14·0	12·5	18·4	16·0	14·1	15·7	16·9
40	14·8	13·2	11·8	17·1	15·1	13·4	14·9	16·2
45	13·7	12·3	11·1	15·9	14·1	12·6	13·8	15·3
50	12·4	11·3	10·3	14·3	12·9	11·7	12·4	14·2
55	11·2	10·2	9·4	12·4	11·3	10·3	11·0	12·8
60	9·8	9·0	8·4	10·5	9·7	8·9	9·7	11.3
65	8·3	7·8	7·3	8·9	8·3	7·8	8·2	9·6
70	6·7	6·4	6·0	7·1	6·7	6·3	6·8	7·9
75	5·2	5·0	4·7	5·5	5·2	5·0	5·4	6·3
80	3·8	3·6	3·5	4·4	4·2	4·0	3·8	4 9
85	2·6	2·5	2·5	3·2	3·1	3·0	2·3	3·8
90	1·8	1·8	1·7	2·5	2·4	2.3	1·3	2·1
95	·2	·2	·2	2·8	2·7	2·6	·6	1·0

The first of these is calculated from the Northampton Table, formed by Dr. Price, from observations of burials, &c., at Northampton. As compared with all other Tables of authority, it gives too high a mortality at all the younger and middle ages of life, and consequently, too low a value of the annuity; the second is from the Carlisle Table, formed by Mr. Milne, from observations made at Carlisle. It gives much less mortality than most other Tables, and, therefore, gives higher values of the annuities; but it has since been proved to represent the actual state of life among the middle classes in the century then ending, with much greater accuracy than could have been supposed, considering the local character of the observations from which it was derived. The third table is that constructed by Mr. Finlaison, from the observation of the mortality in the government tontines and among the holders of annuities granted by government in redemption of the national debt, and differs from the former two in distinguishing the lives of males from those of females. Most observations hitherto published unite in confirming the fact, that females, on the average, live longer than males, and in the annuities now granted by government, a distinction is made accordingly. The mean between the values of annuities on male and female lives, according to the Government Tables, agrees pretty nearly with the Carlisle Tables, the rate of interest being the same.

For the materials of Table V., we are indebted to the works of Dr. Price, on 'Reversionary Payments;' of Mr. Milne, on 'Annuities and Insurances;' and to Mr. Finlaison's 'Report to the House of Commons on Life Annuities;' to all of which we refer the reader. The tables are of course very much abridged.

To use the Table V., suppose the value of an annuity of 100*l.* a-year, on a life aged 35, is required, interest being at 4 per cent., which is nearly the actual value of money. We find in the column marked 4 per cent., opposite to 35, under the Northampton Tables 14·0, under the Carlisle 16·0, and under the Government Tables 15·7 or 16·9, according as the life is male or female. These are the number of pounds which ought to buy an annuity of 1*l.*, according to these several authorities; and taking each of them 100 times, we have:—

Northampton Table	1400*l.*
Carlisle Table	1600*l.*
Government Table (males) . . .	1570*l.*
Government Table (females) . . .	1690*l.*

We cannot suppose that the annuity could be bought for less than would be required by the Carlisle Tables.

To find the value of an annuity on a life whose age lies between two of those given in the table, the process must be followed which has been already explained in treating of annuities certain.

An annuity on two joint lives is one which is payable only so long as both the persons on whose lives it is bought are alive to receive it.

TABLE VI.—PRESENT VALUE OR PURCHASE-MONEY OF AN ANNUITY OF 1*l.* ON TWO JOINT LIVES.

Carlisle.—4 p. c.

Age.	0.	10.	20.	30.	40.	50.	60.	70.
0	8·9	12·3	11·7	10·9	9·9	8·6	6·6	4·7
5	16·8	16·5	15·6	14·4	12·9	10·5	7·8	5·0
10	17·0	16·3	15·2	13·8	12·0	9·2	6·5	4·1
15	16·3	15·5	14·3	12·9	10·5	7·9	5·1	3·0
20	15·6	14·7	13·4	11·8	9·0	6·4	4·1	2·4
25	14·8	13·8	12·5	10·3	7·8	5·0	3·0	2·6
30	13·9	12·9	11·4	8·8	6·3	4·0	2·3	1·6
40	12·1	10·9	8·6	6·2	3·9	2·3	1·6	
50	10·1	8·1	6·0	3·9	2·3	1·6		
60	6·9	5·3	3·6	2·1	1·5			
70	4·4	3·1	1·9	1·5				
80	2·4	1·6	1·3					

Northampton.—4 p. c.

Age.	0.	10.	20.	30.	40.	50.	60.	70.
1	8·3	10·8	10·1	9·4	8·6	7·5	6·1	4·4
5	13·6	13·5	12·6	11·7	10·5	8·9	7·0	4·6
10	14·3	13·4	12·6	11·5	10·1	8·3	6·0	3·5
15	13·4	12·6	11·8	10·6	9.1	7·1	4·7	2·5
20	12·5	11·9	10·9	9·6	8·0	5·8	3·4	1·7
25	11·9	11·2	10·2	8·8	6·9	4·6	2·4	0·2
30	11·3	10·5	9·3	7·8	5·7	3·4	1·7	
40	9·8	8·8	7·5	5·6	3·3	1·7		
50	8·1	7·0	5·3	3·2	1·7			
60	6·2	4·9	3·1	1·6				
70	4·1	2·8	1·5					
80	2·1	1·3						

The preceding Table gives the results of the Carlisle and Northampton Tables on the value of this species of annuity, interest being at 4 per cent. The first column shows the age of the *younger* life, and the horizontal headings are *not* the age of the elder life, but the excess of the age of the elder life above that of the younger. For example, to know the value of an annuity in two joint lives, aged 25 and 55, in which the difference of age is 30 years. In the Carlisle Table, *opposite* to 25, the *younger*, and under 30, the *difference*, we find 10·3; and 8·8 in the Northampton. For the value of an annuity of 100*l.*, the first tables give, therefore, 1030*l.*, and the second 880*l.*

The value of an annuity on the longest of two lives, that is, which is to be payable as long as either of the two shall be alive to receive it, is found by adding together the values of the annuity on the two lives separately considered, and subtracting the value of the annuity on the joint lives. For the above species of annuity puts the office and the parties in precisely the same situation as if an annuity were granted to each party separately, but on condition that one of the annuities should be returned to the office so long as both were alive, that is, during their joint lives. For example, let the ages be 25 and 55 as before, and let the Carlisle Table be chosen, interest being at 4 per cent., we have then :—

TABLE V.—Annuity at age 55	11·3
„ „ 25	17·6
Sum	28·9
TABLE VI.—Joint annuity, 55 and 25 . .	10·3
Difference	18·6

The value, therefore, of an annuity of 1*l.* per annum on the survivor is 18·6*l.*

The value of an annuity which is not to be payable till either one or other of two persons is dead, and which is to continue during the life of the survivor, is found as in the last case, only subtracting *twice* the value of the joint annuity, instead of that value itself. In the preceding case it is 8·3*l.* For this case only differs from the preceding in that the annuity is not payable while both are alive, that is, during the *joint* lives. Consequently the value in this case is less than that in the last, by the value of an annuity on the joint lives.

The value of an annuity to be paid to A. from and after the death of B., if the latter should happen to die first, is the value of an annuity on the life of A. diminished by the value of an annuity on the joint lives of A. and B. For the situation is exactly the same as if the office granted an annuity to A., to be returned as long as both should live. The ages and Table being as before, and the life on whose survivorship the annuity depends being that aged 25, we have:—

TABLE V.—Annuity at age 25	17·6
TABLE VI.—Joint annuity, 25 and 55 . .	10·3
Difference	7·3

whence the value of the required annuity of 1*l.* is 7·3*l.*

The following Table, extracted with abridgment from Morgan on Insurances, deduced from the Northampton Table, with interest at 4 per cent., gives the average sum to which the savings of an individual may be expected to amount at the end of his life, improved at compound interest from the time when he begins to lay by :—

TABLE VII.—PROBABLE AMOUNT OF 1*l.* LAID BY YEARLY, AND IMPROVED TO THE END OF LIFE.

Age.	Amount.	Age.	Amount.	Age.	Amount.	Age.	Amount.
0	137·8	25	79·2	50	29·5	75	7·2
5	159·1	30	66·0	55	23·6	80	4·8
10	137·9	35	54·6	60	18·5	85	3·2
15	114·1	40	44·9	65	14·1	90	2·0
20	94·5	45	36·6	70	10·3		

That is to say, according to the Northampton Tables, if a person were, at the age of 26, (that is, a year after 25,) to begin laying by 100*l.* a-year at interest, he might expect the amount at the end of his life to be 79·2*l.* for each pound laid by yearly; or 7920*l.* Or to speak more strictly, if 100 persons were to do this, they might expect that the average amount of their savings, reckoning the accumulations at their deaths, would be 7920*l.* each. As we have already observed, the mortality of the Northampton Table is greater than the fact, and the average accumulations would be greater, from young ages considerably greater, than those shown in the preceding table.

We have seen that the security of the method for estimating the value of life annuities, depends upon the presumption that the average mortality of the buyers is known. This average cannot be expected to hold good, unless a large number of lives be taken. Therefore, the granting of a single annuity, or of a few annuities, as a commercial speculation, would deserve no other name than gambling, even though the price demanded should be as high as that given in any tables whatsoever.

In the preceding tables, we would again remark, that our object has been simply to furnish the means of giving a moderately near determination of a few of the most simple cases. We should strongly recommend every one not to venture on important transactions, without professional or other advice on which he can depend, unless he himself fully understand the principles on which tables are constructed. The liability to error, even in using the most simple table, is very great, without considerable knowledge of the subject: and most cases which arise in practice contain some circumstances peculiar to themselves, which have not and could not have been provided for in the general rules.

The following references to works on this subject may be found useful. See also MORTALITY; REVERSIONS.

ANNUITIES CERTAIN. 1. Smart's 'Tables of Interest,' &c. London, 1726. There is an edition published in 1780, which is said to be very incorrect. The values for the intermediate half years given in this work are not correctly the values of the annuities on the supposition of half yearly payments; in other respects it is to be depended upon. 2. Corbaux, 'Doctrine of Compound Interest,' &c. London, 1825. 3. Baily, 'Doctrine of Interest and Annuities.' London, 1808. Smart's Tables are republished in this work from the correct edition. Works on *life-annuities* generally contain principles and tables for the calculation of annuities certain.

LIFE ANNUITIES. 1. Price, 'Observations on Reversionary Payments,' &c. Edited by W. Morgan, London, 1812. (Seventh Edition.) 2. Baily, on 'Life Annuities and Assurances.' London, 1810. 3. Milne, on the 'Valuation of Annuities and Assurances,' &c, London, 1815. 4. Morgan, on the 'Principles of Assurance, Annuities, &c., London, 1821. 5. Davies' 'Tables of Life Contingencies.' London, 1825. 6. Finlaison, on the 'Evidence and Elementary Facts on which Tables of Life Annuities are Founded. Printed by the House of Commons, 31st March, 1829,' 7. Gompertz, 'Estimation of the value of Life Contingencies,' in 'Philosophical Transactions,' 1820.

ANNUITY (in Law) consists in the payment of a certain sum, annually calculated, and charged upon the person or personal estate of the individual from whom it is due; if charged upon real estate, it is not an annuity, but a rent-charge. [RENT.] A sum payable occasionally does not constitute an annuity; the time of payment must recur regularly, but it is not necessary that the times of payment should be at an interval of a year; an annuity may be payable quarterly, or half-yearly, or at any other aliquot portion of a year; it may be made payable once in two, three, twenty, or any other number of years.

Under the Roman law, annuities were chiefly created by will, constituting a charge upon the heir in favour of the legatee. ('Dig.,' lib. xxxiii. tit. 1.) In the middle ages they were frequently given to professional men as a species of retainer; and in modern times have been much resorted to as a means of borrowing money. When the person who borrows undertakes, instead of interest, to pay an annuity, he is styled the *grantor;* the person who lends, being entitled to receive the payments, is called the *grantee* of the annuity. This practice was introduced on the Continent with the revival of commerce, when the advantages of borrowing were already felt, but the taking of interest was strictly forbidden. In the 15th century contracts of this kind were decided by the popes to be lawful, and were recognised as such in France, even though every species of interest upon money borrowed was deemed usurious. (Domat's 'Civil Law,' part i. b. i. t. 6.) The commercial states of Italy early availed themselves of this mode of raising money, and their example has since been followed in the creation of the national debts of other countries. [NATIONAL DEBT; STOCKS.]

An annuity may be granted for a term of years, for the life or lives of any persons named, or in perpetuity; and in the latter case (though as in all others, the annuity as to its security is personal only) it may be granted to descend in the same manner as real property; and hence such an annuity is reckoned among incorporeal hereditaments.

A perpetual annuity, granted in consideration of a sum advanced, differs from interest in this, that the grantee has no right to demand back the principal sum; he must be content to receive the annuity which he has purchased. But the annuity is in its nature redeemable by the grantor, who may discharge himself from any further payments by returning the money borrowed. It may however be agreed between the parties (as it generally has been in the creation of our own national debt, which consists chiefly of annuities of this sort) that the redemption shall not take place for a certain number of years.

An annuity for life or years is not redeemable in the same manner; but it may be agreed by the parties that it shall be redeemable on certain terms; or it may afterwards be redeemed by consent of both parties. Where the justice of the case requires it (as where there has been fraud, for instance, or the bargain is unreasonable), a court of equity will decree a redemption. When such an annuity is granted in consideration of money advanced, the annual payments may be considered as composed of two portions; one being in the nature of interest, the other as a periodical return of a part of the principal, so calculated, that when the annuity shall have determined, the whole of the principal will have been repaid. Annuities for life or years, being the only security that can be given by persons who have a limited interest in property, are frequently granted in consideration of a loan. Besides this advantage, annuities for life, inasmuch as they are attended with risk, were not within the reach of the usury laws, and were therefore, while these laws were in force, constantly used in order to evade them. The legislature was then driven to require that certain formalities should be observed in creating annuities. By statute 53 Geo. III. c. 141, s. 1, every instrument by which an annuity is granted was made null and void, unless within thirty days after execution thereof a memorial was enrolled in Chancery. If any part of the consideration money was returned, or paid in notes which were afterwards cancelled, or retained on pretence of answering future payments; or if the consideration being expressed to be paid in money, was paid in goods, the person charged with the annuity (that is, the borrower) might, if any action were brought against him, by applying to the court have the instrument cancelled (s. 6). The statute also enacted that every contract for the purchase of an annuity made with a minor should be utterly void, and should remain so, even though the minor, on coming of age, should attempt to confirm it (s. 8). The provisions of this act were intended to be confined to cases where the annuity was granted in consideration of a loan. It was amended and explained by the 3 Geo. IV. c. 92, and 7 Geo. IV. c. 75; but all the usury acts, of which this might be termed one, have been repealed (17 & 18 Vict. c. 90), and parties are now left perfectly free to make their bargains in the terms they think fit.

Annuities may be, and frequently are, created by will; and such a bequest is considered a general legacy, and, in case of a deficiency in the estate of the testator, will abate proportionably with the other legacies.

An annuity may be charged either upon some particular fund (in which case, if the fund fails the annuity ceases), or upon the whole personal estate of the grantor, which is usually effected by a deed of covenant, a bond, or a warrant of attorney. If the person charged with the payment of an annuity becomes bankrupt, the annuity may be proved as a debt, and its value ascertained. (Bankrupt Law Consolidation Act, 12 & 13 Vict. c. 106, s. 175.) Sureties for the payment of it by the bankrupt may also prove (s. 176). The value of the annuity becomes a debt upon the estate of the bankrupt.

If the person on whose life an annuity is granted, dies between two days of payment, the grantee has no claim on him in respect of the time elapsed since the last day of payment. From this rule are excepted annuities granted for the maintenance of the grantee. On government annuities, a quarter's annuity is paid to the executors of an annuitant, if they come in and prove the death. [APPORTIONMENT.]

ANNUITY (in the Law of Scotland). The 53 Geo. III. c. 131, did not extend to Scotland. In that country a fixed sum per annum paid periodically, secured on heritable property, is called an annuity: grants of annuity on personal security are, however, almost unknown. An annuity is generally granted for life: and it may either be created by reservation in a transfer of the property, thus constituting a burden on the new proprietor's title; or it may be granted by the proprietor, the annuitant making his title real, as in the case of an absolute estate in land, by seisin. Provisions to widows and children are thus secured. This species of security on land is to be distinguished from right of annual-rent, which was formerly the mode in which the payment of the interest of money lent on heritable security was made a real burden on the lands, before the modern and more effective security was devised of taking a redeemable conveyance of the lands themselves to the creditor. When the obligor or grantor of an annuity became bankrupt, there was no statutory provision in Scotland for enabling the annuity creditor to prove. The Court of Session was in use to interpose equitably to allow the annuitant to draw a dividend on the value of the annuity. Provisions for the valuation of annuities, and as to the claims of the sureties for its payment, are made by the recent statute 19 & 20 Vict. c. 79. The Act for the amendment of the law of entail in Scotland (11 & 12 Vict. c. 36) enables heirs of entail to grant bonds of annual-rent for the value of the improvements effected by them (ss. 13 & 14). These annual-rents may be made payable for 25 years after the death of the grantor.

ANNUITY (WRIT OF). A writ which lies for the recovery of an annuity, but which is in practice now obsolete (Fitzherbert, 'Nat. Brev.' 356). When annuities are granted, there is always a covenant for payment by the grantor, on which the grantee may sue in covenant.

ANNULET, in architecture. This term is applied to the small eccentric rings or bands which enrich the lower part of the moulding of the Doric capital, just where it falls into, or grows out of, the top of the shaft, or trachelium. It is formed from the Latin word signifying a ring.

AN'NULUS, the geometrical name of a ring, or solid formed by the revolution of a circle about a straight line exterior to its circumference as an axis, and in the plane of the said circle.

To find the surface of a ring, measure the interior and exterior diameters in feet or inches, &c. Multiply together the sum and difference of these diameters, and multiply the product by 2·4674011, taking as many decimals as may be thought necessary. For common purposes, it will be sufficiently exact to divide 200 times the product of the sum and difference twice successively by 9. If still greater correctness be required, subtract from the last result its 500th part. The result will be the number of *square* feet, or inches, &c., in the surface of the ring.

To find the solid content of a ring, measure the outer and inner diameters as before, multiply together their sum and the square of their difference, and multiply this product by ·3084251. For common purposes, it will be sufficient to annex three ciphers to the product of the sum and the square of the difference, and to divide by 3242. The result will be the number of cubic feet or inches, &c. in the ring.

ANNUS DELIBERANDI, in the law of Scotland, is the year immediately following the death of the proprietor of heritable property, which is allowed to the heir that he may make up his mind whether he will accept the succession with the burden of his predecessor's debts. Within that time he cannot be compelled to adopt an alternative, unless he has expressly or virtually resigned the privilege. The practice is adopted from the title of the Pandects ('De Jure Deliberandi,' xxviii. tit. 8). The term of a year was fixed by a constitution of Justinian ('Cod.' vi. tit. 30, s. 19).

ANODY'NES, from the Greek word ἀνώδυνος (*anódunos*), which sometimes signifies, "that which relieves from pain." We may consider pain as an intimation of some derangement of the system, the continuance of which would be hurtful. It therefore prompts us to take measures to remove the causes of it, which being done, the pain generally ceases. But as pain itself, from the inconvenience and suffering which it occasions, frequently aggravates the disease of which it is the accompaniment, it becomes necessary to employ means to lessen or suspend it, even though we should not be able to control the disease: these means are termed *anodynes*, and are either applied externally, or given internally.

The seat of pain is evidently in the nervous system, but its cause and origin appear to be intimately connected with the state of the circulating system, particularly with the quantity of blood contained in the arteries, and the degree of force and rapidity with which it passes through them. Hence pain may be said to be of two kinds; that which occurs when the blood stagnates in the extreme vessels, or capillaries, while the larger vessels propel it with increased force, or the state termed *inflammation*; and that which occurs when there is a deficiency of blood in the extreme vessels, from the action of the large vessels being too feeble to propel it, as happens after long abstinence from food, or other causes of exhaustion—such as prolonged suckling of infants by mothers. The discrimination of these two kinds of pain is of great practical importance; for while the first will be relieved by bleeding and anodynes, the second will be greatly aggravated by the employment of either of these means. It is therefore to the former that the use of anodynes must be limited, in which they appear to be productive of benefit in two ways; first, by rendering the nerves of the part less sensible; and, secondly, by diminishing the violence with which the large vessels propel the blood, when the anodynes are given in sufficient quantity to influence the brain, and through it, by a process extremely complex, which we need not explain here, the contractile power of the heart and arteries. As most of the articles termed anodynes have a powerful influence over the brain, they generally produce sleep, if given in a large dose; hence they are also denominated *hypnotics*; and from causing insensibility, they are also denominated *narcotics*. The knowledge of their possessing this power should lead us to observe great caution in their administration, lest by an over-dose we should produce a fatal coma, or very profound sleep, from which the patient might never be roused.

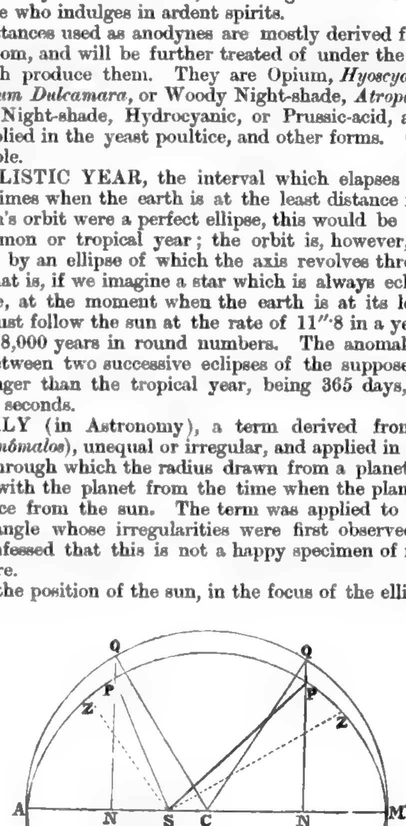
It deserves also to be mentioned, that their frequent repetition produces an injurious effect on the frame, particularly on the nervous system, and function of nutrition; we should therefore carefully guard against acquiring a habit of having recourse to them on slight occasions, or without the sanction of a competent authority. The opium-eater not less certainly induces disease, and brings himself to an untimely end, than he who indulges in ardent spirits.

The substances used as anodynes are mostly derived from the vegetable kingdom, and will be further treated of under the names of the plants which produce them. They are Opium, *Hyoscyamus*, or Henbane, *Solanum Dulcamara*, or Woody Night-shade, *Atropa Belladonna*, or Deadly Night-shade, Hydrocyanic, or Prussic-acid, and Carbonic-acid-gas applied in the yeast poultice, and other forms. Chloroform is most valuable.

ANOMALISTIC YEAR, the interval which elapses between two successive times when the earth is at the least distance from the sun. If the earth's orbit were a perfect ellipse, this would be exactly equal to the common or tropical year; the orbit is, however, more nearly represented by an ellipse of which the axis revolves through 11″·8 in a year. That is, if we imagine a star which is always eclipsed by the sun's centre, at the moment when the earth is at its least distance, that star must follow the sun at the rate of 11″·8 in a year, or a revolution in 108,000 years in round numbers. The anomalistic year, or the time between two successive eclipses of the supposed star, is 25 minutes longer than the tropical year, being 365 days, 6 hours, 13 minutes, 45 seconds.

ANO'MALY (in Astronomy), a term derived from the Greek ἀνώμαλος (*anômalos*), unequal or irregular, and applied in astronomy to the angle through which the radius drawn from a planet to the sun, has moved with the planet from the time when the planet was at its least distance from the sun. The term was applied to this angle, as being the angle whose irregularities were first observed; though it must be confessed that this is not a happy specimen of mathematical nomenclature.

Let S be the position of the sun, in the focus of the ellipse described



by the planet, A the *perihelion*, or point of least distance from the sun, A P M the ellipse described by the planet, A Q M the circumscribed circle, P the place of the planet, and Q P M a perpendicular to the axis A M. Let C be the centre of the ellipse and circle. The planet moved quickest at A, and slowest at M. Conceive a fictitious planet Z to move round the ellipse A P M, with the average motion of the real planet, so as, without varying its motion, to make the angle A S Z increase uniformly, and to describe the whole revolution in the same time as the real planet. Then, for the moment when the planet is at P, the angle A S P is called the *true anomaly*, A S Z is called the *mean anomaly*, and A C Q the *eccentric anomaly*. In speaking of the sun or the moon, it is the earth which is supposed to be at S, and the sun or moon at P. Also, in speaking of the satellites of Jupiter or Saturn, the planet is supposed to be at S, and the satellite at P. For a double star, one star is supposed to be at S, and the other to revolve round it.

The determination of either two anomalies from the third, is a problem of considerable difficulty, the discussion of which may be found in any mathematical work on astronomy.

ANTACIDS, from the Greek word *anti*, against, and the Latin word *acidum*, an acid, signify means used to correct acidity in the stomach. Though hydrochloric acid (formerly called muriatic acid, or spirit of salt) is present in a free state in the stomach during the process of healthy digestion, yet under particular circumstances it is apt to be generated in excess; so also lactic acid. Other acids, such as butyric, acetic, carbonic, &c., are also occasionally evolved in the stomach, probably from the fermentation of the articles, as vegetables and fruits of different kinds, by which the acetic acid is produced, or introduced ready formed, in wines or hard beer; and in certain vegetables, as sorrel, which contains oxalic acid. The most frequent source of acidity is that first mentioned, the secretion of acid by the vessels of the stomach. It is therefore dependent upon constitutional causes, or the state of the system generally. This is further proved by considering what kind of persons are most subject to it; these are individuals either naturally of a feeble and weak constitution, or who have weakened the stomach and system generally by excessive indulgence in *good living*, as it is termed, that is, too much animal food and wine, unaccompanied by exercise and other counteracting measures. Hence, we see these persons, or their children, and even their children's children, subject to gout or gravel, and stone in the bladder. As it has been ascertained (see the works of Mr. Murray Forbes, 'A Treatise on Gravel and Gout,' 1786; Wilson Philip, Marcet, Blane, Prout, and Majendie) that these painful diseases have their origin in the tendency of the stomach to the formation of an excess of acid, an inquiry into the causes of this and the circumstances under which it takes place, is of great importance as a means of preventing or counteracting them.

When an excess of acid is introduced into the blood it occasions much irritation of the system generally, and the composition of the blood being different from its natural constitution, the secretions formed from it are unhealthy, proving a further source of disease. In consequence of the composition of the blood being altered, matters usually held in solution by it can no longer be kept in that state, but are precipitated; hence we have *chalk stones*, as they are termed, formed around the joints in gout, and calculi, or *stones* of different kinds, in the kidney or bladder.

The signs or symptoms of acid being in excess are not in general limited to the stomach, but show themselves in several parts of the body. There is heartburn (cardialgia), often followed by eructation and rejection by the mouth of a fluid so extremely acid as to cause effervescence when it falls on a marble stone; the urine generally scanty and high coloured, from which, on standing, a sediment falls down; the skin dry, harsh, and often affected with eruptions of different kinds; and the mind of the patient fretful, and much given to take gloomy views of his health or circumstances,—in short, decidedly hypochondriacal.

The medicinal means of remedying this state are all alkaline, either the pure alkalies or some combination of them, such as solution of potash, or carbonates of soda, potash, magnesia, ammonia, or lime. Where the bowels are not disordered, but the urine denotes that the excess of acid mostly finds an outlet by that channel, the preparations of potash and soda are to be preferred. Where the bowels are much confined, magnesia or its preparations may be given in conjunction with rhubarb. Nothing is more hurtful than the frequent use of magnesia alone, it being apt to accumulate in the bowels. In the case of an individual much addicted to its use, a mass of it was found after death lodged in the large intestines, which weighed six pounds. If, on the other hand, the bowels be in a loose state, prepared chalk may be given with advantage, or lime-water, which is a very useful addition to milk where, from excess of acid, it disagrees, and hence most serviceable for weak children. Should the mind be much depressed, or general languor of the system exist, and no state of stomach be present forbidding its use, ammonia in some form may be exhibited.

Such are the medicines by which the effects of an excess of acid may be in some degree counteracted; but the most efficient means of preventing its formation consist in a strict attention to diet and regimen. Great moderation must be observed in the quantity as well as quality of the food and drink. The plainest and most digestible animal food should be taken once, or at the utmost twice a day, and sparingly. Hard-boiled puddings and dumplings must be avoided. Toast and water, or soda-water, or well-fermented beer, or cyder, are preferable as drinks to wine or ardent spirits; the only one of which last that can be allowed is Hollands, and never but under particular circumstances, and with the sanction of a medical adviser.

Regular exercise, friction, and every means, such as flannel next the skin, which can keep up a free action of the skin, form a most important part of the prophylactic treatment.

ANTÆ. This is a term used by architects to designate the pier-formed ends of a wall, as in the terminations of the lateral walls in a Greek temple, where a plain face returns on each side, having some relation in general proportion to the columns with which they compose. The antæ (for the word is used alike in the singular and in the plural) has a moulded and otherwise enriched cap or cornice, and generally a moulded base. In the simple Greek Doric style or order, both the cap and the base-moulding are of few parts, and the enrichments are few, and are confined to the mouldings, which may be either carved or painted; but in the more ornate Ionian or voluted style, both the cap and base of the antæ are in proportion deeper, are in a greater number of parts, and have extrinsic ornaments, besides the carving or painting of the mouldings of the cap, and the fluting or reeding of those of the base. The antæ of the foliated or Corinthian style admits of still further enrichment, though the bold foliage and diagonal volutes of the capital of the column should never be placed on the square faces and sharp angles of the antæ. The moulded caps and bases of antæ are, in Greek works, generally continued along the flank walls so as to form the cornice and base of the whole wall, and not of the protruded faces of its ends alone. In Roman works, and in modern imitations of both, breaks are often made on the face of a wall with the caps and bases of antæ, but more frequently with those of columns, and these are called pilasters, though indeed they are but an abuse of the Greek *parastas*, or antæ. In classical Greek, and in the best Roman works, antæ and pilasters are never either diminished or fluted. [TEMPLE.]

ANTAGONIST MUSCLE, from ἀντί, against, and ἀγωνίζομαι, to strive—a muscle, the action of which is opposed to that of some other muscle. Muscles are the instruments by which, in the animal body, motion is effected. The object of each muscle is to produce some specific motion: among the various motions which are needed in the animal economy, it necessarily happens that some are directly opposite to others, and the muscles which accomplish these directly opposite movements are said to be with relation to each other *antagonists*. When any part of the body is placed between muscles which have an opposite or antagonising action, the result of the combined action of such muscles is to keep that part steadily in a certain position. The form and position of the human mouth, for example, are maintained, such as they are, in a state of health and during repose of the features, by a number of muscles, composing the lips and cheeks, the action of some of which is directly contrary to that of others: the natural figure and position of the mouth may, therefore, be truly said to be the result of the combined action of a number of antagonising muscles. The consequence of the disturbance of this antagonising action is to change the natural form and position of the mouth. This is shown by the effect of paralysis when it affects one side of the face. Paralysis is a disease depriving the muscle of its power of acting. In paralysis of one side of the face, the muscles of that side are deprived of their power of acting; and the consequence is, that the muscles of the other side, which retain their usual power, pull the mouth to their side, because they do not meet with the resistance which formerly opposed their effort to do this. Hence comes distortion of the mouth; and distortion is one of the most frequent and striking signs of apoplexy and paralysis, a sign dependent, it is obvious, on the loss of the antagonising power of the muscles of that part of the body in which the distortion takes place. Sometimes the elasticity of a part is put in opposition to a muscle, and becomes the antagonising power. The elasticity of the ribs, of the windpipe, of the arteries, may be so considered.

ANTALKALIES, from *anti*, against, and *alkali*, an alkali, are means of counteracting the presence of alkalies in the system. An alkaline condition of the system is not an unusual occurrence, and leads, when long continued or extreme, to very serious consequences. The worst of these is the formation of those calculi or stones in the bladder denominated *phosphates*. A tendency to this state exists in most weak individuals: hence, most commonly in children, old persons, and females. It may also be brought on by any cause which occasions either temporary or general debility. The prevalence of the depressing passions, as fear, anxiety, or any other which keeps up a *nervous state* of the system, the frequent and continued use of mercury, of powerful purgatives in sickly frames, injuries of the back, or the previous existence of a very acid state of the system, will occasionally give rise to an alkaline state of the system, which, when considerable, shows itself by great general debility, pale countenance, deranged state of the stomach and bowels, and excessive secretion of urine of a pale colour, which, on standing, makes a white deposit. To cure and prevent the return of such a state, the causes must, as far as possible, be removed. This is best done by diet, regimen, and appropriate medicines. The diet should be nourishing, mostly animal food, but taken in moderation; and where wine is used, light French or Rhenish should be preferred; hard water should be carefully avoided; saline purgatives, as Rochelle salts or seidlitz powders, and indeed all combinations of a vegetable acid with an alkaline base, such as the common saline draught, must be abstained from. The irritability of the system is best lessened by opium and tonic medicines. These last furnish an excellent vehicle for the administration of acids, which are the most fitting medicines, either muriatic, nitric, or the citric acid, which is most grateful to children. The phosphate of iron is also a very useful medicine. Purgatives of an active kind should seldom be given; but when the stomach and bowels of children are much disordered, calomel and rhubarb taken frequently for some time are of much service, especially when the phosphate of iron is employed at the same time. Pure, invigorating air, and moderate exercise, are very beneficial, with relaxation from too great mental exertion, where this has preceded the disease.

ANTARES, a name given to the bright star marked α in the constellation SCORPIO, which see. In the latitude of Greenwich, it has not more than $12\frac{1}{4}°$ of altitude when on the meridian, where it is at midnight in the beginning of July. In 1846, this star was discovered to be double by Professor Mitchell, of Cincinnati, U.S. According to Mr. Dawes, the two constituent bodies were about $3''\cdot 4$ apart in the year 1848.

ANTECEDENT, a mathematical term used in proportion, meaning the *first* of the two terms of a ratio, in opposition to the *consequent*, or second term. Thus, in the continued proportion :—

$$2 : 4 :: 3 : 6 :: 4 : 8 :: 5 : 10, \&c.$$

2, 3, 4, 5, &c., are antecedents; 4, 6, 8, 10, &c., are consequents. Antecedents may be made consequents, and consequents antecedents without altering the truth of the proportion. Thus, if

$$a : b :: c : d,$$

it is equally true that

$$b : a :: d : c.$$

ANTECEDENTIA. When a heavenly body moves contrary to the order of the signs of the zodiac—from Gemini to Taurus, from Taurus to Aries, &c.—it is said to move *in antecedentia*. When it moves according to the order of the signs, it is said to move *in consequentia*.

ANTEFIXA, or ANTEFIXÆ, for this term is more frequently used in the plural, for both singular and plural, than otherwise. Antefixæ are blocks with vertical faces placed along the top of a cornice in ancient Greek and Roman buildings, to hide the ends of the covering or joint tiles, and their faces are generally carved with a flower, leaf, or other enrichment, to make them ornamental. The lions' heads and masks sometimes carved or fixed on the upper mouldings of cornices, which serve as spouts to carry off the water, are also called antefixæ. Several terra cotta antefixæ of very beautiful design, from Rome, are in the British Museum. The flanks and rounded projection from the eastern end of the church of St. Pancras, in London, exhibit antefixæ ranged over the cornice, but without the parts of which they are the fitting accompaniments. The Pall Mall and Carlton Gardens fronts of the Travellers' Club House, in London, show antefixæ more judiciously composed with the roof, with which they form an ornament to, and help to enrich, the elevation.

ANTEPAGMENTA. This is an ancient term for the jambs of a door, or, as they are familiarly termed, the door-posts.

ANTHELMINTICS, from two Greek words, signifying means used to expel worms from the intestinal canal, and to prevent their formation. Though the origin of worms in the intestines has been a subject of inquiry and controversy for many ages, we are far from having arrived at a satisfactory conclusion respecting it. While some have regarded them as the result of what is termed *spontaneous* or *equivocal generation* occurring in the intestines (see Aristot. 'Hist. Anim.' v. 19), others have maintained that they are introduced into the stomach from without, either along with our food, or in some other way, in so small a form as to be unobserved. Great difficulties attend either view of the question. If it is held that they come from without, the sources of them have never been seen, and cannot be pointed out. The opinion of their spontaneous generation is also rendered very improbable, both by the consideration that such an occurrence would be at variance with the present universal mode of production of all other animals, which invariably issue from parents similar to themselves, and by the fact that, however the worms may be at first produced, when once developed in the intestines, they are propagated like other animals of the same grade in the scale of organisation, namely, by parents of distinct sexes; and the *ova* or *eggs* which the female produces are both to be seen in the oviducts (see fig. 1, *a*), before they escape, and also are to be found among the contents of the intestines previous to their development as perfect worms. The settlement of this question would be interesting, and might prove useful in directing us in our prophylactic treatment. But as we cannot pretend to this in the present state of our knowledge, we must refrain from further discussion of the subject, and rather inquire into the circumstances and conditions favourable to their development and the means of counteracting them.

The causes of worms, and of the tendency to their formation, may be divided into, 1, general and local, referring to the residence; and, 2, special, referring to the individual infested by them, his constitution, habits, diet, &c.

Of the first division, the most general is climate. In certain countries worms prevail more than in others; and hence their frequency in Holland, where there is no want of personal cleanliness, or attention to the food; but the constant moisture of the atmosphere, both producing general weakness, and acting hurtfully on the skin,—the state of which, owing to the sympathy existing between it and the digestive organs, influences greatly the health of the body,—farther predisposes to their development. We see the same causes operate in producing the rot in sheep, which is always accompanied by the presence of a worm (the *Distoma hepaticum* or *fluke*) in the liver; and we shall find the same means prove successful in preventing their formation in both cases: as only sheep feeding in wet pastures, such as marshes, are subject to the rot.

Dwelling in an impure air, where there is not sufficient ventilation, prepares the body for becoming the seat of worms, and hence their greater frequency among the crowded inhabitants of towns than among the peasantry.

The effect of these general causes is to produce a weak state of the system, the existence of which, however occasioned, seems the first requisite for the development of worms. When in addition to these there are other causes which operate only on individuals, we perceive the reason why one person becomes subject to worms, from which another person continues exempt. This naturally conducts to the second set of causes, connected with the individual affected by these parasites. These we shall find to be a constitution, either hereditarily weak, or debilitated by sedentary occupations and improper diet. Accordingly, those most subject to worms are females and children, especially of a scrophulous habit. In these last there exists very commonly weakness of the digestive organs, along with an immoderate craving for food, which injudicious parents and nurses are too apt to indulge—regarding it as the sign of a good appetite—by which more aliment is introduced into the stomach than it can conveniently digest, and consequently the stomach and bowels become clogged, both by the undigested matters remaining in them, and also by the unhealthy secretions, which, under such circumstances, are invariably poured into them. The articles given to satisfy this craving, which generally shows itself between meals, are almost always those which experience has shown to be the most calculated to favour the production of worms, namely, articles of too farinaceous a kind, as biscuits, cakes of different sorts, or bread and butter, or cheese: for milk, and the preparations of it, which we have just mentioned, seem to dispose to the formation of worms more decidedly than anything else.

The presence of worms in the intestines cannot always be determined by any one, or even by the concurrence of many symptoms, for enormous tænias (*tape worms*) have sometimes been passed, of the existence of which not the least suspicion was entertained by the individual; nor was any derangement of the health observable. But we are justified in suspecting them to be present where the appearance and expression of the countenance are much altered from the natural state; when it is of a pale, somewhat leaden, hue, subject to sudden flushings, often limited to one side of the face, where the eyes have lost their brightness, the pupil is enlarged, and the lower eyelid surrounded by a livid circle. In addition to these symptoms, the nose is often swollen, and affected by an intolerable itching, or frequently bleeding; there are pains in the head, with ringing of the ears; the tongue is coated, and the breath disagreeable. The appetite is very variable, sometimes there is none, at other times it is ravenous: there is often a feeling of sickness and a disposition to vomit; occasionally there are violent cholics, the bowels irregular, seldom costive, more frequently loose; the stools slimy, sometimes tinged with blood; the belly swollen and hard, while there is generally a wasting of the rest of the body; the urine is rarely clear, often of a milky appearance. The sleep is disturbed, and the child grinds the teeth; during the day, it is indolent, and very variable in temper.

It is necessary to be thus minute in stating the symptoms of worms, as, sometimes on very slight grounds, individuals have been subjected to a long and severe course of treatment for worms, when none existed; while, too often, they are allowed to commit their ravages unmolested, and to plunge the unhappy victim into a state of great misery and suffering, and even lead to a fatal termination. We are not willing to attach full credit to all the horrible consequences attributed to worms, but that they often produce many serious diseases, and aggravate others, is certain.

The number of different kinds of worms infesting the stomach or intestines of man is not very great, but they propagate their species often with astonishing rapidity. We shall enumerate the most common sorts, following the nomenclature of Bremser, ('Lebende Würmer in lebenden Menschen.' Wien, 1819; also translated into French, by Dr. Grundler, Paris, 1828. 'Traité des Vers Intestinaux.')

The *Trichocephalus dispar* (or *long thread worm*), found in the upper part of the large intestines (or *Cæcum*); *Oxyuris vermicularis* (*Ascaris vermicularis*, the *maw*, or *thread worm*), which inhabits the rectum, or lowest intestine; *Ascaris lumbricoides* (the large round worm), mostly found in the small intestines; *Bothriocephalus latus* (*Tænia lata*, the *broad tape-worm*), found in the small intestines (principally of the inhabitants of Russia, Poland, and Switzerland, seldom met with in Britain); *Tænia solium* (the *tape-worm*), in the small intestines, generally alone, but occasionally three or four together: the *Distoma hepaticum* (or *fluke*), is sometimes found in the liver and gall-bladder of man, but more commonly of sheep, goats, &c.

The worms which are occasionally found in other parts of the body are not under the influence of the medicines termed *anthelmintics*, and we therefore leave them unnoticed here.

To assist us in distinguishing the particular kind of worm present in the intestinal canal, and to regulate thereby our treatment, it is proper to mention that the maw, or thread worm, and large round worm, are most common in youth, and the tape-worm in adult age.

From what has been said above, the principles of treatment may readily be deduced: these are, to strengthen the individual, and weaken the worms, which facilitates their expulsion, and diminishes the tendency to their formation. This last is a point of great practical importance; for not only is it of little use to expel worms already existing in the intestines, unless we remove the tendency or disposition to their production, but, very frequently, many of the articles inconsiderately administered (which however are regarded as valuable anthelmintics, because, by their operation, they bring away worms), often do more harm to the individual who takes them than to the worms. It is clear that all articles which by their sharp angles merely irritate the worms must do much more injury to the inner coat of the stomach and intestines, and cannot possibly be introduced or insinuated between the mouths of the animals and the surface to which they are attached. The woodcut (*fig.* 4) shows by what a number of hooks the *tape-worm* attaches itself to the gut. When we see these, need we wonder at the difficulty of expelling this formidable and most determined parasite?

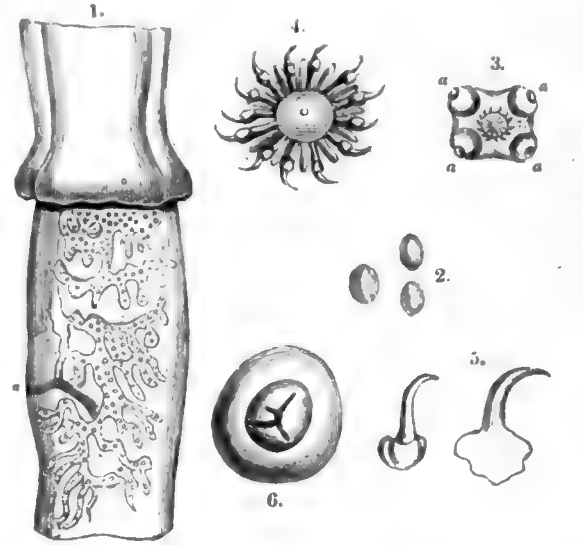
The means employed to effect the ends proposed are very numerous, but reducible to three heads: namely, those which by increasing the peristaltic motion of the intestines, displace the worms, and often occasion their expulsion, as purgative medicines of different kinds; those which tend to increase the strength of the stomach and intestines, and system generally, as tonics, or analeptics; and lastly, those which are conceived to act in an especial manner on the worms, dislodging, weakening, or killing them—or anthelmintics, in the strict sense of the word. Our means must be varied, for not only are the different kinds of worms limited to different parts of the intestinal canal, and the species of worms infesting it different at different periods of life, but particular substances are found to be more efficacious against one species than against others.

As a part of the general treatment of worms, purgatives are indispensable, and those should be selected which bring away the greatest quantity of slime; but the frequent repetition of such is inexpedient. Calomel with jalap, or scammony may be given, with the interval of two days between each dose, two or three times, followed by tartrate of antimony in very small doses for a week: this may be succeeded by aloes, with antimonial powder, which last being laid aside, preparations of iron alone, or with gentian and canella, may be united with the aloes. This plan may be pursued, whatever be the kind of worm supposed to be present, being merely intended to improve the general health of the patient. When the strength is somewhat increased, cold, which is very pernicious to the worms, may be added to our means of cure, and employed in various ways. Large quantities of cold water, rendered still colder by dissolving in it, immediately before drinking, a quantity of table-salt, or muriate of soda, may be taken. Sea-water may also be drunk with great benefit.

Among our purgative means we must not omit to mention sulphate of potass and rhubarb, to which if there be nervous symptoms present, such as a tendency to epilepsy or hysteria, valerian may be advantageously added. Different mineral waters are of great service, particularly in the treatment of the maw-worm. These both remove the slime in which the worms nestle, and diminish the tendency to its formation. With this view we may have recourse to the waters of Cheltenham, and above all, to the sulphureous springs of Harrogate, followed by chalybeates there, or at Tunbridge.

The means of strengthening the digestive organs, consist of tonic and astringent medicines, both vegetable and mineral. Vegetable bitters are doubly advantageous, since they both strengthen the stomach, and prove direct poisons to the worms: of these, the best are chamomile tea, and infusion of quassia, or gentian, to which muriatic acid, or tincture of muriate of iron may be added; for children the tartrite of iron, being almost tasteless, is advisable. The utility of vegetable bitters is proved by the fact, that wherever the *Menyanthes trifoliata* (*bog-bean*), or the tormentil, grows, however damp the pastures may be, the rot never infests the sheep. A similar immunity from the rot is generally enjoyed by sheep fed on the salt marshes, or where salt is regularly mixed with their food. (See 'Reports of Lord Somerville.') The omission of a proper quantity of salt with our food favours the engendering of worms. The great tendency to the formation of worms in Holland has been mentioned, and when the "ancient laws of that country ordained men to be kept on bread alone, *unmixed with salt*, as the *severest* punishment that could be inflicted upon them in their moist climate, the effect was horrible; the wretched criminals are said to have been *devoured by worms*." The medicines enumerated constitute the most effectual means of preventing the return of worms; those which follow are deemed the best for expelling particular kinds of worms. The tape-worm (*Tænia solium*) is almost invariably expelled dead, by a large dose of oil of turpentine; and even the *long round worm* is influenced by it in somewhat smaller doses. Scarcely any other article need be employed, unless the disagreeable smell and taste be objected to, when the *Brayera anthelmintica*, Kousso, should be given as at once safe and efficacious: we might naturally expect this result, since it belongs to the same natural family tribe as the tormentil, namely, the *Rosaceæ*. The root of the pomegranate is much esteemed in India. No reliance should be placed on the root of the male fern, as it is only useful against the *Bothriocephalus latus*, or *broad tape-worm*, which, though common in Switzerland, is rare in Britain.

The *long round worm* is almost invariably expelled by the *Spigelia Marylandica*, or Indian pink, which belongs to the same natural family as the bog-bean, or water trefoil, namely, the *Gentianæ*. The *Oxyures*, or maw-worms, are the most troublesome to the patient, and the most difficult to remove, as medicines taken by the mouth are too much altered before reaching the rectum to produce any great effect; compound chalk powder, which contains tormentil, is very useful. After the employment of the above-mentioned general measures, we should use local means only. The intolerable itching which they occasion about the rectum, is best relieved by a lavement of sweet-oil. A lavement of very cold water, or lime-water, may be useful, if, after it, a portion of aloes be introduced, and left to dissolve in the bowel. Injections of tobacco, and the use of all such dangerous articles as bear's-foot (*Helleborus fœtidus*), are to be avoided. The same may be said of tin-filings, cowhage, and all things which can act only as mechanical irritants.



1. Two joints of the *Tænia solium*, tape-worm, magnified, in one of which are seen the numerous ova, or eggs. *a*. The oviduct by which they pass out. 2. Some of the eggs, much magnified. 3. Head of the animal, seen in front to show the mouth in the centre, surrounded by a circle of hooks, and the four suckers, *a*, *a*, *a*, *a*, of which two are alternately protruded, and two retracted. 4. The mouth with its hooks. 5. Two of the hooks, very greatly magnified. 6. A sucker, much magnified.

ANTHEM, in music, was originally a simple hymn, or kind of psalm-tune, sung alternately by the two sides of the choir. The term is now, however, applied to compositions in use in all our choirs, set to verses from the Psalms, or to any portion of the Scriptures or Liturgy; and the anthem may be for one, two, or any number of voices, but rarely exceeds five parts. [ANTIPHONY.]

There are three kinds of anthem, namely, verse; full, with verse; and full. The first, which is solo, or duet, &c., has only one voice to a part, and, requiring nicety of execution, is generally assigned to the best singers in the choir. The second, consisting chiefly of chorus, is sung by the whole choir, but the verse parts by single voices. The third is chorus wholly, and performed by all the voices.

The English school has always excelled in the composition of anthems. Tallis led the way in full anthems, and was immediately followed by Birde and Farrant. Their harmony is quaint, but indescribably solemn, and in true keeping with the Gothic structures wherein it was first heard. Orlando Gibbons soon succeeded those masters, and in the same kind of anthem—but highly elaborated, and enriched with whatever florid counterpoint could supply—brought forth works that have always been, and must ever continue to be, admired, not for their ingenuity only, but their effect. Blow was one of the first to introduce the verse anthem, but his compositions, dry and stiff, are become nearly obsolete. Purcell, his pupil, produced numerous anthems, some few of them exhibiting striking beauties, and much grandeur of conception; but the majority, being written in the manner of his master, are more learned than pleasing. Michael Wise and Jeremiah Clark made our cathedrals acquainted with natural and pathetic melody. Croft, Greene, Boyce, and Nares, in anthems of all the three species, united air and harmony, genius and learning, in a manner unequalled; though it is to be regretted that their works are little known, except where choir service is performed, and seldom heard, in our parochial churches and other places of worship.

A'NTHEMIS NO'BILIS (COMMON or ROMAN CHAMOMILE)—*Medical Properties of.* This is an indigenous plant, frequent on our commons; but the flowers used in medicine are generally obtained from cultivated plants. Of these there are two kinds, the single or semi-double, and the perfectly double. The doubling of the flowers is attended with a lessening of their virtues, as the single are more aromatic, and contain more volatile oil, which resides in the yellow tubular florets of the disk. Their excellence may be determined by the beautiful whiteness of the radiant florets, the yellowness of those of the disk, and the strength of the aroma and taste.

Those which are brown, mouldy, and faintly smelling, should be rejected. They contain a volatile oil of a beautiful blue colour, camphor (?), a gum resinous principle, and a small quantity of tannin.

The difference both of taste and smell, the diversity of the oil, and the absence of the camphor-like principle, show the impropriety of substituting for the *Anthemis* the flowers of the *Matricarica Chamomilla* (or Feverfew). In this genus the receptacle is naked, in the *Anthemis* it is paleaceous,—besides, the flowers are smaller, and of an unpleasant smell. The flowers should be gathered before they fully expand. The forms of exhibition are, powder, infusion, extract, and oil.

Chamomile is an excellent bitter and tonic agent. Given in powder, or pill, or extract, with addition of a few drops of the oil, it is of great service in dyspepsia, atonic gout, and in intermittent fevers. The infusion may be made the vehicle for alkalies or acids.

The infusion when tepid is emetic, and may be given beneficially in dyspepsia, and at the commencement of catarrh (particularly influenza), and hooping-cough.

The decoction is an objectionable form, as it dissipates the oil. Even the infusion should be made with cold water. A most grateful aperient for weak dyspeptic patients is made by steeping senna leaves, chamomile flowers, and a very few cardamoms for ten hours in cold water, straining, and adding to the infusion any saline medicine required. The extract possesses valuable tonic properties, but in preparing it the volatile oil is dissipated, which deprives it of aroma. This may be restored to it by adding a few drops of the volatile oil. Extract of chamomile, with sulphate of quinine and the volatile oil, furnishes a combination of immense power in improving the appetite and aiding the digestion in convalescences from acute diseases, or after an attack of gout.

Infusion of chamomile, either warm or cold, furnishes an excellent application to weak eyes, or after exposure to the wind in travelling, especially by railroads. This used early will often ward off inflammation.

A'NTHEMIS (or ANACYCLUS) PYRETHRUM—*Medical Properties of.* Pellitory of Spain grows in the south of Europe, north of Africa, and in Syria, but the root of another variety, *Pyrethrum*, Willd. native of Germany, is also met with. The first is called the Roman or true Pellitory, the latter the German; this is necessary to be known, as the chemical analysis varies considerably. Gautier seems to have analysed the Roman, and found it to contain—

An acrid fixed oil or resin (Pyrethrin)	5
Volatile oil (a trace)	
Yellow extractive	14
Gum	11
Inulin	33
Muriate of lime (a trace)	
Woody matter	35
Loss	2
	100

It is devoid of smell, and though it does not at first excite any sensation in the mouth, it is followed by a pungent taste, and flow of saliva.

Its use is confined to local affections of the mouth, whether sub-inflammatory or paralytic. In rigidity of the muscles of the jaw, or rheumatic pains, from exposure to currents of air, chewing this is often of great service. An infusion may be held in the mouth, also, in toothache from cold. A tincture may be formed of it, which would be a useful agent in paralysis of the stomach, added to the infusion.

ANTHO'LOGY, a compound Greek word, used metaphorically, signifying "a Garland of Flowers," viz., of poetry, and consisting of short poems on amatory, convivial, moral, funereal, monumental, descriptive, dedicatory, satirical, and humorous subjects. Their characteristic merit consists in the just expression of a single thought with brevity and poetic beauty. The term *anthology* is peculiarly appropriated to a collection of Greek epigrams, taking the word not in the confined sense in which we now use it, for a pointed and witty conceit, but in the more enlarged and literal acceptation, of an *inscription*. The earliest and closest application of the term epigram was to certain short sentences inscribed on offerings in the temples. Inscriptions on buildings in general, on the statues of gods, heroes, living or dead men, next came under the denomination. They might be either in verse or prose. A moral precept, or the main bearing of a law, was embodied in this convenient form. Hence every little poem, presenting one distinct idea or insulated argument, gradually acquired the title of epigram. The largest portion of those collected in the Greek Anthology was written in honour of the dead, introducing their names and characters, or occupations; or as tributes to beauty, in gratitude for acceptance, or in complaint on account of rejection; some of them are panegyrics on living and illustrious virtue; others contain brief records of remarkable events; others again consist of observations on human life, for the most part in a dark style of colouring.

Meleager the Syrian, whose exact date seems difficult to fix, lived probably somewhat less than a century before the Christian era, and is generally understood to have first collected the scattered fragments of the Grecian inscriptive muse. Its interest mainly arises from its being a record of the intellectual vigour of Greece in its declining days, when her energy, whether in arms or in arts, had become less active, but had not entirely died away.

Philip of Thessalonica continued the work about the time of Tiberius. The additional compositions were less interesting, but still pleasing. In the sixth century Agathias collected the miscellaneous fragments of his time, and added his own contributions to the expiring muses of Greece. The bent of his own mind towards poetry seems to have been strong; in early youth he had produced a collection of amorous poems, entitled 'Daphniaca,' which would have done honour to better times. He had a coadjutor in his friend Paul the Silentiary (an officer in the court of Justinian, corresponding to the modern gentleman-usher), whose topics were desultory, and his style that of the courtier and the voluptuary. From the decay of manuscripts and the zeal of the clergy in the dark ages against all works of imagination or of gaiety, our present collection, although large, has lost many of its brightest and earliest ornaments; and it so happens, that it retains more pieces from the compilation of Agathias, than from that of his two predecessors conjointly.

In the 10th century, Constantinus Cephalas saved these manuscripts from oblivion by re-editing them. Maximus Planudes, a monk of the 14th century, was the last collector. The first printed edition of the 'Anthologia' was that of Lascaris, accompanied with some Greek verses by the editor, and a Latin epistle to Pietro de Medici. It bears the date of Florence, 1494. Claude de Saumaise, better known to the world by the Latin name of Salmasius, and to Englishmen as the antagonist of Milton, who lived in the 16th and the first half of the 17th centuries, detected the unfitness of Planudes for the duties of an editor, by the discovery, in 1606, of a MS. in the library of Heidelberg. During the 18th century, Suidas and the manuscripts in the public libraries of Europe were ransacked, and a valuable booty of epigrams, undiscovered or rejected by Planudes, enriched the 'Analecta' of Brunck and the 'Anthologia' of Jacobs. The former work, 'Analecta Veterum Poetarum Græcorum,' is contained in three volumes, octavo, Strasburg, 1772-6: the latter in thirteen volumes, octavo, Leipzig, 1794-1814. The edition of Jacobs is the latest, and best: but there is much matter strictly applicable to this purpose still left unedited. There are some inscriptions, for instance, in the Elgin collection of the British Museum, that ought to be added to any future edition.

A volume of translations, chiefly from the Greek 'Anthology,' was published in 1806 by Messrs. Bland and Merivale, with contributions from other gentlemen. Subsequent editions have been since published, in which the superfluities of the preceding ones are removed, and a number of additional specimens, many of them by younger translators, are introduced: and in this state the work may be recommended as presenting a very elegant and faithful specimen of the original Greek Anthology, and one which is not likely to be surpassed. (For a full account of the editions, &c., of the Anthology, see Schoell, 'Geschichte der Griech. Litt.' vol. iii.)

ANTHRACIN. [PARANAPHTHALIN.]

ANTHRANILIC ACID. [PHENYL; CARBAMIC ACID.]

ANTHROPO'GRAPHY, a term designed to express the object of one branch of physical geography.

The object of anthropography, which literally signifies *man-description*, is, to describe the actual geographical distribution of the human race; to classify it according to the varieties of physical character and language; to distinguish between nations or tribes which have the same general physical character and speak the same language, and nations or tribes which seem to belong to one stock, and have from circumstances adopted the language of another stock; to describe briefly the religious and domestic usages which constitute the basis of national character.

The term ethnography (nation-description) is sometimes used by German writers in the sense which we have given to anthropography; though, as far as we have observed, when so used, the word ethnography is rather more limited in its signification than that which we have assigned to anthropography. Some German writers use also the word *Völkerkunde* (people-knowledge) as an equivalent to ethnography. But ethnography has of late years been rather used to express an historical investigation into the origin and migrations and connection of various peoples. Taking it in this sense, ethnography is purely of an historical character, and may be considered as distinct from anthropography. A series of anthropographies, of different epochs, would form the true basis of ethnography.

ANTHROPOMORPHISM, a compound Greek word, literally signifying "the representation of human form:" but it is properly used to signify the "representation of divinity under a human form;" and the nations or sects who have followed this practice have been sometimes called Anthropomorphites. The Egyptians represented deities under human forms, as well as those of animals, and sometimes under a combination of the two. The ancient Persians, as Herodotus tells us (i. 131), adored the Supreme Being under no visible form of their own creation, but they worshipped on the tops of mountains, and sacrificed to the sun and moon, to earth, fire, water, and the winds. The Hebrews were forbidden (Exod. xx. 4, 5) to make any image or the representation of any animated being whatever.

The Greeks were essentially anthropomorphists, and could never separate the idea of superior powers from the representation of them under a human form: hence, in their mythology and in their arts, each deity had his distinguishing attributes and a characteristic human shape. Painters in modern times have, in Roman Catholic countries, represented both the First and Second Persons of the Trinity under a human form: in Protestant countries our Saviour is usually only so represented during his sojourn on earth, though individual painters have represented the risen and glorified Saviour.

Anthropomorphists is also the name of a sect of early Christians.

ANTHROPOPHAGI. [CANNIBALS.]

ANTIARIN ($C_{14}H_{20}O_{10}$), the poisonous principle of the *Upas antiar.* It forms small pearly crystals, soluble in 27 parts of boiling water, and also in alcohol and ether; it cannot be sublimed without decomposition. Introduced into a wound, it rapidly brings on vomiting, convulsions, and death. The gum resin from which it is extracted is used by the Javanese for poisoning their arrows.

According to Mulder, this gum-resin contains—

Vegetable albumen	16·14
Gum	12·34
Resin	20·93
Myricine	7·02
Antiarin	3·56
Sugar	6·31
Extractive matter	33·70
	100·00

ANTI-ATTRITION, is a preparation used to lessen friction in machinery, and also to prevent iron from rusting. It is made by grinding black lead with four times its weight of lard or tallow, and adding a little camphor to the mixture.

ANTICHRIST (Ἀντίχριστος) means, literally, the opponent of the anointed, or of the Messiah. The name of Antichrist was given by Jews and Christians to the great enemy of true religion, who shall, according to the Holy Scriptures, appear before the coming of the Messiah in glory.

The name of Antichrist occurs in the New Testament only in the first two epistles of St. John: thus, 1 Epist. ii. 18, 22, St. John says, "He is antichrist, that denieth the Father and the Son;" and in chap. iv. 3, "Every spirit that confesseth not that Jesus Christ is come in the flesh is not of God: and this is that spirit of antichrist, whereof ye have heard that it should come; and even now already is in the world." See also 2 Epist. 7. St. Paul calls Antichrist that *man of sin*, the son of perdition; who opposeth and exalteth himself above all that is called God, or that is worshipped; so that he sitteth in the temple of God, showing himself that he is God. That Wicked "whom the Lord shall consume with the spirit of his mouth, and shall destroy with the brightness of his coming:" "whose coming is after the working of Satan, with all power and signs and lying wonders."—2 Thess. ii. Emblematical descriptions of Antichrist occur in the twelfth and thirteenth chapters of the Revelations.

ANTIDICOMARIANITES (from two Greek words signifying *adversary*, and *Mary*), a sect of so-called heretics, whose peculiar belief was that Mary the mother of our Saviour did not continue a virgin after his birth, as the Roman Catholic Church asserts that she did to the end of her life, but bore other children to her husband Joseph. The founders or first preachers of Antidicomarianitism were Helvidius and Jovinian, two Roman theologians of the latter part of the 4th century, the latter of whom is also charged with various other heresies. The original accounts of Helvidius and Jovinian, and of their opinions, are to be found in the writings of Augustine, Jerome, and Epiphanius, who were their contemporaries.

ANTIDOTES, from two Greek words, signifying, *given against;* the means of counteracting the effects of poisons. The term *antidote* had formerly a much wider signification, and was applied to the remedies for diseases occurring from natural causes, as well as to the remedies for the derangements of the functions arising from the direct introduction into the system of a known and material poison. Doubtless every disease may be looked upon as springing from some poison; as fevers from an altered and unhealthy state of the atmosphere; or eruptive and contagious diseases from the vitiated fluids or breath of one individual communicated to another, as small-pox, and hooping-cough. This opinion is expressed by the employment of the term *virus*, or *poison*, to signify the immediate cause of such diseases; as when we speak of the small-pox virus, or the vaccine virus.

But as, in the present day, the word antidote is used only to signify the means of counteracting the effects of poisons, strictly so called, we shall confine our observations to what is properly comprehended under the term, when employed in this sense. While thus limiting its signification, it is equally necessary that we should limit the application of the word *poison*. It is, however, extremely difficult to define what a poison is. Foderé considers poisons to be "those substances known to be capable of rapidly altering or destroying some or all of the functions necessary to life." This must be understood to apply to their introduction (whether accidentally, intentionally on the part of the person suffering, or criminally on the part of others) into the body when in the usual state of health; for there are certain diseased conditions of the system, which seem to render it incapable of being injuriously affected by doses of medicines which at another time would speedily destroy life; and other states, such as when the body is under the influence of one poison, where another proves the most effectual remedy or antidote. This latter state is strikingly exemplified in the case of the bite of the *Coluber carinatus*, a species of snake common in the West Indies, during the state of stupor or insensibility occasioned by which, a large quantity of arsenic may be given, not only with safety, but with such advantage that the recovery of the patient may be considered as owing solely to it.

To acquire a correct idea of the different ways in which poisons operate in destroying life, we must be made aware that what we commonly regard as an *individual*, is made up of a number of distinct organs, which, though in some respects independent of each other, yet exert a reciprocal influence, the harmonious play of the whole being necessary to the continuous exercise or display of the principle of life, and that a cessation of the functions of any one of the more important organs necessitates the successive suspension of the rest. The most essential of these are consequently denominated the *vital functions*, viz., the circulation, respiration, and innervation. The circulation of red or *arterial* blood through the system, but especially through the nervous matter of the brain and spinal chord, is essential to the existence of the vital properties, and due performance of the functions of the different organs—which circulation is effected by the action of the *heart*,—while, to render the blood arterial, respiration is necessary, and this is effected by the *lungs*, assisted by a great number of muscles, the co-operation, or simultaneous action of which is occasioned by the influence of the *spinal chord*, directed or influenced by the *brain*. Now, certain poisons act either solely on one of these organs and functions, or upon two or three, but always in an ascertained order or uniform succession. Oxalic acid (or the acid of sugar, as it is popularly called), for example, in a small dose, acts first on the brain and spinal chord, but in a larger dose also affects the heart: in the former case, the respiration will be perceptibly interfered with, while the heart will go on acting for some time; in the latter case, both will cease at the same moment. Recovery, therefore, is much more probable in the first instance than in the second; for we can carry on *artificial* respiration till the brain and spinal chord have resumed the exercise of their functions; but if, as in the second instance, the heart also has ceased to act, recovery is impossible.

An arrangement of poisons according to their mode of action, that is, according to the order in which the vital functions are successively affected and destroyed by them, would be of great utility in regulating our treatment, teaching us when to be content with the employment of antidotes alone, and when to employ supplementary means,—as artificial respiration, blood-letting, &c. At present we can only make an approximation to such an arrangement.

Another point of consequence is the settlement of the question,—Do poisons act solely on the sentient extremities of the nerves of the part to which they are applied, and influence remote organs, only by sympathy, or are they absorbed into the circulating fluids, and by them carried to the organs, whose impaired or suspended functions show them to be markedly affected by them? Without entering into this dispute, it may be stated that some poisons act in the one way, some in the other way, and a few in both. Of these, the first set are the most formidable and the most speedy in their action, allowing little time for the employment of antidotes.

Some poisons act, but with different degrees of violence and speed, whatever part of the body they are applied to; others, again, only when received into the stomach or intestines; while some, such as the poison of the viper, are quite powerless when swallowed. Of all parts of the body, the brain and nervous substance are the least susceptible of the action of poisons, when applied directly to them, though acted upon by so many poisons when applied elsewhere.

With respect to the local operation of poisons, that is, their direct action on the part to which they are applied, some decompose chemically, or alter the structure of (corrode) the part which they touch, and hence they are called *corrosive* poisons; such are the mineral acids, of which sulphuric, or oil of vitriol may serve as an example. Besides this local effect, many of the corrosive poisons act speedily upon remote organs, the impaired function of which may become a source of greater danger than the destruction of the part first attacked.

Other poisons, without immediately altering the structure of the part, irritate it so that inflammation ensues, by which it is altered, and the general system affected, as it would be by inflammation of the same part arising from any other cause—even when the poisonous substance does not produce any immediate or powerful effect upon a remote organ—which is not often the case, as most of them influence some of the vital functions, and thus prove fatal. These are termed *irritant* poisons, such as arsenic; but they are frequently also termed corrosives, though inaccurately.

Lastly, there are poisons which neither corrode nor irritate the part, but cause a peculiar impression upon the sentient extremities of the nerves, which is conveyed along these to some remote organ or organs, the function of which they impair or suspend. Many of these should be termed sedatives, in the strictest sense of the word [SEDATIVES]; others are narcotics; and those which produce some degree of local irritation are termed narcotico-acrids. But often one and the same article, according to the dose and mode of administration, acts in all the three ways; tobacco, for example.

The selection of appropriate means to counteract the effects of poisons must be determined by a knowledge of the manner in which each particular poison acts; but as we cannot enumerate or specify these here, we shall give only general rules to this effect. These may be reduced to three, namely, 1, to remove the poisonous substance; 2, to prevent or limit its local effects; 3, to obviate its effects on remote organs, supporting their action by appropriate measures, till the injurious impression has subsided. The first of these is to be accomplished mostly by mechanical means. If the poison has been applied to any external part, as by the bite of a viper or rattle-snake, a cupping-glass, or what will answer as well, a wine-glass, tumbler, or cup of any kind, from which a part of the air has been expelled, by holding within it a lighted candle for a second of time, should be immediately applied. If the poison has been taken into the stomach, and is not of a kind to arrest instantly the action of the heart, its removal is to be attempted by the stomach-pump, or by exciting vomiting. The stomach-pump cannot well be used without introducing into the stomach a considerable quantity of water, which, by diluting the poison, lessens its violence in all cases, except that of oxalic acid. The stomach-pump is also to be preferred in the case of narcotic poisons, as the insensibility which they occasion prevents the stomach from being affected by emetics. But should a stomach-pump not be at hand, nor any one be present skilled in the use of it, we must attempt to produce vomiting by every means in our power. For this purpose, a table-spoonful of flour of mustard, which is mostly to be found in every house, may be put into a tumbler of warm water, and given to the patient; or a scruple of sulphate of zinc (white vitriol) dissolved in a pint of distilled water; or ten grains of sulphate of copper dissolved in half a pint of any distilled water, as cinnamon, may be drunk by the patient, and the disposition to vomit encouraged by tickling the throat with a feather, and pressing on the pit of the stomach. Neither ipecacuanha nor tartar emetic should be given, as their action is always preceded by much nausea, during which the absorption of the poison is often facilitated.

Where the poison is of a corrosive or irritant nature, instead of losing time in seeking the means of causing vomiting, it is in general advisable to adopt the second rule, and attempt to prevent or limit its local, and thereby its remote, effects. To accomplish this, we must ascertain what the poisonous substance was, from which the patient is suffering, and must also know how it acts, as upon this depends the success of our treatment. The objects we must have in view are either to dilute, and so weaken it; to supply from an external source the particular principle, which the poison would abstract from the coats of the stomach; or by adding something to it, so change its nature as to render it comparatively or altogether harmless, which last will always be effected, if we can succeed in forming an insoluble compound. The first may be done by giving plenty of warm water; and when we know the particular poison, if the warm water can be made the vehicle of an antidote, the second or third object will also be insured. Suppose sulphuric acid (oil of vitriol) has been swallowed, add to the water chalk, magnesia, or soap: the chalk will make, with the acid, sulphate of lime, which being insoluble, will do no harm, while with the magnesia the acid will form sulphate of magnesia (Epsom salts), and with the soap sulphate of potash, both of which are purgative salts, and will, by their action on the bowels, assist in lessening the inflammation caused by the poison before it was decomposed. So when sugar of lead (acetate of lead) is swallowed, by giving Epsom salts we form an insoluble sulphate of lead, which will be discharged by the bowels operated upon by the magnesia, which has been freed from the sulphuric acid. Corrosive sublimate (bi-chloride) of mercury abstracts from the coats of the stomach the albumen which they contain, by which it is converted into protochloride, or calomel; now, if by giving white of egg, which is pure albumen, we supply it with the principle which it would otherwise obtain from the coats of the stomach, we shall preserve these entire.

Such means, then, are antidotes, properly speaking; for the means by which the secondary or remote effects are to be combated, deserve rather to be termed counter-poisons. The counter-poisons are of no small value in cases of poisoning by the corrosive and irritant, while they are of the utmost importance in the treatment of the sedative and narcotic poisons. To administer these appropriately, we must know which of the vital organs the poison most speedily affects. When it affects the heart, the symptoms greatly resemble syncope (or fainting), and as such poisons are the most dangerous, agents which act as rapidly as the poisons are alone to be trusted to: such agents are to be found among the diffusible stimuli, ammonia, or its carbonate, that is, smelling salts, applied to the nostrils, or dissolved in water and taken into the stomach, warm brandy and water, &c. Where it chiefly affects the spinal marrow, there occur spasms and difficulty of breathing; and when the brain, there is partial or complete insensibility (coma), often with, at first, full pulse, flushed face, and laborious breathing, resembling apoplexy. In such a state of affairs, artificial respiration, and afterwards bleeding, with the subsequent administration of coffee or vinegar, greatly contribute to save the patient.

We have not spoken here of gaseous poisons, which would lead to unnecessary details. They act either by excluding the common atmospheric air, in which case removal into pure air is required; or by producing inflammation, like the irritant, or oppression of the brain, like the narcotic poisons, and are to be combated on similar principles. It will be more useful to append a list of the poisons which act on the brain, and of those which act on the heart. Of poisons which act upon the brain the most common are alcohol, that is spirituous liquors, opium, henbane, hemlock, camphor, and the essential oil of almonds, and of tobacco. Of those acting on the heart, the chief are, infusion of tobacco, and large doses of prussic acid, foxglove, strychnia (principle of nux vomica), oxalic acid, arsenic, preparations or salts of antimony and of baryta, chloroform, and several animal poisons.

From what has been said on this subject, the great necessity of an acquaintance with it must be sufficiently clear, not only to insure our doing right, but to prevent us from doing wrong. By administering an ill-timed antidote (as we conceive it to be), we often hasten the fatal event: as where vinegar is given when opium has been swallowed, before it has been ejected from the stomach; and by throwing tobacco smoke into the bowels of a person apparently drowned, we extinguish the feeble spark of life which might have sufficed to re-animate him but for such injudicious interference.

It is to be hoped that more just principles of treatment will be diffused among the people, as well as among medical men, by which many lives may be preserved to their families and to the community. [POISONS.]

ANTI-FERMENT. In the cider-districts a substance under this name is sold for the purpose of correcting fermentation. Mustard seed and clover, or mustard seed and sulphate of lime, are usually the ingredients: they tend to allay the fermentation of cider or perry, or even beer.

ANTI-FRICTION WHEELS. The action of friction or anti-friction wheels in machinery is to diminish resistance by converting what would otherwise be a rubbing into a rolling contact. Friction rollers, which are generally of small diameter, are not necessarily fixed upon axles or shafts, but are interposed bodily between the rubbing or sliding surfaces which press upon them; and they may thus be employed to alleviate friction between surfaces. In some arrangements of mechanism, friction rollers are provided with small axles which do not bear any important strain, but are used chiefly for the purpose of keeping the rollers in their proper place. The wheels of an ordinary carriage are in principle very little other than anti-friction wheels or rollers.

The various applications of anti-friction rotation are very numerous; but they all depend on this principle—that when the surfaces of two bodies are made to pass over each other with a rubbing or sliding motion, their inequalities necessarily meet and oppose each other, and thereby cause both resistance and wear; but if rollers or wheels be applied between them, instead of the inequalities of the roller being dragged against those of the surface upon which it rolls, they are successively laid upon (so to speak) and lifted up from them.

ANTILOGARITHM, as used in this country, means the *number to the logarithm*. Thus, in Brigg's system, 100 is the antilogarithm of 2, because 2 is the logarithm of 100. We have introduced this term, because the French 'Encyclopædia,' followed by Dr. Hutton, have defined the word to mean what is more usually called the *complement* of the logarithm, namely, the remainder produced by subtracting the logarithm from the next higher term in the series, 1, 10, 100, &c. This is not the most commonly received meaning of the word in this country.

It is becoming usual to express the number to a logarithm by writing the logarithm in brackets. There is, however, another notation much more consistent with received symbols. In the same manner as $\sin^{-1}x$ stands for the *angle whose sine is* x, $\log^{-1}x$ should mean the *number whose logarithm is* x. Thus, we might write either

$$\log 100 = 2$$
$$\text{or } 100 = \log^{-1} 2.$$

ANTIMONIC ACID. [ANTIMONY.]

ANTIMONIOUS ACID. [ANTIMONY.]

ANTIMONY (Sb), a metal, sometimes called *regulus of antimony*, to distinguish it from *crude antimony*, the name by which the native sulphuret is known in commerce. The ores of antimony have long been known, but Basil Valentine first obtained it in the metallic state towards the end of the 15th century. It occurs, though rarely, native, but is generally obtained from the sulphuret, which is by far its most abundant ore. The sulphuret is roasted in reverberatory furnaces, by which it is converted into a compound of oxide and sulphuret of antimony, known as *glass of antimony*; this is then mixed with charcoal impregnated with carbonate of soda, and heated in crucibles; and the oxide is reduced to the metallic state by the carbon, then the sulphuret is converted into oxide by the carbonate of soda. As it occurs in commerce the metal contains lead, iron, sulphur, and arsenic, from which it may be freed by fusion with 10 per cent. of nitre.

Antimony has a silver white colour, of great lustre, and a fracture varying from broad laminated to granular crystalline, according to the rapidity with which it has been cooled; it crystallises mostly in acute rhombohedrons. It is very brittle, and easily powdered. Its sp. gr. varies from 6·70 to 6·86; it fuses at 778° F., and does not expand on cooling. At a white heat it can be distilled in an atmosphere of hydrogen. It does not sensibly alter in the air at ordinary temperatures, but readily oxidises when melted in contact with air. Its symbol is Sb (*stibium*), and its atomic weight 120·3 (Scheeren). In its chemical relations it is closely allied to nitrogen, phosphorus, and arsenic.

Oxide of Antimony—Antimonic Oxide (SbO_3) occurs native as white antimony ore. When antimony is heated in an imperfectly closed crucible, this substance is deposited on the sides in the form of brilliant white prismatic crystals, which have been called *argentine flowers of antimony*. Thus prepared it often contains antimoniate of oxide of antimony; and the purest oxide is obtained by digesting oxychloride of antimony with a solution of carbonate of soda, and carefully washing and drying the residue.

Oxide of antimony is of a grayish colour. Heated in contact with the air it is resolved into antimoniate of oxide of antimony, it is insoluble in water, but is dissolved by dilute nitric and hydrochloric acids, and by strong nitric acid is oxidised to antimonic acid. It is a feeble base, and unites with acids to form salts of oxide of antimony, which have a weak metallic taste, and act as emetics. The most important of these, and indeed the most important compound of antimony, *tartar emetic*, $SbO_3, KO, C_8H_4O_{10}, 2HO$, is a combination of tartaric acid with potash and oxide of antimony. It is prepared by boiling oxide of antimony, or glass of antimony, with cream of tartar; the solution filtered hot, deposits on cooling white brilliant octohedra, which are the salt in question. The neutral salts of antimonic oxide are decomposed by excess of water into a free acid, which retains some of the oxide in solution, and into a basic salt which precipitates. The addition of tartaric acid prevents this precipitation. Sulphuretted hydrogen produces in acid solutions of teroxide of antimony, an orange-coloured precipitate of tersulphide of antimony soluble in potash, and sulphide of ammonium.

Antimonic Acid (SbO_5) is prepared by dissolving antimony in aqua regia, evaporating to dryness, and calcining the residue at a temperature below redness. Thus obtained it is anhydrous, and is a white powder, which when strongly heated gives off oxygen, and is converted into an intermediate oxide, SbO_4. It is also insoluble in water, but when boiled with alkalies or alkaline carbonates, it gradually dissolves, and from this solution acids precipitate the hydrated antimonic acid, SbO_5, HO. It is a monobasic acid, and the general formula of the antimoniates in the anhydrous condition is MO, SbO_5. Antimonic acid is also obtained when pentachloride of antimony is decomposed by excess of water;

$$\underbrace{SbCl_5}_{\text{Pentachloride of Antimony.}} + \underbrace{7HO}_{\text{Water.}} = \underbrace{SbO_5, 2HO}_{\text{Metantimonic Acid.}} + \underbrace{5HCl}_{\text{Hydrochloric Acid.}}$$

But the acid thus prepared differs from the former one in being bibasic. It forms salts which have the general formula, $2MO, SbO_5$, and MO, HO, SbO_5: it is called *metantimonic acid*, and its salts *metantimoniates*.

Antimoniate of antimonic oxide ($SbO_4 = SbO_3, SbO_5$), or *antimonious acid*, is formed when either of the two oxides is heated in the air. It is a grayish white, infusible, non-volatile powder, insoluble in water. When treated with tartaric acid, teroxide of antimony is dissolved, and antimonic acid left; while treatment with alkalies removes antimonic acid and leaves antimonic oxide.

Antimony forms with chlorine two compounds, the terchloride and the pentachloride.

Terchloride of antimony ($SbCl_3$) may be prepared by mixing one part of metallic antimony with two parts of chloride of mercury, and submitting the mixture to distillation in a retort. The chloride distils over as a buttery mass, which becomes crystalline in solidifying. From its appearance the term *butter of antimony* is derived; the substance occurring in commerce under this name is a more or less concentrated solution of the terchloride in hydrochloric acid, and is usually prepared by treating native sulphuret of antimony with strong hydrochloric acid.

$$\underbrace{SbS_3}_{\text{Sulphuret of Antimony.}} + \underbrace{3HCl}_{\text{Hydrochloric Acid.}} = \underbrace{SbCl_3}_{\text{Terchloride of Antimony.}} + \underbrace{3SH}_{\text{Sulphuretted Hydrogen.}}$$

It is used as a caustic in veterinary surgery, and is also employed for bronzing gun-barrels; in which latter case it acts by the deposition of a thin film of antimony, which protects the barrel from oxidation.

Terchloride of antimony is very deliquescent; when treated with a small quantity of water it dissolves, but on the addition of a larger quantity, a white flocculent precipitate is formed, which changes after some time to a crystalline powder. This is the *powder of algaroth*, an antimonial preparation, formerly of great importance; it is a compound of teroxide of antimony with chloride of antimony, its formula being $SbCl_3 + 5SbO_3$. The flocculent precipitate which at first forms is considered to be an oxychloride, SbO_2Cl.

Pentachloride of antimony ($SbCl_5$) is prepared by distilling antimony in a current of chlorine; the combination is effected with disengagement of heat, and the pentachloride distils over as a mobile, pale yellow liquid, which emits white fumes in the air, and has a strong disagreeable smell. It attracts moisture from the atmosphere, and, by a larger quantity of water, is decomposed into antimonic and hydrochloric acids. Pentachloride of antimony readily gives up part of its chlorine; on passing olefiant gas through it, chloride of ethylene ($C_4H_4Cl_2$), Dutch liquid, is formed, and phosgene gas ($C_2O_2Cl_2$) is produced when carbonic oxide (CO) is conducted into it. With dry sulphuretted hydrogen it forms a white crystalline compound, the sulphochloride of antimony (SbS_2Cl_3), analogous to the sulphochloride of phosphorus.

Bromine and iodine form with antimony respectively the *terbromide* and *teriodide of antimony* ($SbBr_3$, and SbI_3).

Antimony forms with sulphur two sulphides of antimony (SbS_3 and SbS_5), corresponding to antimonic oxide and antimonic acid. The tersulphide occurs native; it is of a leaden gray colour, with radiating crystalline fracture and metallic aspect. When heated in closed vessels it melts and crystallises in striated masses. It may be prepared by heating together antimony and sulphur. When heated in the air it absorbs oxygen, and becomes converted into oxide of antimony, which combines with undecomposed sulphuret in proportions which vary with the duration of the experiment and the temperature employed. These oxysulphides are known as *glass of antimony*, or *crocus*, or *liver of antimony*. Native tersulphide of antimony is used as an ingredient in Bengal fire.

Tersulphide of antimony (SbS_3) is formed as a characteristic orange-red precipitate, when sulphuretted hydrogen is passed through an acid solution of antimonic oxide. It dissolves readily in alkalies and alkaline sulphides, and is again precipitated by acids.

Kermes mineral, a preparation occasionally used in medicine, consists essentially of the hydrated tersulphide mixed or combined with teroxide of antimony and sometimes sulphantimonic acid. It may be prepared in the moist way by boiling native tersulphide of antimony in fine powder with solution of carbonate of soda; the solution deposits, on cooling, the kermes as a red amorphous powder.

Pentasulphide of antimony (SbS_5), or *sulphantimonic acid*, is formed when sulphuretted hydrogen gas is passed through solution of pentachloride of antimony. It is a yellowish red precipitate, which readily dissolves in alkalies and in alkaline sulphides; with the latter it forms sulphur salts, which frequently crystallise well. A *sulphantimoniate of sulphide of sodium*, occasionally used in medicine, forms pale yellow crystals, which have the formula $3NaS, SbS_5 + 18HO$.

Antimoniuretted hydrogen (SbH_3). When an alloy of zinc and antimony is treated with dilute sulphuric acid, or when a solution of teroxide of antimony is added to dilute sulphuric acid and zinc, the gas disengaged consists of hydrogen containing a small proportion of antimoniuretted hydrogen. The gas has an alliaceous odour, and imparts to the flame of the hydrogen a livid white appearance. When passed through a heated narrow tube, or when its flame impinges on a cold porcelain plate, a mirror of reduced antimony is deposited. The gas has not been obtained pure, but its composition is most probably SbH_3. It is analogous to ammonia and phosphuretted hydrogen.

When antimony is alloyed with other metals, it generally renders them harder and more brittle. By far the most important alloy is that of antimony and lead, which forms *type metal*; it contains 17 to 20 per cent. of antimony. This alloy expands at the moment of solidification, and takes a very sharp impression of the mould.

Mr. Gore has recently found, that when antimony is electrolytically deposited from a solution of three or four parts of tartar emetic in one part of butter of antimony, it possesses most singular properties. By friction, by scratching, or by feeble percussion, it is reduced to powder, with a sufficient disengagement of heat to melt tin, and a sort of explosion accompanied by the emission of white vapours. The same phenomena take place when it is immersed in water of 75° C., which is then found to contain hydrochloric acid and oxychloride of antimony.

The compounds of antimony are recognised by the characteristic colour of the precipitates produced by sulphuretted hydrogen in their solutions.

ANTIMONY (MEDICAL USES OF). Though the introduction of antimony into the number of medicinal agents was very violently opposed, and even decrees by the Parliament of Paris were passed against its use, it is now justly regarded as a most valuable remedy in many diseases. As antimony cannot produce any effect on the human system, unless when so prepared as to be capable of decomposition by the fluids of the body, the tartarised form, being the most soluble, has properly superseded the others. Its action varies according to the dose, the mode of administration, and the state of the system when it is exhibited. In very small doses, it seems to increase the activity of the function of secretion, particularly of the mucous membranes; hence it occasions a flow of thin fluid from these surfaces, which form the inner lining of the lungs and intestinal canal; and also an increased action of the skin, and flow of perspiration, if the patient be kept warm. In a larger dose it causes vomiting, with all the phenomena of that action; and from being commonly employed for this purpose, it is designated *Emetic Tartar.* Compared with other emetics it may be said to be distinguished by the ease with which it causes vomiting, as well as by the certainty, though in this latter respect it is surpassed by sulphate of zinc (white vitriol). It may be given to persons of any age, except to very young children, for whom ipecacuanha wine is preferable. It ought not to be given in cases of poisoning, for reasons stated under the head ANTIDOTES, and least of all should it be given in cases of narcotic poisons, since in large doses it is itself a poison, unless vomiting take place; and as, by narcotic poisons, the sensibility of the stomach is so lowered or destroyed as not to occasion the rejection of anything received into it, the impropriety of exhibiting tartar emetic in such cases is manifest. From the extremely small quantity of this substance which is sufficient to occasion vomiting, there is one state in which it is to be preferred to every other means of causing vomiting. By whatever channel tartar emetic is introduced into the system, it invariably excites the stomach to perform the act of vomiting, unless the person be in a state of insensibility or coma; a solution of two grains of it, in three ounces of warm distilled water, may, by a skilful operator, be injected into a vein when the gullet is obstructed by any extraneous body lodged in it. In the same way it may be sometimes tried in tetanus, or lock-jaw, when the teeth are so firmly clenched together that nothing can be made to pass them.

As tartarised antimony is decomposed by most bitter or astringent vegetables, which contain tannin (except oak-bark), and an insoluble, and consequently an inert, tannate of the protoxide of antimony is thereby produced, such vegetables, in the form of infusion, decoction, or tincture, furnish the best antidote in cases of over-dose, or poisoning by this article, should it not, by inducing vomiting, prove its own antidote. Under these circumstances, we should administer decoction or tincture of yellow cinchona bark, or, when these cannot be easily procured, a strong infusion of tea.

Employed in appropriate doses, its action as an emetic is seldom violent, while it certainly acts more powerfully than other emetics in prompting the secretion of the fluids of the stomach, as well as of the bile and pancreatic juice, with those of the lungs, and indeed all the secretions, external as well as internal. Now, as the suppression of the secretions is one of the most common occurrences in the early stage of fever, and the restoration and improved character of these one of the most favourable signs of its abatement, antimony is employed with great advantage in the treatment of fever, and it cannot be used too early. Indeed, many a fever is stopped or prevented by the employment of this or some other emetic, as ipecacuanha, upon the first intimation of the disease being felt. It is also suited to the beginning of each paroxysm of intermittent or remittent fevers [AGUE]. It may also be advantageously given about the period of the expected crisis in continued fever. When the disease is of a highly inflammatory type, it should be combined with, or followed by, saline medicines; but when there is great depression of the vital powers, as in typhus, the salines must be soon laid aside, and stimulating medicines cautiously substituted.

Antimony is also used in some eruptive or exanthematous fevers, such as measles and scarlet fever, being less suited for those in which the eruption is of a vesicular or pustular character, and which affect the deeper layers of the skin. (For a classification of cutaneous diseases on this principle, see Craigie's 'Pathological Anatomy.') Antimony is well suited for rheumatic fever and erysipelas, as in these diseases the liver is deranged, and furnishes an unhealthy biliary secretion. It is also useful in what are sometimes termed mucous and bilious fevers, which are attended with very depraved secretions from the intestinal canal, which may be removed and improved by repeated small doses of an antimonial.

It is also in daily use for the cure of catarrhal affections, that is, colds affecting the mucous membrane of the lungs.

Tartrate of antimony, when intended to act as an emetic, is generally given in the dose of a quarter or half a grain dissolved in distilled water, and repeated every ten or twenty minutes till vomiting occurs; but when merely intended to cause nausea, or to act gently on the secretions of the intestinal canal of the lungs or that of the skin, it is given in even smaller doses, and at the interval of two, four, or six hours. Lately, however, a mode of employing it in much larger and more frequent doses has been practised with marked benefit in several diseases of an inflammatory character, particularly in pneumonia or inflammation of the lungs. According to this plan, from two to three grains dissolved in water, are given, and repeated every two hours or so, for a considerable time, even for two or three days. The early doses cause vomiting and purging, but these effects soon cease to appear, while the pulse is found to have fallen to fifty beats, or even less, in a minute. When pursued with caution and managed skilfully, it often enables us to overcome the disease, and to dispense with the removal of so much blood from the system, as might otherwise have been necessary. It ought not to be tried, however, if the mucous membrane of the stomach be in a state of irritation or subacute inflammation; a condition which often occurs during pneumonia. This state of the stomach must be removed by general or local means before we venture upon the exhibition of the antimony.

This plan of administering tartar emetic is generally believed to have originated with the Italian physicians Rasori and Tommasini; but whatever merit it possesses is justly due to Dr. Marryat of Bristol, who proposed it in 1790, many years before its employment in Italy.

Tartrate of antimony is applied externally as an ointment and plaster; and in either way it excites an action of the part, leading to the formation of a vesicular eruption, similar to that of vaccinia or cow-pox; and it is consequently used as a means of counter-irritation, often with great advantage. The ointment and plaster may be prepared of different degrees of strength, but care must be taken not to make them too strong, as the antimony may be absorbed from the ulcerated surface, and produce violent vomiting, which in some cases has been so serious as to cause death.

Other forms or preparations of antimony are used, but more as ingredients of certain compounds than in their simple state. Oxide, more properly teroxide of antimony, called also *flowers of antimony*, is the chief active ingredient in the pulvis antimonialis composition, the officinal substitute for the empirical article called James's powder. This possesses the same diaphoretic, expectorant, and emetic properties as tartarised antimony. It is also the active ingredient in the oxy- or gray sulphuret, the glass of antimony, kermes, and golden sulphuret.

Terchloride (formerly muriate) of antimony, called popularly *butter of antimony*, is a powerful caustic. When applied to the skin, it spreads, cauterising wherever it goes. Proper steps must be taken to limit it to the part to be destroyed. If at hand, it is good to apply instantly to the bite of serpents or mad-dogs.

Oxysulphuret, or precipitated, or golden, sulphuret is the chief active ingredient in the compound chloride of mercury pill, formerly called Plummer's pill. This is of great service in cutaneous diseases as an alterative.

ANTIMONY, OXIDE OF. [ANTIMONY.]

ANTINO'MIANS, from the Greek, signifies *against the law.* It is applied by theologians to those, if any there be, who hold that faith in Jesus Christ dispenses with, and renders unnecessary, so far as a future state is concerned, the observance of morality and the performance of good works. We say, if any there be, because there is reason to suppose that the accounts of earlier antinomians contain much exaggeration, and that there never was any body of men, worthy to be called a sect by numbers and duration, which professed the above opinion.

So far as avowed abandonment of morals, we find various antinomian sects in the first three centuries; but the name was first applied to the followers of John Agricola, a townsman and contemporary of Luther, born at Eisleben in Saxony. His opinions had the tendency above mentioned, and were attacked by Luther, who, with the assistance of the elector of Brandenburg, obliged him to publish a retractation. It must, however, be observed, that Bayle points out (in the article *Islebiens*) the exaggerations which have been made of Agricola's opinions and their source, and that Agricola himself was employed with others in drawing up the 'Interim,' a provisional confession of faith, promulgated by the emperor Charles V., at Augsburg, in 1548, which Dupin (and Catholic writers are, in general, shrewd judges between one Protestant and another), admits to be perfectly orthodox on the article of justification.

This sect has obtained very little notice from Continental writers, and its followers appear rather to have been distributed among other persuasions. The assembly of divines in 1643 condemned several writings which appeared to them antinomian; and the Parliament in 1648, in what ought to be called the Presbyterian persecution Act, among other provisions, enacted, that any one convicted, on the oaths of two witnesses, of maintaining that the moral law of the Ten Commandments is no rule for Christians, or that a believer need not repent or pray for pardon of sin, should publicly retract, or, on his refusal, be imprisoned till he found sureties that he would no more maintain the same.

The little importance of this sect renders it unnecessary to dwell further upon its history; but the name, like others, is bandied about as a term of reproach by many who do not understand its meaning.

ANTINOUS. [AQUILA.]

ANTI'PATHY (from the Greek ἀντιπάθεια, compounded of ἀντί *contrary*, and πάθος *feeling*), properly signifies an involuntary dislike or aversion entertained by an animate being for some sensible object. Thus a man may have an antipathy to particular smells or tastes—a turkey-cock to the colour red, or a horse to the smell of raw meat, &c. There is no doubt that many antipathies are natural, and do not arise from any accidental circumstance: such as the aversion in mankind to the tastes and smells of many drugs, and of bodies in a state of putrefaction. Such natural antipathies may, however, in many cases, be overcome by habit; as in the case of surgeons, who soon learn to conquer the disgust occasioned by the effluvia arising in the dissection of the human subject. Some nations constantly eat food which the rest of mankind would nauseate, as the Esquimaux, who live on whale blubber and train oil. When the Cossacks were in London and Paris, in 1814, they sometimes drank the whale oil from the lamps in the streets: probably an Englishman or Frenchman would, if starving, reject the draught which the Cossack considered as a luxury. It is moreover quite conceivable that individuals may have such physical peculiarities as will cause them to feel pain from impressions on the senses, which, to the generality of mankind, are indifferent, or even pleasurable: thus some persons are painfully affected by the smells of certain flowers or perfumes, which are commonly considered agreeable, and are sold as means of sensual enjoyment. Many antipathies, however, are not natural, but acquired, and arise from our associating certain objects with the idea of something terrible or dangerous. Thus people acquire antipathies to spiders, earwigs, wasps, snakes, rats, and other animals, from forming exaggerated notions of their powers of harming mankind; and by encouraging such aversions, they may acquire so great sensitiveness and acuteness in distinguishing these animals by the smell, sight, or hearing, that they may be aware of their presence when other people are unconscious of it. Persons may acquire antipathies to certain kinds of food by having been surfeited with them, or by having been accustomed to eat them for long periods of time, as under a medical regimen during an illness; or because they are made of substances which they consider as unclean, or because they are unfashionable, as being eaten by people whom they think less refined and delicate than themselves. This may not unfrequently be observed in persons of narrow and feeble minds, and more especially in children, in whom such fanciful dislikes ought to be carefully but not harshly corrected. See Locke's 'Essay on the Understanding,' b. ii. c. 33, §§ 7 and 8.)

Antipathy properly means, as we defined it, a dislike of an *animate* being for some *sensible* object. Its meaning, however, is sometimes improperly extended to *inanimate* beings; a phraseology now nearly obsolete, but which was much used by the ancient naturalists, who would, for example, have said that an alkali had an antipathy to an acid, or that water had an antipathy to oil. At other times the word is restricted to animate beings, but is applied to things which are not objects of the senses. Thus it has been said that the mind has an antipathy to certain classes of actions; by which it is meant that it is endued with an innate faculty of distinguishing between right and wrong. [MORAL SENSE.]

It is sometimes stated that *antipathy* is the contrary of *sympathy;* but this is not strictly true, at least as respects the use of those two words in modern language. Sympathy means *joint sensibility*, or the feeling of pain or pleasure in consequence of pain or pleasure felt by another sentient being. Thus a person who pitied the misfortunes of another, or who felt delight in the same pursuits, amusements, or studies, as another, would in either case be said to sympathise with him. Sometimes sympathy is applied to the simultaneous irritability of different parts of the body; thus one eye is said to sympathise with the other, when an injury inflicted on one is felt by both.

ANTIPHLOGISTIC TREATMENT (from two Greek words, ἀντὶ, *against*, and φλόγωσις, *inflammation*), is the means of removing or lessening inflammation, and of obviating its effects. As it would be out of place here to consider fully either inflammation, or its causes, we shall merely state that these last are, either mechanical, as wounds, bruises, &c., or of a more general nature, as atmospheric changes operating on the body from without, or altered conditions of some of the organs or functions of the body, operating within, and influencing, more or less, the rest of the system. The effects of the first set of causes are, primarily, always local, but sooner or later become general, that is, affect the whole system; the effects of the second set of causes may be, primarily, either local or general; but when local, having a much greater tendency early to become general. The local effects seem to consist in an alteration of the vital action of the part, accompanied with *pain, swelling*, and increased *heat* and *redness*. The general effects are disturbance of various functions, most usually a diminution of the functions of secretion, exhalation, and nutrition, or assimilation: the heart's-action, the respiration, and functions of the nervous system are also affected, but in different degrees and order in different cases. The change of the vital action of the part appears to produce a quickened movement of the blood in the extreme vessels, or capillaries, as they are termed, which are sometimes slightly contracted, though more commonly dilated, so that the blood presently begins to move more slowly, and at length stagnates in the part, as we may see in the white of the eye when inflamed. The blood, too, in the neighbouring capillaries, seems to incline towards the part, while the large arteries leading to it, and ultimately the heart, assume an increased action, which occasions greater frequency and, generally, force of pulse. The consequences of these alterations of the action of the vessels are, the effusion either of some of the constituents of the blood, as the serum or albumen, in their natural state, or their change into substances not found in the blood, or any other fluid of the body, in its healthy state. These become the source of further change of structure, as suppuration, ulceration, &c., and the cause of disturbance in the functions of the system, varying with the seat of the inflammation, its intensity, and other circumstances.

The means of preventing or moderating these constitute collectively the antiphlogistic treatment and regimen. We shall here briefly notice the chief of these.

Blood-letting.—We have just stated that one of the effects of inflammation is to produce effusion of the serum or lymph of the blood, the extent of which depends on the quantity of blood which goes to the parts affected. The processes of inflammation, in its earlier stages, may be very certainly restrained or arrested by diminishing that quantity. This is done by abstraction of blood, either local or general. If the inflammation be allowed to proceed, suppuration, ulceration, or other changes, and destruction of parts, according to the texture affected, will ensue. Now, abstraction of blood, though it may prevent the extension of suppuration and ulceration to parts not yet affected, is rarely found effectual in checking the formation of pus or *matter*, where that has been already established. We see then the necessity of the early employment of bleeding, and the other antiphlogistic means, if we desire them to be productive of the greatest amount of benefit. The prejudices and prevailing habits of the people are, however generally in direct opposition to such beneficial measures; and too often timid practitioners allow their judgment to be overborne by the importunate requests for delay of the well-intending but ignorant relations. Thus the time when these measures would have proved most serviceable, is allowed to pass over; and when at last put into practice, their good effects not being so conspicuous, they are not so highly appreciated as they would be if employed at an earlier period. Indeed, at a very late stage, far from being useful, they are decidedly hurtful. (See the case of a professional man mentioned under the article ABSTINENCE.)

During inflammation of shut sacs or cavities, that is, those cavities of the body which do not communicate with the external air and which are lined with *serous* membranes, the disposition to effusion of much lymph, or the albumen of the blood, is greater than in other cases. To prevent this, more prompt and vigorous measures must be used. Modern physicians have ascertained that mercury, especially in combination with opium, has a powerful influence, not only in preventing the effusion of lymph, but in removing it soon after it is effused: an example of this is witnessed when, in the inflammation of the eye, called *iritis*, the pupil is filled up, and vision prevented by the lymph effused; yet this is speedily removed if a sufficient quantity of mercury be early introduced into the system. This, then, constitutes another valuable antiphlogistic means.

Purgatives.—The quantity of blood in the system, and the amount of serum, may be greatly lessened by the use of purgative medicines, especially the saline purgatives, which generally produce very liquid motions, consisting of a large proportion of serum. These are not only proper, but constitute an essential part of the antiphlogistic treatment.

Nauseants, that is, such doses of emetic medicines as occasion a constant feeling of sickness, without causing vomiting, reduce the action of the heart, and lessen the tendency to effusion, while they promote the absorption of the fluid already effused. They are, consequently, very valuable auxiliary agents in subduing inflammatory diseases.

Diaphoretics.—The quantity of blood may be diminished, and its acrimony lessened, by increasing the perspiration or discharge from the skin, which in most cases of inflammation is lessened, and in some altogether suppressed. By this diminution or suppression of perspiration, not only more blood is retained in the system, but also those salts and acids which in a healthy state find an outlet by this channel. The means of increasing perspiration are termed diaphoretics, or sudorifics. These, however, seldom produce the desired effect, if there be much heat of surface, that is, of the skin. This must previously be moderated by the use of the means already stated, namely, bleeding and purgatives, and also by the use of

Refrigerants.—These consist of cooling drinks to be taken internally, and cold applications, as cloths dipped in iced water, or vinegar and water, or even ice itself, or evaporating lotions laid upon the part affected. The cold *affusion* is often very serviceable in reducing the temperature and procuring sleep, during which a flow of perspiration, which frequently proves critical, is apt to occur.

It is self-evident that no good can follow the use of any or all of these means of lessening the quantity of blood in the body, if we continue to supply the means of forming it as fast as we remove it. The *diet* of the patient is, thefore, *a*, we might almost say *the*, most important point in the treatment.

During inflammation, as stated above, the functions of secretion and exhalation, as well as of nutrition, are lessened or entirely suspended; there is, therefore, no means of consuming or disposing of the nutritious matter already contained in the blood. How inconsiderate then, and how absurd it is, if life be valued at all, to use means which greatly increase this? Persons do not die of inanition, or from the effects of the absolute privation of food, under many days or weeks (see the two cases narrated under ABSTINENCE), while thousands, millions, die of inflammatory diseases, in a period varying from a few days down to a few hours. At the beginning of all severe inflammations, there is a failure of the appetite; this intimation on the part of nature, ever watchful for the preservation of her works, cannot be slighted with impunity. Reason and experience strictly enjoin an immediate attention to the diet. Its quantity should be lessened, and in most cases its quality changed. In respect to the reduction of quantity no limit need be placed at the commencement, as it can never be reduced too low; but during convalescence careful regulation of it is necessary, that it may not be insufficient on the one hand, or excessive on the other. Still there is much less likelihood of erring on the side of deficiency, than of excess. The vessels of the part being much weakened, are again easily distended, and the inflammatory process renewed; hence the frequency of relapses. Dr. Baillie has recorded it as the result of his experience, "that he never observed a person having a relapse of *fever* where it has not been caused by eating animal food." It may be well to explain here in what way animal food proves hurtful. During its use the blood requires more frequent purifying by exposure to the air in the lungs, or by respiration. To effect this, not only is the more frequent respiration necessary, but also the heart's action is increased, so that the blood is propelled with greater frequency and force, and consequently the distention of the vessels of the inflamed part is increased. The greater frequency of the respiration, occasioned by the greater demand for oxygen, during the use of animal food, is illustrated by the experience of the workmen in diving-bells, who require the air to be renewed much more frequently when living upon animal food and drinking spirituous liquors, than when living on vegetable food and drinking water. For this reason, the pearl-divers of Ceylon, who live exclusively on rice and other vegetables, can remain much longer under water, without requiring to come to the surface to breathe, than any Europeans who live on a mixture of animal and vegetable food. Animal food and spirituous or fermented drinks must be strictly interdicted at the commencement of inflammation, and their use be avoided till the permission of the medical attendant be deliberately and voluntarily given; previous to which mild, farinaceous food, and diluent drinks, should constitute the only diet.

Rest.—A person in a horizontal position respires less frequently than when in an upright position; the heart also pulsates less frequently. In every case of inflammation affecting the system generally, the patient should be confined to bed; and as there is mostly diminished power of the muscular system, all unnecessary exertion should be avoided. Numerous visiters should not have access to the sick-room; for speaking, which requires the exercise of the respiratory organs, fatigues the patient, and quickens the circulation. Besides this, the air is vitiated by the respiration of visiters. A supply of pure and cool air is requisite in all inflammatory complaints, but especially fevers, both for the benefit of the patient and the safety of others.

The repose of the mind is as essential as that of the body. All causes of anxiety should, when possible, be removed, and cheerful looks be put on before the patient, both by the physician and the attendants, in order that, as far as practicable, he may be inspired with confidence and entertain hopes of recovery.

This is a very brief outline of the means termed antiphlogistic, by which we attempt to restore both the part affected and the system generally, to the natural and healthy state, when labouring under an inflammatory attack. The special application will be given as each disease falls under notice, and we need not here do more than endeavour to impress upon every one a conviction of their importance. "Under favourable circumstances inflammation is more completely under the control of remedies than any other disease; and nevertheless, it is more or less concerned in producing a very large share of the mortality in every part of the world." (See Alison's 'Outlines of Pathology.')

ANTIPHONY, in music (ἀντιφωνία, alternate singing), the ancient name for a kind of anthem, the verses of which were chanted by each side of the choir, alternately.

The fathers of the church pretend that the method of antiphonal singing was revealed to St. Ignatius in a vision, who taught it to the Greeks. St. Ambrose introduced it in the Western churches about the year 374. The chanting of the Psalms in our cathedrals is a close imitation of the ancient antiphony.

The 'Antiphonary' or 'Antiphonarium,' was a book in which the antiphonies were written; and, being copied by hand, was generally a costly volume. Some specimens entailed an expense which in present money would be equivalent to nearly 100*l*.

ANTIQUARIES, SOCIETY OF. Mr. Gough, in the introduction to the 'Archæologia,' fixes what he considers to have been the earliest foundation of the Society of Antiquaries to the fourteenth year of the reign of Queen Elizabeth, A.D. 1572; when a few eminent scholars, under the auspices of Archbishop Parker and Sir Robert Cotton, united their efforts for the preservation of the ancient monuments of their country. The members met for near twenty years at the house of Sir Robert Cotton, and as early as 1589 determined to apply to Queen Elizabeth for a charter of incorporation; a manuscript still remaining in the Cottonian collection (Titus, b. v. fol. 184) preserves the reasons which were urged at this time in support of the petition. But whether the petition was ever presented, or what was its success, does not appear. The writer of the life of Carew, the Cornish antiquary, says, their hopes were frustrated by the queen's death. This society, however, admitted members till 1604; about which time King James I., alarmed for the arcana of his government, and as Hearne conceived for the Established Church, thought fit to dissolve it. An attempt to revive the society was made in 1617, in an application for a charter, through the Marquis of Buckingham; but this also appears to have failed.

From this time to the beginning of the 18th century the society ceased to exist; or, as Mr. Gough expresses it, remained in abeyance.

In 1707, a number of gentlemen, attached in a similar manner to the study of our national antiquities, agreed to meet weekly for the same purposes as the former society, on a Friday evening, at the Bear tavern in the Strand. Among these were Humphrey Wanley; Mr. John Talman; John Bagford; Peter Le Neve, Norroy; Mr. Holmes, the keeper of the Tower records; Madox, the Exchequer antiquary; Mr. Batteley; Mr. William Elstob; Stebbing, the editor of Sandford's 'Genealogical History:' and Mr. Sanderson, clerk of the Rolls. Le Neve was at this time president. In 1708 they removed their meetings to the Young Devil tavern in Fleet Street, and soon after to the Fountain tavern over against Chancery Lane. Here they were joined by Samuel and Roger Gale, Dr. William Stukeley, Mr. T. Rymer, Browne Willis, and Anstis. The plan of their pursuits, comprising everything which such a body of men might be expected to do for the illustration of their national antiquities, appears to have been drawn out for them by Humphrey Wanley.

In 1717 the members re-founded, or rather re-constituted, their society, and made their first election of officers; Peter Le Neve, Esq., was president, Dr. William Stukeley, secretary, Mr. Samuel Gale, treasurer, and Mr. John Talman, director. At this time also George Vertue, the engraver, became an active member, and was appointed sub-director. The number of members was limited to a hundred, and no honorary members were allowed. The minutes of the society begin January 1, 1718; whence it appears that every member, or whoever was admitted to be present, brought from time to time whatever they had of their own, or their friends', that was curious or uncommon; as coins, medals, seals, intaglios, cameos, manuscripts, records, rolls, genealogies, pictures, drawings, printed books, extracts, or even memoranda; a few produced dissertations. In 1727 the society removed to apartments in Gray's-Inn, and afterwards to the Temple; and, for a very short period, seemed to decline. In 1728, however, they renewed their meetings at the Mitre Tavern in Fleet Street, fixing them to Thursday evenings, after the Royal Society had broken up. In 1753 they removed from the tavern to a house of their own in Chancery Lane.

In 1750, it was unanimously resolved to petition the king for a charter of incorporation on the plan formed in 1717, with improvements. This, by the concurrence of the Earl of Hardwicke, then lord chancellor, was obtained in the following year, when his majesty having declared himself 'Founder and Patron,' the society became incorporated by the name of 'President, Council, and Fellows of the Society of Antiquaries of London;' they were empowered to have a body of statutes, and a common seal, and to hold in perpetuity lands, &c., to the yearly value of 1000*l*. The council to consist of twenty-one persons, including the president, and to be elected yearly with the other officers. The first council named in the charter, bearing date November 2, 1751, pursuant to the powers therein given them, re-elected as members the other persons not particularly specified. In 1781 the society removed from Chancery Lane to Somerset Place, where his majesty King George III. had been graciously pleased to grant to them, as well as to the Royal Society, appropriate apartments. The Society of Antiquaries held its first meeting there on January 11, that year. It now occupies apartments in Somerset House, and has recently [Nov. 1858] exchanged its old meeting-room in the same building, for that till lately occupied by the Royal Society.

The anniversary of the society is held on the 23rd of April, when ten of the twenty-one persons of whom the council consists are annually changed. The election of members is by ballot; a certificate having been signed by three or more fellows, is previously exhibited for four successive meetings (including those of proposition and election), except in the cases of peers, members of the privy council, and judges, who may be proposed by a single member, and balloted for upon the same evening. The election is determined by a majority of four-fifths. Every member pays an admission fee of five guineas, and two guineas a year; or an additional sum of twenty-five guineas to the admission fee, to be constituted a member for life. The society's meetings are held on Thursday evenings at eight o'clock, in apartments in the front building of Somerset House. The session of the society begins with the third Thursday in November, and ends with the third Thursday in June. The total number of Fellows of the Society of Antiquaries, on April 23rd, 1858, was 635. The presidents, since the incorporation of the society by charter, have been:—1750, Martin Folkes, Esq.; 1754, Hugh Lord Willoughby, of Parham; 1765, Charles Lyttelton, LL.D., Bishop of Carlisle; 1768, Jeremiah Milles, D.D., Dean of Exeter; 1784, Edward King, Esq., (temporarily elected by the council); 1784, George Ferrars Townshend, Baron de Ferrars of Chartley, afterwards Earl of Leicester and Marquis Townshend; 1812, Sir H. Charles Englefield, Bart. (temporarily elected by the council); 1813, George Earl of Aberdeen; 1846, Philip Earl Stanhope (then Lord Mahon).

By an Act of Parliament, 5 Geo. IV., chap. 39, the President of the Society of Antiquaries for the time being is declared to be an official trustee of the British Museum. By another Act, 3 Will. IV. c. 4, the president and council of the society have to elect one of the five additional trustees of the Soane Museum.

ANTIQUES (from the Latin *antiquus*, ancient), a term used in the English language, somewhat vaguely, to designate 'ancient works of art.' The term properly refers to works of Grecian art in sculpture, rilievi, engraving of gems, medals, works of ornamental art, &c. As these arts flourished in the states of Greece, and also under the Roman empire (though probably they were always successfully cultivated chiefly by Greeks), it is scarcely possible to find any precise chronological limits that shall determine whether a work of art belongs to the *antique* or not. No work of a date later than the overthrow of the western empire would, however, be called an antique, and the term is perhaps not applied with any strictness to works produced during the decline of the empire.

ANTIQUITIES. This term is sometimes used as synonymous with antiques, but generally it has a wider signification. Books that treat of Greek and Roman antiquities, to which the term is sometimes confined, treat not only of works of art, but of political constitutions, judicial and legislative forms, religion, architecture, domestic manners, naval and military affairs, weights and measures, mode of reckoning time, &c. Some of these branches of inquiry are capable of illustration, both from ancient writings that remain and from existing works of ancient art; some can only be known to us from the study of ancient writings. This extensive signification of the word *antiquities*, though certainly not very precise, still keeps up a distinction between antiquities, as thus understood, and the *political* history of the Greeks and Romans, and the study of the Greek and Roman *languages*.

The study of *antiquity* is in like manner understood to mean the study of all that belongs to the Greeks and Romans; of all the knowledge concerning them that has been transmitted to our times: the word philology is used in this sense in Germany. Under the general term *antiquity*, then, we may class all the several subjects which it comprehends; such as ancient forms of polity, ancient systems of philosophy, of astronomy, with political history, ancient architecture, sculpture, poetry, &c.

But it is manifestly too confined a use of either term to restrict it to Greece and Rome. With the increase of our knowledge of the durable memorials which man has left behind him in various parts of the earth, we have come very properly to apply the term *antiquities* to the monumental remains and to the works of art of most nations. We now speak of Egyptian, Assyrian, Persian, Hindoo, Peruvian, Mexican, Danish, and British antiquities, when referring to the works of art existing in these countries or collected in museums. The term antiquities, in this extended application, when not specially used with reference to works of art, is also understood to comprehend history, mythology, &c.

ANTI'QUITY. [ANCIENTS; ANTIQUITIES.]

ANTIS. A portico is said to be *in antis* when columns stand in a line, in front, with the antæ or projecting ends of the side walls of the temple or other building. [ANTÆ.] There is a good example of the portico *in antis* in North-Audley-street, London, forming the entrance to an episcopal chapel there. [TEMPLE.]

ANTI'SCII, an old astronomical term derived from the Greek, signifying those whose shadows are in opposite directions. It is applicable, during part of the year, to any two persons, one or both of whom reside within the tropics; and during the whole year, to any two persons, neither of whom lives within the tropics, and both in different hemispheres.

ANTISCORBUTICS (from ἀντί, 'against,' and *scorbutus*, a barbarous word, intended as the Latin for *scurvy*), the remedies, real or reputed, against scurvy. The term scurvy is popularly, but incorrectly, given to two distinct diseases, which arise under different circumstances, spring from different causes, present few symptoms in common, and are cured by means not only unlike, but diametrically opposite. The confusion has crept in owing to the skin in true scurvy occasionally, but by no means invariably, peeling off in scales or scurf; while in the other disease or diseases, improperly termed scurvy, desquamation, or other affection of the skin, is an essential and invariable symptom, the portions or scales of which being commonly called scurf, the adjective scurfy has insensibly come to be used as a substantive, and to be applied indiscriminately to the two diseases. The one occurs mostly at sea, hence called sea-scurvy, and is, owing to temporary causes, capable of affecting persons of any constitution; the other occurs mostly on land, is owing to more permanent causes, and is always connected with a peculiar constitution. The necessity of making this distinction is manifest, since the remedies for the one disease are few and certainly efficacious; the medicines for the other are multifarious and generally very inefficacious. This circumstance points out an essential difference between the two disorders.

For a long period the men employed as seamen, both in the royal and commercial navy, were dreadful sufferers from this disease. In 1593, Admiral Hawkins states it as within his personal knowledge that 10,000 men had perished of scurvy; and at a much later period, Commodore Anson, in his voyage round the world, lost four-fifths of his men from its ravages. On an attack, the patient began to lose his natural and healthy colour: the skin, first of the face, and afterwards of the rest of the body, became pale, and assumed a bloated appearance; the lips, instead of a rich vermilion, acquired a greenish tinge: indeed, the countenance in this disease is always very much depressed, indicating a corresponding state of mind. The patient is conscious of weariness, and is averse to exertion; and when that of a bodily kind is attempted, his unfitness for it is seen by the weakness of the knees (which often become stiff and contracted) and of the whole muscular system, greatly increased frequency of breathing following the least effort. The skin is dry, sometimes rough, but more generally smooth and shining, with spots of a red, blue, or black appearance, according to the length of time that the blood has escaped from the vessels, which is the cause of these stains. The limbs become dropsical; the gums, spongy and swollen; ulcers or any sores, cuts or scratches, bleed profusely and cannot be healed; even old ulcers break out anew, and broken limbs, apparently firmly united, separate again, and cannot be reunited so long as the disorder continues. The blood when drawn scarcely coagulates, but remains loose and flabby; yet during the whole of this state the appetite generally continues good. These symptoms all denote great debility, which is occasioned by a peculiar alteration of the blood, and is produced by the causes we have now to mention.

One of the most extensive and powerful causes of debility is constant exposure to a cold and damp atmosphere. The construction of ships was formerly such that the sailors were continually exposed to the operation of this cause, which was further aided by the unwholesome exhalations from the bilge-water, the sand used for ballast, and the remains of animal and vegetable matter which were strewed about the ship: no means of removing or lessening these causes existed, from the utter absence or imperfect nature of the means of ventilating the ship, or washing it without increasing the dampness. The sailors were also very inattentive to personal cleanliness, were unprovided with soap, and were too insensible of the advantage of changing their dress when wet, and were also without the opportunity of changing or washing and airing their bedding. The measures adopted by Captain Cook, on the occasion of his second voyage round the world, were very similar to those since universally pursued. Out of 318 men, during a voyage of three years and eighteen days, throughout all climates, from fifty-two degrees north to seventy-one degrees south, he lost only one. For this, in the year 1776, he received from the Royal Society the Copley medal. (See Kippis's 'Life of Cook,' 1788, p. 315.)

By the change effected by Sir Robert Seppings in the construction of ships, and the substitution of iron instead of sand for ballast, and of iron tanks instead of casks for water; by the efficient means he has devised for ventilating the ship, without exposing the persons of the sailors to cold; and by the employment of portable iron fire-places in different parts of the ship, as well as by a change of bedding, and a proper allowance of soap to each sailor—these debilitating causes no longer exist, or are rendered powerless.

Another cause of debility was either excessive fatigue or deficiency of proper and regular exercise; the former cannot always be avoided, as in the case of much bad weather, when the labour of all hands is increased, or great sickness among the crew, which requires more exertion on the part of the healthy. But deficient exercise can always be avoided by the officers finding employment, or inventing amusing occupation for the sailors, and above all for the marines, who, having less active duty in the ship, were the most frequently attacked by scurvy. Intemperance also greatly contributed to prepare the system for a scorbutic attack, but this vice is now much repressed.

None of these causes singly, nor indeed all of them combined, are adequate to produce scurvy, unassisted by some specific cause, which cause is to be found in the diet. The diet of seamen during long voyages was formerly merely salted meat and biscuit; fresh animal food or recent vegetables formed no part of it. It was also often deficient in quantity.

Salt, if taken in moderation, facilitates digestion, but if in excess, hinders the digestion of the food, even of fresh meat and vegetables; when employed as a means of preserving meat, it hardens it, and impairs its nutritive power, as well as renders it more difficult to digest. Such meat is less nourishing, but more stimulating, than fresh meat, and its long-continued use produces what may be termed the disjunctive inflammation, owing to which old wounds and ulcers break open, and fractured bones separate after re-union. The salt seems to be pernicious in a two-fold way: first, by lessening the nutritious power of the meat; and secondly, by its stimulating properties. The former of these, unaided by the latter, is sufficient to produce scurvy, if the predisposing causes of cold, moisture, and imperfect or excessive exercise be in operation. The diminution of the quantity of food, and not its quality, was the principal exciting cause of scurvy in the Millbank Penitentiary in 1819. [ABSTINENCE.]

In what way the absence or inadequate supply of fresh vegetables operates has not been ascertained. That the deficiency of this article of nutriment has a large share in producing scurvy is established by the facts, that before the extensive introduction of esculent vegetables into Britain, scurvy was almost as common on land as at sea; and also by the rapid disappearance of scurvy from among the crews of ships, so soon as they procure a supply of vegetable articles of diet of any kind, but more particularly those belonging to certain tribes of vegetables,—as the Hesperideæ or Aurantiaceæ (the orange tribe), the Grossulariaceæ, or gooseberry tribe, which are all acid vegetables; and the Cruciferæ, or mustard tribe, containing cabbages (from which sour-kraut is prepared) and the well-known scurvy-grass, which are alkalescent vegetables; the Coniferæ, some of which yield spruce, &c.

These vegetables, or the articles prepared from them, constitute the *antiscorbutics*, or means of preventing and curing sea-scurvy; but they are not all of equal value, some far surpassing the others in efficacy. Those are the least valuable in which no vegetable acid greatly predominates, so as to impart to them an acid or acidulous taste. Hence the Cruciferæ are not so useful in their natural state, as the name of scurvy-grass, bestowed on one of them, would seem to indicate; but when by their fermentation, as that of cabbages to form sour-kraut, a vegetable acid (acetic acid? or vinegar) is produced, they rise in the scale of antiscorbutic power. But at the head of all, the hesperideæ deserve to be placed, the members of which contain citric acid: accordingly, any of the species may be employed; but the most powerful belong to the genus *Citrus*, especially the *Citrus limonum* (Risso), the well-known lemon, since the introduction of which into the navy, in 1796, scurvy has almost ceased. It may be used in various ways; the best is in the form of the fresh fruit sucked by the patient: but in the absence of this, lemon-juice may be employed, and this is the usual mode in the naval practice. Several gallons of it, having a tenth part of spirit of wine added to preserve it, are supplied to each ship, and in about a fortnight after leaving port its use is begun; each sailor is allowed one ounce of it and one ounce and a half of sugar to mix with the grog, or in many instances with wine, a stated quantity of which is granted in lieu of a certain quantity of spirits, which is withdrawn. This has the effect of almost invariably preventing scurvy affecting any of the crew; but should symptoms of the disease begin to show themselves, they quickly disappear by an increase of the quantity of lemon-juice. Citric-acid, which has been crystallised and again dissolved in water, is not so efficacious, neither is vinegar, nor any other vegetable acid, such as tartaric, or malic, so useful, though the fruits containing them (unripe gooseberries, tamarinds) are the best substitutes for lemons, when these cannot be procured.

No one, as far as we know, has attempted to explain how these vegetable acids produce their beneficial effects. It may be remarked, however, that all acid fruits have a very cooling and soothing effect in many complaints; they are among the most useful refrigerants, and often sit on the stomach and restore its power, when in a very irritable or weakened state. This is particularly the case where the powers of the stomach and nervous system have been much impaired by intemperance, especially from the abuse of spirituous liquors, in which tartaric acid is eminently serviceable; even during a fit of intoxication, a draught of vinegar will restore the drunken man to his senses more speedily than any other means. These acids appear to exert a very considerable vital action on the system generally, but especially on the nervous centres. Further, lemon-juice and vinegar exercise a chemical influence on many articles of food difficult of digestion, as veal; hence the practice of serving these articles to table accompanied by one or other of these acids. If the salt has rendered the meat hard and difficult of digestion, may not these acids produce some change in it, rendering it less so by their chemical properties, as well as by their general action heightening or increasing the vitality of the stomach, and consequently its power of extracting the nourishment? Some local effect is produced by the direct application of lemon-juice, as slices of lemon placed on the ulcers hasten the healing processes.

Mineral acids, such as elixir of vitriol, are found less useful, though they and other strengthening medicines, such as sulphate of quinine, may occasionally prove serviceable, when lemon-juice is wanting, or fails in effecting a cure, which has happened in some very rare instances. Chloride of soda appears to have some claim to a favourable regard; but at present we have too little experience of it, in this respect, to speak positively of its antiscorbutic power.

In addition to the lemon-juice, ships intended to be sent on long voyages are supplied with animal food, so prepared, as to be almost as fresh at the end of six years as if it had been killed but a few days, and dressed the day previous to its being used. This valuable discovery, which tends so greatly to lessen the inconvenience of a sea-life, as well as to secure the health of those devoted to it, was made by Mr. Appert: the mode of effecting it, and the principle on which it depends, will be explained under ANTISEPTICS.

After every fair degree of merit is assigned to other means and articles, the main instrument of banishing scurvy from among the number of diseases incident to a sea-life has been the liberal use of lemon-juice. The nation owes a deep debt of gratitude to those who effected its universal introduction into the naval service, and who lived to witness the beneficial effects of their enlightened views: these were Earl Spencer, who was first lord of the Admiralty in 1795, and Sir Gilbert Blane, physician to the fleet, and at the head of the Navy Medical Board in 1795. But for their exertions, it seems scarcely probable that our navy could, during the twenty years of the war which followed that day, have achieved those victories which have rendered our country so illustrious. (See paper on the comparative health of the British navy, by Sir Gilbert Blane, in his 'Select Dissertations on Medical Science,' London, 1822; also in vol. vi. of 'Transactions of the Medico-Chirurgical Society.')

The historian of Anson's voyage, speaking of scurvy, says, "The cure seems impossible by any remedy or by any management that can be employed." In the present day, instead of the remedy being unknown, it is, happily, the disease; a fact which suggests the most important subject for contemplation, and justifies the reflections and language of Sir Gilbert Blane: "Does it not afford a cheering and consolatory prospect, 'amidst the thousand shocks that flesh is heir to,' that there may be still in store for us, in the boundless progression and endless combinations of knowledge, other hidden means of advancing human happiness, of mitigating human misery, and of making accessions to the dominion of man over nature, which have not yet been dreamt of in our philosophy." [SCURVY.]

The other diseases to which the name of scurvy has been improperly given, and some of the remedies for which are termed antiscorbutics, have no connection with sea-scurvy, or its remedies. These various affections of the skin are more or less connected with a scrofulous constitution, to which are owing the disordered functions of the digestion, whence these eruptions spring. Acidity in the stomach is a concomitant and characteristic symptom of these diseases, for the cure of which vegetable acids are unavailing, though the mineral acids, by their strengthening virtues, are often serviceable. These so-called scorbutic affections are of very frequent occurrence among persons subject to gravel and gout, which are, at the commencement, caused by acidity in the stomach: the appropriate means of cure for both complaints are alkalies [ANTACIDS], the very opposite of the means useful in true scurvy.

The nostrums vended under the name of antiscorbutics, and intended for these cutaneous diseases, though varying in their composition, mostly contain, as their active principle, some preparation of mercury, often a very poisonous one, which is always hurtful in sea-scurvy, and can only be serviceable in particular cases of the other kinds. Its use requires the greatest caution, directed by the utmost skill; the employment of such articles should, therefore, be carefully avoided.

ANTISEPTICS, from ἀντὶ, *against*, and σήπομαι, to *putrefy*, the means of preventing those changes in organised matter which are comprehended under the term putrefaction. All organised bodies consist of different materials, which are designated their proximate principles, and these again are formed by the union or combination of certain ultimate principles. An organised body, therefore, is always a compound one, and the tendency of its original or natural proximate principles to form others, and, at last, to be resolved into the ultimate elements of which they are formed, is the occasion of putrefaction, which takes place in all bodies, sooner or later, according to the circumstances in which they are placed. To give an example of each: flour, prepared from what was once a living and organised body, called a seed, contains two proximate principles, gluten (bird-lime) and starch: each of these is resolvable into definite combinations of what are termed simple or elementary bodies, of the same nature as the constituents of inert or inorganic matter; the most common of these are oxygen, hydrogen, carbon, and nitrogen. The first or proximate principles are only met with in organised bodies; the latter equally in organised and inorganic matter. Oxygen, for instance, forms a portion of the air which we breathe, and also of water; hydrogen forms a portion, or is an element, of water; nitrogen is found in the atmospheric air; and carbon exists in the diamond, in the charcoal obtained from wood, or from animal matter.

All organised bodies spring from parents similar to themselves, possessed of, or endowed with, a vital principle. Every such body possesses the power of assimilating to itself matter introduced from without, whether inorganic, as table-salt, or organised matter, as dead animal and vegetable substances, in the case of man and some other animals, or merely inorganic matter, as in the case of vegetables. After being received into the interior of the body, these matters undergo changes previous to being distributed to that part of the frame destined for the reception of the different proximate principles which are formed out of them by the vital processes of digestion and assimilation. When deposited in the part intended for them, they would speedily enter into fresh combinations, were not their tendency to do so controlled by the agency of the living principle, which counteracts the usual chemical affinities of the constituent or elementary principles. When this principle is weak, or does not act with sufficient energy, either through the whole frame or in any particular part of it, the elementary principles manifest a disposition to exert their ordinary affinities which would lead to the decomposition of a part or the whole. Partial decomposition occurs when a limb or other part of the body has been the seat of such violent inflammatory action that its structure is changed, and its vitality destroyed, so that it sloughs, as it is technically called, that is, becomes dead: complete decomposition occurs when the vital principle quits the entire frame, that is, when death of the whole body takes place, and putrefaction begins. But the presence of the vital principle does not always hinder the commencement of putrefaction, as we see the tendency to it manifested in the worst kinds of fevers several days before dissolution: on this account they were termed putrid fevers, and were conceived to be owing to putrescency of the fluids, a doctrine common during the prevalence of the humoral pathology. But more correct views of fever have taught us that the changes in the fluids, both as respects their properties and chemical constitution, are consequent upon a change in the vital action of the system, resulting from the impression of a powerfully morbific agent on the nervous or circulatory systems. This impairs the vital force or energy of the frame, and lessens the power by which the chemical affinities were controlled; and hence the early tendency to putrefaction in persons affected with fevers of a typhoid type or character.

The complete departure of the vital principle is not sufficient to occasion the commencement or ensure the continuance of the processes of putrefaction: the concurrence of several other circumstances is necessary. These are air, heat, and moisture: if any one of these be wanting, decomposition will in general be prevented. If the air has an admixture of certain particles or principles, the tendency to putrefaction will be greatly increased; and, on the other hand, impregnating the air with certain other principles, greatly lessens the disposition to decomposition. These circumstances have so large a share in the production or prevention of disease and death, that a thorough understanding of them is of vast importance to the welfare of the community.

The atmospheric air, considered in reference to its chemical composition, is a mixture of nitrogen and oxygen gases, in fixed and uniform proportion, with carbonic acid gas in a small and variable proportion. But close to the surface of the earth, it receives an admixture of particles or principles of different kinds, by which it is contaminated, and rendered less fit for the support of animal and vegetable life. By the respiration of animals, particularly of warm-blooded animals, as man, a portion of the oxygen is withdrawn, and a corresponding portion of carbonic acid gas is substituted in its place. By the respiration of plants, the carbonic acid gas is withdrawn, and an equivalent portion of oxygen substituted. By the mutual action of the members of the animal and vegetable kingdoms, the balance of the constituent elements of the atmosphere is maintained. But by a preponderance of the members of either of these kingdoms, an excess of the one principle and a deficiency of the other will be occasioned. Hence, where there is a large assemblage of men, the air is less fit for respiration, as happens in close apartments: the most melancholy example of this is to be found in the narrative of the Black Hole at Calcutta; of one hundred and forty-six persons confined in this dreadful place, one hundred and twenty-three perished during one night. Trees crowded together in plantations suffer more from deficiency of carbonic acid and oxygen, both of which are required for respiration, than from deficient nutriment by the roots—a fact of which proprietors and managers of timber-plantations are either not aware, or at least they neglect the practice to which it should lead. It may be remarked by every one that on the coast, where animal life acquires an accession of strength from the purity of the air, which abounds in oxygen, vegetable life languishes from the deficiency of carbonic acid. In addition to these sources of deterioration, the air is contaminated by various other means, some occasional and limited in their operation, others more constant and extended in their influence. A brief review of these will here be proper; but, before proceeding to enumerate them, it will afford conclusive evidence of their importance to adduce one example of the influence of even a slight admixture of a deleterious principle with the ordinary constituents of the air. "This gas (hydrochloric acid, or muriatic acid gas) must therefore be very injurious to vegetable life, since so small a quantity as a fifth of an inch, though diluted with 10,000 parts of air, destroyed the whole vegetation of a plant of considerable size in less than two days. Nay, we afterwards found that a tenth part of a cubic inch in 20,000 volumes of air had nearly the same effects." Drs. Turner and Christison, in 'Brewster's Journal,' vol. viii. p. 145.

These are principles with the chemical qualities of which we are well acquainted, and the sources of which we can easily ascertain, and often remove; but there exist others, of the nature and origin of which far less is known, though their effects are very conspicuous: such are the exhalations from decaying vegetable matter, termed marsh miasmata, or malaria, and the exhalations from the bodies of men and animals, when crowded together, or from that of men labouring under certain diseases, as fevers, called the matter of contagion, or from dead animal matter, in a state of putrefaction, termed putrid effluvia. These are the fertile sources of fevers, whatever their form, type, or appellation; and though it is commonly thought that the fevers from vegetable matter are always of an intermittent or remittent character, yet they often assume the continued form [AGUE]; while the effluvia from animal matter mostly give rise to fevers of a continued and typhoid character. (Boot's 'Life of Armstrong.')

What the precise nature of this deleterious principle is cannot be stated, but whatever it be, when received in sufficient quantity into the human system, it seems to act as a ferment or yeast, and produces a series of changes, the ultimate object of which is to reduce the body attacked to a state of putrefaction. We have no test of its presence beyond its effects, but we know the sources whence it springs, and the circumstances which favour its concentration, and occasion the human frame to become more susceptible of its influence. It is only by removing or lessening these that we can escape this insidious foe, and the success which has attended the enlightened measures proposed by physicians and chemists should lead to their extended application. ('Reports of Registrar-General.')

Long-continued calms, in which there is a stagnation of the air, and during which fresh and purer particles of the atmospheric principles do not descend from the higher regions to replace the heated and contaminated air near the surface of the earth, conduce much to the concentration and virulence of these agents. For several weeks before the plague broke out in London, in 1665, there was an uninterrupted calm, so that there was not even sufficient motion in the air to turn a vane. And at the season in which the last plague visited Vienna there had been no wind for three months. To produce agitation in the air, fires were formerly lighted, and pieces of artillery discharged, means altogether inefficient to cause a considerable commotion in the atmosphere at large, though a fire is extremely serviceable in renewing the air of apartments in houses: the only means adequate to this end are beyond our control, though they frequently take place at the moments of the utmost need; these are storms and hurricanes, which, however desolating in their immediate effects, are instruments of great, though less obvious, good. After the hurricane which proved so destructive to the inhabitants of the West Indies in 1780, less disease occurred than had been known before; even those who laboured under sickness at the time were benefited by it; fever, diarrhœas, and dysenteries, but above all, disorders affecting the lungs, were cured. After the excitation of a storm, plants give out more oxygen, which accounts for the delightful and life-giving freshness of the air, of which every one is sensible, who walks out into the fields immediately afterwards.

We may imitate nature, and employ ventilation on a small scale, but with the best effects, in our dwelling-places, hospitals, and sick-rooms. The evils of neglecting this salutary measure contrast strikingly with the beneficial consequences of attending to it. It is remarked by Dr. Macculloch, in his 'Account of the Hebrides,' that while the inhabitants had no shelter but huts of the most simple construction, which afforded free passage for currents of air, they were not subject to fevers; but when, through the good intentions of the proprietors, such habitations were provided as seemed more comfortable and commodious, but which afforded recesses for stagnating air and impurities, which they had not the means, or had not a sufficient love of cleanliness, to remove, febrile infection was generated. The mortal fevers which have occurred from crowding human beings together in small ill-ventilated apartments are numerous. They were termed jail and hospital fevers, from their infesting those places; the survivors of the night in the Black Hole of Calcutta were, almost without a single exception, attacked by fever; and the unhappy victims of the mercenary actors in the slave-trade were often released from suffering by the fevers which resulted from crowding so many into a confined space. To avert such calamitous diseases, we must have recourse to measures which will lessen or remove their causes; such as dispersion of the inhabitants or patients over a larger space; enforcing cleanliness of the apartments and of their persons, and freely ventilating every room. Formerly, in the hospital at Leeds, no patient suffering from compound fracture or other severe accident survived, till the ventilation of the wards was improved. One of the most convincing proofs of the different influence of foul and pure air is to be found in the 'Report of the Lying-in Hospital of Dublin.' In the space of four years, ending in 1784, in a badly ventilated house, there died 2944 children out of 7650. But after freer ventilation, the deaths in the same period of time, and in a like number of children, amounted only to 279. The soldiers of our army have been proved to have suffered severely from a like cause through the want of sufficient ventilation in their barracks. Wherever proper ventilation has been secured, the building, whether hospital, barrack, or dwelling-house, invariably becomes more healthy.

Stagnant water, and the mud which remains after it has evaporated, marshes and places occasionally overflowed, emit exhalations not less noxious than those from decaying animal matter, or the bodies of human beings. These are the more powerful in proportion to the heat; hence in tropical and warm countries, they give rise to the yellow-fever and the jungle-fever, which are rapid in their course, and generally fatal in their close: in colder countries they produce continued remittent and intermittent fevers. The exhalations are always less hurtful in proportion to the activity of the vegetation. The inhabitants of that part of the town of Batavia which is nearest the mud and slime left by the tide, suffer more from fevers than those who dwell next the marshes, unhealthy as these are. In the marshes of Anké, a great number of different kinds of grasses, rushes, &c., grow, and the spaces between these plants are covered with large quantities of the *Pistia stratiotes*, the leaves of which float on the surface of the water, and absorb a great quantity of the noxious vapours as fast as they are exhaled, and change them, by the aid of the sun's rays, into respirable air. This change is effected by the pistia more than by any other plant; for it is known from experiments to be so powerful a preventive of decomposition of stagnant water, that if fishes be put into a small quantity of water, in which they would otherwise perish in the course of a few days, they may be preserved alive for a long time by covering its surface with these singular plants. The utility of a piece of moss introduced into the vase where gold fishes are kept is well known: on this principle depends the health of fishes and other animals in the vivaria, now so common; and the *lemna* or duckweed, and other plants which cover the surface of ponds in summer, render a similar service to the air here, which the pistia does to that around Batavia. Where marshes cannot be drained, the planting them with marsh and aquatic plants, and such trees as alders and poplars, is the best mode of mitigating the evils which result from them. The beneficial effects of draining and forming under-ground sewers are shown in the perfect immunity which London enjoys from ague as an epidemic, contrasted with former times. Dr. Caius, the most eminent physician in England at that period, states, that the mortality of London from ague in 1558 was such, that the living could hardly bury the dead.

When these natural means of preventing animal and vegetable exhalations cannot be employed, we must have recourse to artificial means of disarming them of their potency. Of the measures formerly resorted to for this purpose, some were useless, while others were hurtful to the sick, and could not be practised without the removal of the patients, which can rarely be accomplished. All of them, in point of efficacy and facility of application, fall short of two agents, which bid fair to render every other superfluous: these are the chlorides of soda and of lime. In these preparations chlorine is combined with the bases in such a way as to be susceptible of decomposition, and is evolved with more or less rapidity according to the ingredients or impurities it meets with in the air. The most common of these impurities is carbonic acid gas, which is produced both by the respiration of living animals, and by the decomposition of their bodies when dead. Another product of putrid animal matter is ammoniacal gas, which generally unites with the carbonic acid, and forms carbonate of ammonia, the presence of which may be recognised by the pungency of the air impregnated with it, which affects both the eyes and the organ of smell. Now, it is interesting to remark, that carbonic acid gas has the greatest tendency to unite with the soda or the lime, and to liberate the chlorine. Again, chlorine decomposes ammoniacal gas by abstracting the hydrogen from the nitrogen, and forming hydrochloric or muriatic acid. One example of its beneficial action will prove its utility. Air was passed through blood, which had been left to putrefy for eight days; being then passed through a solution of the chloride of lime, carbonate of lime was deposited, and the air was rendered inodorous and completely purified. These agents can only be productive of benefit within a limited range of atmosphere, yet they may be employed successfully to purify the air of hospitals, sick-rooms, &c.

Quick-lime, or charcoal recently prepared, has been employed to absorb fetid and noxious exhalations, and though inferior to the chlorides, may be used in some cases, such as when the patient cannot bear the smell either of the chloride of soda or of lime. Nitrate of lead is extremely serviceable when put into night-tables or water-closets. When the matter of contagion is supposed to be attached to woollen or cotton clothes, we may expose these to a high temperature, 212° of Fahrenheit, for some hours, by which it will be dissipated.

An equally important means of warding off the effects of exposure to a contagious atmosphere, is to put the body in a posture of defence by strengthening it, and regulating the general health. Increasing the vital force of the system renders it less susceptible of being acted upon by impure air; hence nourishing food and tonic medicines may be regarded as indirectly antiseptics. It is a wise precaution not to visit the sick without previously taking food. But useful as a supply of proper nourishment is, still it is of inferior efficacy, as a protective means, compared with ventilation and cleanliness, as is demonstrated by the instructive fact, that in Great Britain, we were 200 years later in getting rid of pestilence than of famine. Most of the medicines which were formerly termed antiseptics are either tonics or refrigerants: of which cinchona bark may serve as an example of the first class, and the mineral and vegetable acids, as dilute sulphuric acid, and tartaric acid or citric acid of the second. Tonic antiseptics cannot be employed with propriety or safety at the beginning of fevers or inflammatory complaints, but in many diseases a period arrives when they may be usefully administered. The period when their employment becomes safe requires the nicest discrimination on the part of the medical attendant; and too numerous are the instances where their premature employment has rekindled the disease which might otherwise speedily have subsided. We are, however, justified in having recourse to them at an earlier period in those diseases which we know to have a great tendency to lead rapidly to the death of some part; such as in the malignant or putrid sore-throat of scarlet fever; or in continued fever of a very typhoid character.

The refrigerating antiseptics may be beneficially used from a very early period of inflammatory diseases, especially of the young and robust: in such diseases as scurvy (*i. e.* sea-scurvy), they surpass all other remedies.

As the operations of nature in regard to organised matter seem to consist in reducing to their elementary state each individual, or part, when it ceases to live, and in reconstructing others, it forms an interesting and important subject of investigation to inquire in what way the former of these may be prevented, when it is desirable to preserve the whole or a part of organised matter from putrefaction; by what means can the tendency to putrefaction be so modified, that the result of it, though leading to the formation of a substance having a very different character, shall yet be of a kind which may be preserved for a longer period, than the original substance; and how the process of putrefaction may be rendered a useful, instead of a noxious, operation.

There are many substances which, when added to animal matter, prevent for a longer or shorter time their decomposition, such as saltpetre (nitrate of potass), and common salt (chloride of sodium), which last is supposed to act by abstracting the elements of water: certain it is that meat is rendered by salting much drier, harder, less easily digested, and consequently less nourishing. [ANTISCORBUTICS.] Many aromatic substances have a similar power of preventing putrefaction for a time. They were extensively employed in embalming in ancient as well as modern times, as the Egyptian mummies prove. Oils and resinous substances long resist putrefaction, and preserve other substances from it; bitumen, naphtha, and empyreumatic oils are examples of this. Russia leather, which is dressed with the empyreumatic oil of the birch, not only does not become mouldy, but also preserves the books which are bound with it. The process of decomposition is greatly hastened by the agency of fungi, such as those which cause mouldiness, and the more formidable destroyers which occasion the dry-rot. The fungi which cause mouldiness are generally prevented from developing themselves by the presence of some aromatic oil; and the others which occasion the dry-rot in timber may be prevented from developing themselves by the process invented by Mr. Kyan. This consists in combining the albumen of the wood with bichloride of mercury (corrosive sublimate), which it converts into the protochloride, in the same way that animal albumen combines with, and converts into the protochloride, the same compound [ALBUMEN]; the wood is thus rendered insusceptible of the attacks of the fungi. Fungi often attack and destroy the cereal grains, particularly wheat: the worst of these—namely, the *Uredo fœtida* (pepper-brand)—may be prevented from farther developing itself by steeping the seeds for twelve hours in lime-water.

The collections of entomologists and botanists suffer much from the depredations of insects. Those which infest collections of insects may be driven away by placing camphor in the cases, or by introducing a solution of bichloride of mercury into the blood-vessels of larger animals previous to stuffing them. Dried plants, for botanical specimens, may be preserved from the attacks of the *ptinus fur* by applying to them, when perfectly dry, a solution of bichloride of mercury, of the strength of two drachms to a pint of rectified spirit of wine, to which a little camphor has been added. It must be applied to the whole specimen by means of a camel-hair pencil.

ANTISEPTICS are the means of preventing those changes in organised matter which are comprehended under the term putrefaction, and are used in the preparation of PRESERVED FOOD.

All organised substances do not putrefy with equal rapidity, nor under all circumstances. Decomposition goes on fastest in substances which contain nitrogen, and most slowly in those which are richer in carbon: hence, animal matters putrefy quickly; vegetable, especially of a woody texture, gradually. The conditions necessary for putrefaction to take place are, the presence of air, of a certain temperature, and moisture. If any one of these be excluded, the process is prevented. The moisture may either be external, or it may consist of the fluids of the body itself. The bulk of the animal frame is made up of fluids, which must either be dissipated by heat, abstracted by some chemical process, or rendered solid by a very low temperature, if we wish to preserve any animal substance in the state most near that of its natural constitution.

The modes of preserving food are either natural or artificial. The natural modes comprehend those which effect this end by abstracting or excluding one or more of the chief agents—heat, moisture, and air; the artificial, comprehend those methods of preparation or mixture which produce some chemical change in the substance.

1. Abstraction of heat. The presence of heat is essential to the exertion of those chemical affinities which take place during decomposition, or constitute the process; abstracting it therefore checks or suspends them. Most articles of food keep better in cold than in warm weather. When the heat has been so completely abstracted that the juices are frozen (that is, become solid), the preservation of the substance is more effectually accomplished. Indeed they may thus be preserved for many years, perhaps ages. On this principle the Russians preserve their poultry, which they kill in October, and pack in tubs with interlayers of snow. The markets of St. Petersburg are supplied with veal brought from a great distance in this state, as well as with whole hogs, sheep, and fish. The Canadians preserve their provisions in the same way.

A precaution is necessary in thawing the preserved provision: for this end, they should always be put into cold water first. This meets with an example in the case of persons buried in the snow, when recovery is much more likely to be brought about by plunging the individual into cold water, than by placing him in a warm bed.

This method of preserving food is not applicable to vegetables, but when these are frozen they should also be first put into cold water.

2. The abstraction of moisture by heat is employed in drying fish and other animal substances, as beef, bacon, &c.; though in these the rapid tendency to putrefaction makes the employment of a certain quantity of salt, &c., necessary, along with the drying, unless the process be carried on with great rapidity, which may be effected by a high temperature and a free circulation of air. Hence, in many places, where turf or wood is burnt, hams are hung within the wide kitchen chimney. Drying is also employed for the preservation of vegetable substances, such as grain, hay, &c. It is by this means that botanists preserve plants to form a hortus siccus, or herbarium, and herbalists many plants for medical use; but for this purpose a high temperature should never be applied, as it dissipates their active principles.

3. The exclusion of sources of oxygen gas constitutes another means of preventing or checking putrefaction; and as the atmospheric air is the most common source of oxygen, we shall limit our remarks to the means of excluding it. The effect of such exclusion is very great. Reaumur varnished some eggs, and found that at the end of two years they were yet capable of producing chickens; and Bomare mentions an instance where three eggs were inclosed within the walls of a church in Lombardy, and when found at the end of 300 years they had not lost their flavour. Lime-water is the best medium in which to place eggs for long keeping. But more valuable articles than eggs are preserved by this means, and in a condition nearly equal to their fresh state. We allude to the method of preserving animal food and vege-

tables, promulgated by M. Appert. This consists in boiling the articles (if meat, the bones must be first taken out) to nearly as great a degree as if intended for immediate consumption; they are then put into jars or tin canisters, which must be completely filled with a broth or jelly prepared from portions of the same meat. The canisters are then corked and covered with a luting, and carefully soldered down. After this, they are placed in a boiler of cold water, to which heat is applied till the water boils, and the boiling of which is continued for an hour; the fire must then be instantly extinguished, and the water soon drawn off, but the boiler must not be uncovered, or the bottles taken out, for one or two hours after. By this method, meat has been kept sound and well-flavoured for many years, and has been sent to all parts of the globe. The process of exhausting the air from the vessel which contains the substance to be preserved, and then effectually excluding the atmosphere, is a method now frequently used.

A simpler method of preserving animal food for sea-stores is the following:—the meat is cut into slices of four to eight ounces, steeped for five minutes in a vessel of boiling water, and dried on a network at a temperature of about 120° Fahrenheit. The liquid or soup formed by steeping the meat is next evaporated to the state of a thick varnish, to which a little spice is added. The dry pieces of meat are dipped into this gravy and dried again; and this dipping and drying are repeated two or three times. The meat will in this dry state remain good for a year or two, and may then be cooked in the usual way by boiling, &c.

The natural methods of preserving organised substances are few and simple; the artificial more numerous, as well as more complex. They consist either in causing such changes in the elementary constitution of a body as shall form a new and less destructible article, or in introducing some additional principle which shall hinder the exercise of the natural tendency of the substance to decomposition.

The first set of means constitute the various kinds of fermentation; with respect to which we may remark, that the products of them are not only little disposed to undergo decomposition, but have also a powerful effect in preventing other substances from undergoing it. The most remarkable of these are acetic acid, or vinegar, and alcohol. The formation of sugar, another product of fermentation, is a powerful means of preserving fruits, in which it is formed spontaneously, or to which it is afterwards added. The addition of sugar is practised in forming syrups, jellies, and preserves.

Those parts of plants which contain much carbon last the longest. In trees cut down and exposed to air and moisture, the bark, which contains most carbon, endures after the rest has perished. The seed also contains much carbon, and when seeds are sent from India to England they are generally wrapped in recently prepared charcoal. When stakes or piles of wood are to be driven into the beds of rivers or marshes, they are previously charred; and to preserve water sent to sea, the inner side of the cask is also charred.

Reverting to the subject of preserved meats, we may state that the use of such condiments is extending in the English navy; and although circumstances which occurred a few years ago excited a painful doubt on this subject, nothing has transpired to disprove the excellence of the diet and the advantage of its adoption, provided common honesty be shown in the manufacture, and common prudence on the part of the purchasers.

Mr. Goldner, a foreigner resident in England, obtained a patent in 1840, for a method of preserving meat, founded chiefly on the plan of Appert. In 1844 the Government first entered into a contract with him: and the first supply was obtained from that source in 1845. The meat was in the first instance used experimentally, and in small quantities; in 1846 larger quantities began to be sent out in some of the government ships; and at length in 1847, it became a custom to send out some of these canisters of preserved meat in most of the ships intended for foreign service. Sir John Franklin's arctic expedition was furnished with a supply of this kind, at a time when the system was yet in an experimental state. That meat, properly secured in the canisters, will remain good for many years we knew, from the fact that part of the stores left on shore by Sir Edward Parry, when he abandoned his ship, were found in excellent condition 20 years afterwards. Another contract was signed in 1847; but in 1848 complaints were occasionally made that the meat thus supplied was defective in quality. Steps were taken by the government to ensure, as was supposed, the due fulfilment of the contract; and a new purchase, to a considerable extent, was made in 1850. A few days before the close of the year 1851, circumstances occurred to show the necessity for examining the stores of preserved meat at Portsmouth. The meat had been prepared at Galatz in Moldavia, and packed in canisters containing about 10 lbs. each; and, from the nature of the process, these canisters must not be opened until the meat is required for food, as the admission of air nullifies the antiseptic processes. It was not known, therefore, until the canisters were opened, whether the bulk of the supply corresponded with the samples. When at the close of 1851 and the commencement of 1852, it was deemed necessary to open all the canisters then in store, it was found that out of many thousand canisters, only a few hundreds contained food fit to be eaten. We need not further allude to this part of the subject, since it relates to a dishonest evasion of a proper system, and not the real value of the system itself.

It has been suggested, that the condition of the meat within a canister may be judged from the appearance of the canister itself. Even supposing the contents of the canister to be good and proper in the first instance, yet if any air gain admittance, a certain extent of decomposition ensues: gas is generated, and this gas causes a bulging or convexity of the canister. If a minute hole be made, by accident or design, or rust, in a canister, the entrance of air will be sufficient to spoil the contents; and hence it is deemed a wise precaution to paint the canisters externally.

The manufacture of preserved provisions is now carried on to a very considerable extent. Mr. Gamble has still (or had recently) in his possession some of the canisters of boiled mutton which he prepared for Parry's expedition in 1824, which Sir John Ross found in good condition on Fury Beach in 1833, and which Sir James Ross found to be equally good in 1849. Canisters are prepared by Messrs. Donkin, Hall, and Gamble with preserved beef, mutton, veal, pheasants, partridges, turtle, callipash and callipee, hams, salmon, oysters, cod, haddock, milk, cream, custards, carrots, peas, turnips, mushrooms, turtle-soup, mock-turtle soup, ox-tail soup, and many other kinds of provisions. Messrs. Ritchie and M'Call, and Messrs. Hogarth, similarly prepare meats, poultry, fish, &c., in canisters. Mr. Broccière has a peculiar method of preparing concentrated forms of food from the blood of cattle. Messrs. Leonard, of Hull, practise a system of preparing, curing and rolling beef, so that it may be kept good for any length of time. Mr. Underwood, of Manchester, has a method of preserving meat which, as he states, "is prepared without salt, and may be kept an indefinite length of time without deteriorating its qualities; when cooked, it retains its nutritious qualities, and eats almost as fresh as recently-killed meat."

In various colonies and foreign countries, too, analogous processes are carried on. In New South Wales and Van Diemen's Land, fresh beef and mutton are excellently preserved for use on ship-board. In New Brunswick, salmon, lobsters, cod, and other kinds of fish are preserved in air-tight canisters; and similar preparations are made in Nova Scotia. M. Baup, of Vaud, in Switzerland, besides one of the many modes of preserving meat and fish in canisters, has a method of bringing meat into such a state that it may be exposed to all the varieties of temperature and humidity in the open air, for many years, without being injured; it is said that this process may be adopted in various seasons, and in various latitudes; and that when the meat so preserved is about to be used, nothing more is necessary than to soak it in water for a certain time, to restore or develope its natural but dormant qualities.

In the long interval of peace between 1815 and 1854, preserved foods were used in regular and moderate quantity; but when the Russian war began, vast purchases were made by the English and French governments, with which the combined fleets in the Black and Baltic Seas were supplied. The rather sudden termination of the war in 1856, left the French government with an enormous supply of unused preserved meats in store; and it was deemed better to sell these by auction, in England, than to keep them for future exigencies. Cans of preserved food formed part of the supplies for the troop-ships during the Indian struggle of 1857-8. All emigrant vessels now include a proportion of similar food among their supplies; the allowance varies from one to three pounds per week for each adult passenger, according to the class of accommodation.

ANTISPASMODICS, from ἀντὶ, *against*, and σπασμὸς, *spasm*, the means of removing spasm. The state called spasm, or cramp, occurs only in muscular structures, and consists in an irregular and often excessive action of particular fibres of a muscle, of an entire muscle, or of several muscles. The muscles of an animal of the higher degrees of organisation, such as man, are divided into two classes, the one set comprising those which are concerned in carrying on the functions most essential to life, namely, the circulation, respiration, and digestion, which act independently of the will, and are therefore called involuntary muscles; the other, which are organs of motion, and subject in a certain degree to the control of the will, are termed voluntary muscles. Each set act in consequence of the application to them of some stimulus; and their action is only uniform or natural when their appropriate stimuli are applied. The heart, for example, contracts from the stimulus of the blood; and the intestines are so constructed as to have proper motions excited in them by the food which we take, and the secretions which are mixed with it; which actions, in the healthy state, go on, not only without our willing it, but also without our consciousness. The stimulus to the other set is either a sensation felt in the part and communicated to the chief nervous centres, namely, the spinal chord or brain, or a spontaneous effort of volition proceeding from the brain, and originating in some thought, and connected with some purpose or design, to be executed by the muscles thrown into action. Of the motion of such muscles we are always more or less conscious, and when the system is in its perfect or usual state of health, we can repeat their action for a considerable length of time, and regulate its degree by repeated and distinct efforts of the will, as when a man walks and quickens or slackens his pace according to his inclination. But a variety of circumstances influence the action both of voluntary and involuntary muscles, and render it irregular. When influenced by any of these, the action of the involuntary muscles becomes sensible and painful, and the voluntary muscles cease to be under the control of the will, and act not only without its stimulus, but often against its consent. These disordered actions would appear to be owing to some improper stimulus, instead of the appropriate one, being applied to the organ or part affected. Venous blood, circulating in the arteries, is productive of great disturbance; and if much of it be conveyed to the brain, it will act as a poison to that organ, for which arterial blood is the natural stimulus as well as source of nourishment. In like manner, there are bodies which, though perfectly mild, such as alimentary substances of difficult digestion, yet excite more violent commotions of the stomach than other substances which are of a very acrimonious nature. Undigested food, or unhealthy secretions in the intestines, excite more disturbance and spasmodic contractions (that is, cholic, in different degrees of severity) than foreign substances, which we might expect to prove very hurtful; such, for instance, as the poison of the viper, which is perfectly innocent when received into the stomach.

Both voluntary and involuntary muscles, and the organs of secretion, are very much influenced by emotions of the mind. Under the influence of hope or joy the heart beats vigorously; while under the depressing passions its action is slow and laborious, and accompanied with such oppression as to have given origin to the phrase, 'a heavy heart.' Fear excites to irregular contraction and relaxation many of the voluntary muscles, whence comes trembling, and produces relaxation of certain muscles, called sphincters, which are usually contracted; it also augments several of the secretions. Grief, when not excessive, increases the secretion of the lachrymal gland, producing a flow of tears; if extreme, it hinders secretion, and forms the state truly characterised by our great poet:

"A misery too deep for tears."

Anger often causes the bile to be secreted in greater quantity, to be altered in its quality, and often absorbed into the blood, thus producing jaundice. The state of mind which may be termed vexation often lessens the secretion of bile, but augments that of the kidneys; and every attack of hysteria terminates in a profuse flow of limpid urine, which is destitute of the usual admixture of bile.

These mental emotions, either directly, or indirectly through the altered and unhealthy secretions, occasion in many persons spasmodic contractions of some muscular organs, which are so violent as to produce alarming and often fatal diseases. Of this, ANGINA PECTORIS furnishes an example; and so powerful are the effects of excessive joy in some instances, that the heart bursting is not a mere figure of speech, and of grief in other instances, that the heart breaking is not a metaphor, but a reality. Many spasmodic actions, such as the cough of hooping-cough, are kept up by habit; others, such as the strange gesticulations of St. Vitus's dance, are acquired from imitation, as stuttering or stammering is occasionally; and both may become a habit, difficult, if not impossible, to lay aside.

What is termed sympathy is even more powerful than imitation, which implies a voluntary adoption of the peculiarities of others: scarcely any persons in company can avoid yawning if one sets the example. Now, yawning is an involuntary spasm of the muscles of the jaw, which is thus propagated through a large assemblage of persons; so hysterical and even epileptic spasms are communicated from one to another, often to a frightful extent, if an individual subject to these complaints suffer an attack in theatres, churches, or private apartments. Such an occurrence is sometimes merely the result of affectation, but more frequently it is the consequence of an irresistible impulse. No one was ever seized with tetanus from witnessing the spasms of a person affected with that excruciating disease; a circumstance which can only be accounted for by observing that in it the mind is in no degree implicated, the mental faculties remaining clear and undisturbed to its termination: and there is reason to believe that in this complaint some inflammation or peculiar state of irritation exists about the origin of the nerves, which no one can induce at will, and which neither primarily nor secondarily happens in the others, which are more strictly nervous affections, that is, merely disorders of the functions of nerves without alteration of structure. The development of tetanus is slow, often not showing any sign of its intended attack till some days after the cause of it began to operate on the system. The others are mostly instantaneous, unexpected, and rapid in all their stages. The impression they make on the bystanders is increased by the surprise felt at their unlooked-for occurrence, often without any obvious or sufficient cause. The more sensitive of those around are therefore most apt to fall into a similar state or train of actions. Of the persons so affected, the greater number will be found to be females. What causes render them more subject than others to such attacks? Females, from the larger size of their nerves, are more *mobile*, as it is technically expressed, that is, more easily operated upon by slight causes than others, and their habits of life and education have often a great tendency to increase this sensibility. Whatever diminishes the strength, whether of mind or body, markedly predisposes to such complaints. The female children of the higher and middle ranks, feeble by birth, are rendered more so by the improper modes of education, physical as well as mental, to which they are subjected. After emancipation from the nursery and school-room, their minds and bodies are further enervated by an injudicious course of reading, and an early devotion to the prevailing habits and usages of fashionable life. Such pursuits preclude the possibility of applying themselves to solid studies, or the acquisition of any knowledge of the human system, and of the necessity of maintaining a regular action of every organ and performance of every function.

By a neglect of one of the most important of the natural functions, that is, regular and complete evacuation of the bowels, the tone of the intestines is lessened. Now, when the muscular fibres of any particular part are under a state of more or less tension than the rest of the system, this is communicated by sympathy to every other part of the body. This is particularly observable in the blood vessels and intestines, both of which are muscular tubes; for a relaxation in any part of these will produce a like affection in every other part of the system. And as irritability and sensibility are very much affected by the degree of tension, a want of it in the vessels constitutes what is called a *nervous habit*, such as is most commonly met with in the female sex, and weak effeminate members of the other sex: such persons will generally be found to be of a costive habit. The peculiarities of the female system have a large share in increasing the disposition to be powerfully acted upon, at times, by trifling causes. Exhausting discharges, to which they are very subject, greatly augment the irritability; and all diseases of a very weakening nature will produce a similar effect in the individuals of either sex: during convalescence from these, a disposition to irregular distribution of the blood exists, and a slight excess sent to one part, or a deficient supply of it to another, will cause disorder of the functions of that part. If it be any portion of the nervous structure which is subjected to these errors, spasmodic action is almost surely the consequence. Nothing is more clear or open to proof, than that convulsive motions result from two opposite conditions of the circulatory system, as relates to the quantity of blood, or rapidity of its flow. An animal while bleeding to death suffers violent convulsions, and an excess of blood sent to the head, or its stagnation in the vessels, will produce the same effect; which, indeed, often follows mechanical pressure of the brain, from a portion of depressed bone of the skull, or from effusion of the serum of the blood, in inflammation of the membranes of the brain. The fullness and distension of the vessels of the brain which precedes apoplexy often occasion vomiting, which is a convulsive action of the stomach and some other muscles, and is a warning sign, often unhappily neglected, of the approach of this disease. The more extensive and violent convulsions of epilepsy are, in all probability, the result of a temporarily deranged state of the circulation within the brain, as the loss of consciousness at the time of the attack, the progressive impairment of the intellectual powers, and the usual termination of the disease in apoplexy, palsy, fatuity, and death, attest.

The nature of the causes of the different diseases of which spasm forms, in general, a feature, the complication of these with other diseases or morbid states, and the manner in which each terminates, should all be taken into consideration, if we hope to make a beneficial selection of a remedial agent from among the number of antispasmodic medicines. But such a judicious preliminary measure is rarely adopted; and these articles are often administered in a manner truly empirical, by many professional as well as all unprofessional persons. A brief review of the diseases in which antispasmodic medicines are employed, and which agree only in having spasm for one of their symptoms, while they often differ widely in their causes, nature, and termination, will convince every one how needful is a knowledge of these points to guide us in the choice of the means of cure. The following is not given as a perfect classification or even as an approximation to one, but is merely intended to show the diversified nature of spasmodic diseases, and to furnish an argument for caution in the management of them. The treatment must vary greatly, according as the particular disease is attended with inflammation or not, or according as there is a risk of its occurring, either in the natural progress of the disease, or in consequence of the employment of improper means of treatment. The selection of remedies must be determined also according to the stage of the complaint, and according to the mode in which it is connected with the state of the mental faculties, or its tendency to involve these in the train of morbid actions, if it be not cured before such a calamitous termination take place. Keeping these points in mind, we may arrange spasmodic diseases, in some degree, as follows:

Unattended with inflammation, primarily, or disturbance of the mental faculties:

Simple Cramp. Cholic.—These generally proceed from some undigested substance, or hardened fæces, irritating the bowels: but in the latter disease inflammation is apt to come on; and in the worst forms of cholic, called Ileus, or Iliac-passion, and painter's cholic, it seldom fails to supervene, and then becomes the chief source of danger, as well as most important object of the treatment.

Diarrhœa, or simple looseness, and Cholera.—In these the cramps or spasms are never the first signs, but seem to result from the exhaustion occasioned by the profuse liquid discharges. Inflammation may occur during, or from, diarrhœa, and fever is the most common consequence of cholera, that is, of epidemic cholera; the occurrence of which in either case must lead to a modification or alteration of the plan of treatment.

Angina Pectoris. Asthma.—Affecting the organs of respiration and circulation.

Attended with inflammation, primarily, but causing no disturbance of the mental faculties:

Dysentery.—Affecting the organs of digestion.

Croup, Hooping-cough.—Affecting the organs of respiration.

Unattended with inflammation to an appreciable degree—perhaps in no degree:

Hysteria.—Not affecting the mental faculties, except the volition.

Chorea, St. Vitus's Dance.—Unattended with loss of consciousness; and—

Epilepsy.—Attended with loss of consciousness.

These two diseases sooner or later affect the mental faculties, and have a tendency to a common termination, namely, fatuity, unless they subside spontaneously, or are cured by medical treatment. Chorea generally originates from, or is connected with, accumulations of the bowels, and epilepsy frequently from a similar irritation of these parts, such as worms, but its causes are numerous, and its cure, in most cases, difficult.

Spasmodic diseases, of an obscure nature, chiefly affecting the organs of respiration:

Tetanus and Lock-jaw. Hydrophobia.—These may at some period become attended with inflammation, or rather fever; but this appears to be the result of the constant suffering, and is seldom the direct cause of death, which seems to be the consequence of that depression of the heart's action which long-continued pain or unpleasant sensations produce.

Diseases in which inflammation is the primary affection, spasm the secondary:

Inflammation of the Brain—acute, *Phrenitis*.

Acute or chronic, *Hydrocephalus*, that is, *Water in the Brain*, occurring mostly in children of a scrofulous habit.

Fever.

The treatment of these diseases is as diversified as their causes, and, to be successful, requires a degree of judgment and knowledge which few possess. To comprehend the nature of those spasmodic diseases which are unaccompanied by inflammation, and for which anti-spasmodic medicines are chiefly employed, we must be made aware that, in the human system, there are two distinct sets of nerves, having different origins, and fulfilling separate functions; the one set are called nerves of sensation, the other nerves of motion. The former receive impressions and convey the sensations from all parts of the body *to* the brain; the latter execute the dictates of the brain, by conveying an impulse *from* it to the organs of motion. The organs of motion—that is, the muscles—are so adjusted, and in the healthy state so equally supplied with nervous energy, as precisely to balance or antagonise each other [ANTAGONIST MUSCLE]; and one muscle, or set of muscles, can only overbalance another, or several muscles, when it receives an additional supply of nervous energy from an effort of volition. Thus the hand is opened and shut at will: when opened, the extensor muscles overpower the flexor muscles; when shut, the flexor muscles overpower the extensors.

In diseased conditions of the nervous system, this fine balance is lost from various causes: the nerves of sensation may become preternaturally sensitive; the nerves of motion may become paralysed; the power of voluntary motion may be perverted in various ways and degrees; the flexor muscles, independent of volition, may overpower the extensors, or the extensors the flexors. When affected with tetanic spasm, the extensor muscles of the back of a delicate girl could not be replaced in the natural state of equilibrium by any effort of the will, nor by a weight of eight hundred pounds; and under the influence of hysterical or epileptic excitement, a delicate person cannot be controlled by three or four robust men. The action of the muscles is so violent that the fibres are sometimes torn across, or even the bones fractured.

Some of these spasmodic diseases give, at times, an intimation of their approach, generally by a peculiar sensation being experienced in some part of the body—often the thumb in epilepsy, or between the stomach and throat in hysteria; the spasmodic actions not commencing till these sensations have reached the brain. At other times no warning sensation is felt; yet often, on careful examination, some tender spot will be discovered, of which the patient was not in the least degree previously aware. In hysteria this tenderness is generally felt at some point along the course of the spine or back-bone; and in no case of spasmodic disease should we ever omit a minute examination of this part. Should drawing the finger along the course of the spine, and making firm pressure as we proceed, not reveal its existence, a sponge, dipped in water as hot as can be borne, will, in its progress along the spine, cause the patient to start when it reaches the tender spot. The discovery of this will often furnish a key to all the strange symptoms and spasmodic actions, as well as explain the capricious conduct, of the sufferer, which has alarmed the friends and puzzled the medical attendant. When appropriate treatment is directed to this point, most of the troublesome symptoms abate, or cease altogether.

As most spasmodic diseases, especially if connected with affections of the mind, have a great tendency to recur and become habitual, it is of the utmost importance to stop them at an early period.

The remedies which have been found most efficacious in stopping or preventing these, are either such as make strong and new impressions on the organs of sense, and thereby diminish the effect of sensations already existing, or such as blunt the sensibility in general, and thereby diminish all effects of sensation; or else such as raise the whole of the system to a level with the part spasmodically excited, and so establish the equilibrium, from which forced state all muscles may simultaneously subside.

The fibres of each muscle act generally in concert: if a few act independently of the others, these are in a state of cramp. Particular sets of muscles act in concert, as all the flexors, or all the extensors; one or more of these acting independently of the rest cause spasm. Now we often relieve this by calling the others into action; and as volition simply is not equal to this, we use mechanical or medicinal means. Cramp of the limbs is often removed by pressing the toes or fingers against a resisting body, by which all the muscular fibres are brought to the same level. This example of a mechanical process is the only one worthy of mentioning, and is applicable both in slight cases, as cramp of the limbs is generally merely a symptom of some internal derangement of the bowels, of the spinal chord, or of the brain, and also in the severe cramps of cholera.

The medicinal means constitute the antispasmodic remedies, and are of different kinds. Very few articles are, strictly speaking, merely antispasmodics; that is, used solely to allay spasm, and incapable of being employed for any other purpose. On the contrary, this is only a particular application of substances capable of serving other and more general ends. Consequently, many of the so-called antispasmodics belong to other classes of medicines, such as the stimulants, particularly diffusible stimulants, as alcohol (brandy), sulphuric ether, camphor, &c.; or to the narcotics, such as opium, belladonna, &c., or to the tonics, such as metallic salts, namely, of iron, zinc, and silver; or vegetable bitters, as cinchona bark. The first set, or stimulating antispasmodics, act, apparently, by rousing the nervous energy of the system, and raising the neighbouring muscles to a level with the part in a state of spasmodic excitement. The second set act by rendering the nervous system torpid, and insensible to every sensation; in large doses producing complete insensibility, even to the extent of coma and death. These two are administered when an attack is threatened or actually begun; the tonics are administered while the patient is free from an attack, and act by strengthening the system, so as to render it less susceptible of being acted upon by slight causes, particularly the irritating cause, known, or supposed, to excite the paroxysm or fit. The substances which are more especially considered as antispasmodic are volatile oils, such as mint, lavender, &c., derived chiefly from the tribe of the *Labiatæ*; or cajeput oil, from *Myrtaceæ*; or dill, anise, fennel, &c., from the *Umbelliferæ*, from which tribe also are derived the fœtid gums, as they are improperly termed, being gum-resins, such as assafœtida, galbanum, &c. These, with valerian and myrrha from the vegetable kingdom, and musk and castor from the animal kingdom, are the most valuable antispasmodics. All the volatile oils seem to act in the same way as the purely stimulating antispasmodics; while the fœtid gum-resins act by substituting new and powerful sensations instead of the morbid ones, and must be administered generally when the attack is threatened or begun.

These kinds of antispasmodics differ in value, not only as relates to their mode of action, but to their safety. The stimulating antispasmodics are only admissible when a fit is threatened, or may have begun; and as they greatly excite the vascular system—that is, quicken the circulation—if upon their being given once they fail to remove the spasm, they should not be repeated. This caution is more especially necessary in respect to brandy, which is too commonly resorted to on every threatening or attack of spasm, such as cholic. So many of these diseases being connected with, or disposed to end in, inflammation, the free use of brandy, or other stimulant, is decidedly injurious. The inflammation in croup, hooping-cough, and dysentery must first be removed by appropriate means, when the spasm will generally subside or disappear entirely: if it should remain, in hooping-cough, in a great measure from mere habit, antispasmodics may be used, but even then the narcotic antispasmodics, such as Prussic acid, paregoric, or henbane, are to be preferred. The propriety of employing belladonna extensively in this disease is very questionable. The external employment, in the form of embrocations, of the stimulating antispasmodics, is more allowable in cholic or hooping-cough; but here they act on a different principle, namely, that of counter-irritation. This is, in itself, a most valuable means of curing spasmodic diseases. An irritating application to the spine is of much service in hooping-cough: tartrate of antimony ointment or plaster [ANTIMONY] applied to the tender spot, which we have said often exists in hysteria, and other similar diseases, will be productive of more good than all the antispasmodic medicines which can be tried. Stammering, or other difficulties of speech, might be materially diminished by repeated irritating applications, as blisters, tartrate of antimony ointment, &c., to the nape and sides of the neck. Severe hiccup, continuing for several days, and which resisted all internal remedies, has yielded to a blister applied along the side of the neck. Every physiologist will understand how this happens.

The means which may be employed to intercept the passage of the peculiar sensation to the brain are merely mechanical: for example, tying a string tightly round the thumb prevents the *aura epileptica*, in epilepsy, reaching the brain, and wards off the attack. A cupping-glass would answer as well if applied to any large spot whence the sensation arose.

Free scarification of the gums in children, when teething, is much more efficacious in allaying convulsive affections than internal medicines, except mild purgatives.

The medicines which may be administered while the patient is free from a fit, or in the intervals of the paroxysms, are much more likely to effect a cure than the others. These are tonics and purgatives. For the reasons already stated, purgatives are of primary importance, as they unload the bowels, improve the secretions, and impart vigour to the whole muscular system. Many cases of severe spasmodic disease have been cured by the use of purgatives only, and none can be cured without their free and daily use for some time. (See Hamilton on 'Purgative Medicines,' sixth edition.) Aloetic purgatives are, in general, the best; but where, as in epilepsy, there is reason to suspect the existence of worms, oil of turpentine is to be preferred.

After purgatives have been administered for some time, should the disease not have yielded, metallic or vegetable tonics may be employed with great advantage, particularly in hysteria, chorea, epilepsy, and stammering. In hysteria, chorea, and stammering, the preparations of iron are, in general, best; in epilepsy, preparations of zinc, of copper, but above all of silver, are preferable: sulphate of quinine is also very serviceable.

For the cure of hydrophobia, or tetanus, nothing has yet been found to succeed. There is some reason to hope that, for tetanus, a powerful vegetable compound from South America, called the *woorali*, may be beneficial, if we may judge by its effects on animals affected with tetanic spasm.

Several of the diseases of which we here speak being connected with mental emotions, and some of them originating from imitation or being kept up by habit, mental agency has sometimes been employed to effect a cure, and occasionally with success.

Upon a threatened attack of hysteria or epilepsy, the powerfully attracting the mind to a different object than that which occupies the attention of the patient may ward off the fit. But this requires great judgment and discretion. Formerly the most disgusting means were resorted to, and the sufferers were made to swallow animals of a forbidding kind, or other equally repulsive measures were tried. These cannot be too much reprobated; and we should bear in mind that chorea, or epilepsy, may be brought on by a sudden fright. The separation of a person subject to chorea, or hysterical and epileptic fits, from among others, is often necessary; and when we know that the spasmodic actions are the effects of imitation, the employment of fear may be justifiable; but in any other case it would be criminal to have recourse to it, and thereby, perhaps, add a mental disorder to a bodily one, already sufficiently afflicting.

Our endeavours to lessen the tendency to nervous diseases will be most successfully directed to regulating the education, physical and moral, of children, especially of female children. This subject has been already treated of under the article AGE, to which we refer.

ANTI'THESIS, a Greek word literally signifying 'opposition.' It is used in various senses by the Greek writers: sometimes it means merely 'objections,' or 'opposite arguments;' sometimes it is used to denote the contrasting of one set of circumstances with another; as for instance, when an orator or other person attempting to place the conduct of an adversary in the worst light, first states what the accused *ought* to have done, and then what he *has* done.

But the term antithesis is most commonly used to express contrast of ideas; and the term is equally applied whether the contrast is effected by single words, or by single clauses. (See Quintilian, 'Inst. Orat.,' lib. ix. cap. iii.) The following example from the oration of Demosthenes against Æschines, entitled the Crown, is, in part quoted by Demetrius Phalereus (Treatise Περὶ Ἑρμηνείας, § 262), and by Hermogenes; it is a sample of antithetical invective, in which Demosthenes attempts to show his superiority over his opponent:—"You were employed in teaching, but I was taught: you were a mere menial in the service of religion, but I participated in the sacred rites: you were one of the chorus, but I was the choragus (director of the chorus): you were a petty clerk, but I was a public speaker: you were an actor and played a third-rate part, but I was a spectator; you failed in your part, and I hissed." This taste for antithesis shows itself very strongly in the Greek language, both in poets and prose writers, and more especially in some of the orators and rhetoricians; but it is generally and justly condemned by the Greek writers on style. The antithesis does not necessarily imply contrariety between the things which are brought together; for example, one of the rhetorical exercises of Gorgias, entitled the 'Encomium of Helen,' begins with the following antithesis:—"The ornament of a state is the courage of its men; of the body, beauty; of the mind, wisdom; of action, virtue; of words, truth." Quintilian (ix. 3) expresses the Greek term ἀντίθετον (which is equivalent to ἀντίθεσις) by the Latin word *contrapositum*; and he remarks, that the antithesis does not always contain contrarieties or opposites. He gives the following example from the rhetorician Rutilius: "To us first the immortal gods gave the fruits of the earth: what we alone received, that have we diffused over the whole earth. To us our ancestors transmitted a commonwealth: we have rescued from servitude our allies also." Cicero has the following example of antithesis, which may be compared with similar examples in our own language:—"Quod scis, nihil prodest: quod nescis, multum obest," which may be very imperfectly translated—"What you know, does no good; what you do not know, does much harm." When antithesis is used sparingly and judiciously, it sometimes gives force to expression, and helps to fix distinctions in the memory; but its frequent and indiscriminate use tends to draw the mind from a true perception of the subject, and to fix it on the play of words more than on the real meaning of the sentence.

A'NTLIA PNEUMA'TICA, the air-pump, a constellation in the southern hemisphere, named by Lacaille. It is bounded by Centaurus, Crater, Hydra, Pixis Nautica, and Argo. The following is a classified enumeration of its principal stars:

Magnitude.	Number of Stars.
4·5	1
5·5	6
6·	22
	29

Hence the number of stars visible to the naked eye in this constellation amounts to twenty-nine.

ANTŒCI, from the Greek, signifies those who live over against each other, and is applied to designate the inhabitants of two places which have the same longitudes and latitudes, only differing in one latitude being north and the other south. For example, Malta and the Cape of Good Hope are nearly antœci. Two antœcial places have the same hour of day or night, but opposite seasons of the year.

ANTONINE COLUMN, a lofty pillar which stands in the middle of one of the principal squares of the city of Rome. It was raised by the senate in honour of the emperor Marcus Aurelius Antoninus, and in memory of his victory over the Marcomanni and other German tribes. It was one of the principal ornaments of the Forum of Antonine. In an inscription which has been found near it, and which is now in the Vatican, it is styled 'Columna centenaria Divi Marci.' It was also called 'the greater Antonine column,' to distinguish it from another and a smaller one, made of a solid piece of granite, which had been raised in honour of Antoninus Pius. (Nardini and Nibbi, 'Roma Antica,' and Vignola, 'De Columna Antonini Pii.') During the ages of barbarism which followed the extinction of the western empire, this pillar, and especially its pedestal, suffered greatly from the hands of the various invaders, as well as from the fires which frequently occurred at Rome; the historian Poggio says also from lightning. Pope Sixtus V. repaired it at the expense of 10,000 scudi, and placed the inscription which is now seen on the pedestal, the original one having been probably defaced. He also raised on the summit of the pillar a bronze statue of St. Paul: that of Marcus Aurelius, which formerly stood there, had been removed it is not known when or by whom. The shaft of the pillar is 13 feet 1 inch in diameter at the bottom, and 1 foot less at the top; its height, including the pedestal and capital, is 136 feet, of which 13 are under ground; and the statue on the top and its pedestal are 27½ feet more, making the whole height 163½ feet, (Taylor and Cresy's 'Architectural Antiquities of Rome.') The pedestal of the Antonine column is disproportionate to the shaft. The capital is Doric. The shaft is made of 28 blocks of white marble placed one above the other, a spiral staircase of 190 steps is cut through the interior of the marble, and leads to the gallery on the top, which is surrounded by a balustrade. The exterior of the shaft is covered with bassi-rilievi placed in a spiral line around, which represent the victories of Marcus Aurelius over the Marcomanni and other hostile nations. The style and execution of these sculptures are inferior to those of the Trajan pillar, which the artists evidently purposed to imitate. The sculptures of the Antonine column have been engraved by Santo Bartoli, and illustrated by Bellori. The pillar itself is still one of the most striking monuments of ancient Rome, and one of the principal ornaments of the modern city. It has given to the square in which it stands the name of Piazza Colonna.

ANU'BIS, or **ANUP**, an Egyptian deity, represented with the head of a fox, dog, or jackal, and a human body. In some Egyptian remains we observe him standing by a bier, on which a mummy is lying. The dog was worshipped by the Egyptians, as we are told by Herodotus; and Anubis came to be represented as a symbolical or astronomical character. Anubis was the son of Osiris and Nephthys, the wife of Typhon, and sister of Osiris, and is represented as holding the balance to ascertain the good and evil of the judged before the throne of Osiris, sometimes in company with Horus, and sometimes alone. He appears to have been considered in one sense as the conductor and guardian of departed souls ("the embalmer of the dead, and watcher of the gate of the sun's path"), and in this respect his functions bear some resemblance to those of Hermes of the Greeks, and Mercurius of the Romans. He was placed in the front of the Egyptian temples, in the dromos or line of sphynxes leading from the entrance to the sacred enclosure, as a guard to the other gods: "This is the sacred dromos of Anubis," says Callimachus. He is not mentioned by any Roman writer before the time of Augustus; but his worship must have been introduced towards the end of the republic, as is shown by Appian in his description of the escape of M. Volusius, the ædile ('Bell. Civ.' iv.); and it spread widely under the empire, both in Italy and Greece. Other resemblances are suggested between this Egyptian deity and Hermes (the god with the golden wand, χρυσόῤῥαπις), by the supposition that the element *Anub*, in Anubis, has the same signification as the Coptic *noub* (see Coptic version, Matt. ii. 11), signifying gold.

(Jablonsky, *Panth. Ægypt.* Anubis; and Champollion, *Panthéon Egyptien.* For the phonetic name of Anubis as son of Isis, see Salt's *Essay*, &c., pl. iii.)

ANUS, DISEASES OF. One of the most frequent diseases of this part of the body is that which is commonly known by the name of Fistula, or *Fistula in Ano.* This disease consists of a fistula or sinus by the side of the rectum. It sometimes opens externally, without communicating with the bowel, and is then termed blind external fistula. It more frequently communicates with the bowel, without opening externally, and is then called blind internal fistula. Usually, however, these sinuses have an opening internally and externally, and the disease then constitutes complete fistula. In this latter form pus, flatus, and fæculent matter, are discharged from the openings. It is accompanied by heat of the parts, great discomfort, and sometimes pain and spasm of the sphincter muscles. It is sometimes attended with acute inflammatory symptoms, and the general health suffers.

When this kind of abscess occurs, the healing is prevented by three circumstances:—1. The fistulous condition of the cavity. 2. The presence of foreign matters. 3. The frequent motion of the part by the action of the neighbouring muscles.

This disease originates most frequently in the interior of the bowel by a small ulcer, which, extending, at last produces a second opening. It is often found in persons labouring under pulmonary consumption, and its persistence and inconvenience are increased by the constant cough which accompanies that disease.

The treatment of fistula is simple, and usually very successful. By laying open the whole of the sinus and dividing the sphincter, the two main obstacles to the cure of this disease are removed. The mode of operating in this case is simple. A grooved probe is introduced into the external opening until it passes out at the internal opening. A probe-pointed bistoury is then introduced along the groove, and the sinus is laid open through its whole length. Usually no important vessels are divided in this operation, so that all that is necessary after is to introduce a slight dressing of lint. An opiate should be given after the operation.

Hæmorrhoids or *Piles* consist of an enlarged condition of the veins supplying the anus and rectum. This disease is divided into two kinds, external and internal. It seldom occurs before puberty, and is more common in females than males, and in the rich and luxurious, than in the poor and hard-worked. This arises from the fact that whatever tends to determine blood to the lower part of the rectum, and to retard the return of blood from that part, favours piles. Thus they come on in pregnant females, in persons troubled with habitual constipation, abdominal tumours, obstructions in the portal system of veins, and in those who lead sedentary lives or who feed too well.

External piles consist of a congeries of varicose or enlarged veins, which are surrounded by a condensed and enlarged connective tissue, and are covered partly by mucous membrane and partly by loose rugose integument. The parts are sometimes inflamed, at other times free from any capillary derangement. The mucous or rugose surface occasionally becomes ulcerated. It is under these circumstances that the coats of one or more of the veins give way, and they bleed to a greater or less extent. When this does not take place they do not bleed. These two states are called respectively *bleeding* and *blind* piles.

The treatment of this form of piles may be either palliative or radical. The radical cure consists in removing the parts either by the scissors or bistoury, and leaving them to heal in the ordinary way, or a ligature may be passed round the enlarged vessels, and the strangulated part left to slough off. When this operation is not thought desirable, much may be done to relieve the enlargement and pain of piles by a palliative treatment. Whatever will remove the loading of the vessels in the lower part of the bowels will relieve them. Thus parturition removes them when caused by pregnancy. If the part is inflamed, rest, purgatives, poultices, and anodyne applications may be had recourse to. Astringent applications combined with opium may be applied, as gallic and tannic acids. The purgatives most to be recommended are castor oil, or an electuary with the confection of senna, sulphur, and cream of tartar. In cases where the liver is affected, the state of this organ should be specially attended to.

Internal piles, are of three kinds: 1. Varicose veins surrounded by enlarged connective tissue, and covered by mucous membrane, and bleeding or blind. 2. Tumours of the nature of sarcoma. 3. A congeries of blood-vessels resembling erectile tissue, and occurring in the submucous connective tissue. This last form is the most common. They may protrude from the anus or not. When they do not, they descend occasionally when the bowels are acted on, and become very troublesome till they are returned. If not replaced they become constricted and inflamed or bleed. In these cases bleeding usually occurs when the bowels are acted on. When the tumours are replaced, no great inconvenience occurs. If, however, the bleeding continues, the patient becomes pale, thin, and weak; noises in the ears, giddiness, and palpitation of the heart come on, in fact all the symptoms of anæmia set in.

The treatment in this case may be either palliative or radical. Frequently the latter course should at once be had recourse to. The internal tumours are seldom of a kind to allow of removal by the knife, and ligature is by far the safest process. When the base of the tumour is small, it may be pulled down by a tenaculum and a single ligature placed round it; but when the base is broad, a needle with two ligatures is passed directly through the tumour, and a ligature is tied round each half of the tumour. This operation is very painful and difficult, and wherever circumstances will admit, is greatly facilitated by the use of chloroform. After the operation, opiates should be given.

Nitric acid has been recently recommended in these cases, but unless the tumours are small, and the cases slight, this remedy is liable to fail, and after the infliction of much pain the operation must be had recourse to.

Should the palliative treatment be had recourse to, all those points to which reference has been made under the head of external piles, must be attended to. Astringent remedies and opiates must be injected into the bowels. The bowels must be regulated, the liver looked to, and when the hæmorrhage is considerable, gallic and tannic acids, with acetate of lead, must be given internally.

Prolapsus Ani is a very frequent and troublesome affection of the lower bowels. In consequence of relaxation, the rectum passes down, and becoming averted protrudes itself beyond the anus. This protrusion may be either *partial* or *complete.* It is called complete when the entire bowel comes down, and partial when the mucous coat alone descends. The latter is the most frequent, and sometimes accompanies internal piles. Children and old persons are more liable to the complete form. The quantity of bowel or membrane which passes down varies in size, from a mere annular enlargement to a tumour as large as a child's head. It is sometimes accompanied with inflammation, and the mucous membrane throws off a coloured discharge. Great pain and uneasiness are often felt, and general languor and debility are present.

The treatment is either palliative or radical. When this disease depends on general constitutional weakness, tonics, change of air, and a proper regimen will restore the patient to health. The bowel should always be returned as speedily as possible, and this may be done by proper pressure after lubricating the parts. When they are inflamed, leeches should be applied and rest secured before attempting reduction.

The radical cure is effected by removing one or more of the redundant folds of the mucous membrane by the knife or ligature. The cicatrix thus formed contracts and sustains the replaced parts, or the bowel may be left intact, and a portion of the redundant external integument may be removed, which by its subsequent contraction prevents the painful protrusion.

Imperforate Anus.—Children are occasionally born without an anal orifice. Three forms of this malformation are described:—1. The rectum may be fully developed, and have its orifice closed by an external membrane, or a septum may be developed at some distance from the orifice. In the treatment of this form of imperforate anus, nothing more is required than an incision through the occluding membrane. 2. The rectum terminates at some distance from the perineum, and there is a mere depression where the anal orifice ought to be. This is the most common form. It requires a more serious operation than the last. The meconium should be allowed to accumulate, and pressure being made on the abdomen, an incision must be made down to the bowel, and a passage thus established. 3. In this form the rectum is very deficient or altogether absent. An operation like the last may be performed, and failing this, an attempt may be made to form what is called an *artificial anus.* This operation is performed not only for imperforate anus, but in cases where, from tumours, or the impaction of foreign matters, the fæcal matter does not find its way to the anal orifice. The sigmoid flexure of the colon is the part which is preferred for this operation. It may be reached from before or behind. The former is the easiest operation; the latter is the most convenient position for the new opening to the patient. In performing the latter operation, an incision is made midway between the last false rib and the crest of the ileum. The colon is then secured, an incision made into it, and the edges of the bowel brought in contact with the external wound by means of ligatures. This operation has been successfully performed in cases of non-malignant tumours and other causes of the impaction of the lower bowel. In children with imperforate anus however it seldom succeeds, as other malformations often exist which speedily terminate the life of the patient.

APANAGE (*Apanagium, Apanamentum*), the provision of lands or feudal superiorities assigned by the kings of France for the maintenance of their younger sons.

The prince to whom the portion was assigned was called the *apanagist;* and he was regarded by the ancient law of that country as the true proprietor of all the seigniories dependent on the apanage, to whom the fealty (*foi*) of all subordinate feudatories within the domain was due, as to the lord of the "dominant fief."

Under the first two races of kings, the children of the deceased monarch usually made partition of the kingdom amongst them; but the obvious inconvenience of such a practice occasioned a different arrangement to be adopted under the dynasty of the Capets, and the crown was permitted to descend entire to the eldest son, with no other dismemberment than the severance of certain portions of the dominions for the maintenance of the younger branches of the family. Towards the close of the thirteenth century, the rights of the apanagist were still further circumscribed; and at length it became an established rule, which greatly tended to consolidate the royal authority in that kingdom, that, upon the failure of lineal heirs male, the apanage should revert to the crown.

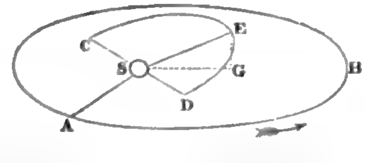
The period at which this species of provision was first introduced into the law of France, the source from which it was borrowed, and the origin and derivation of the term itself, are matters on which the historical antiquaries of France seem not to be agreed. (See Pasquier's 'Recherches,' lib. ii. cap. 18, lib. viii. cap. 20; Calvini, 'Lex Jurid., Appanagium;' Ducange, 'Gloss., Apanamentum;' Pothier's 'Traité des Fiefs;' and Henault's 'Hist. de France,' Anno 1283.)

By a law of 22nd November, 1790, it was enacted, that in future no appanage *real* should be granted by the crown, but that the younger branches of the royal family of France should be educated and provided for out of the civil list until they married or attained the age of twenty-five years; and that then a certain income called *rentes apanagères* was to be granted to them, the amount of which was to be ascertained by the legislature for the time being.

"It is evident," says Mr. Hallam, "that this usage, as it produced a new class of powerful feudatories, was hostile to the interests and policy of the sovereign, and retarded the subjugation of the ancient aristocracy. But an usage coeval with the monarchy was not to be abrogated, and the scarcity of money rendered it impossible to provide for the younger branches of the royal family by any other means. . . . By means of their apanages and through the operation of the Salic law, which made their inheritance of the crown a less remote contingency, the princes of the blood-royal in France were at all times (for the remark is applicable long after Louis XI.) a distinct and formidable class of men, whose influence was always disadvantageous to the reigning monarch, and, in general, to the people." ('Middle Ages,' vol. i. p. 121, 2nd edit.)

APELLEANS, or **APELLITES**, a sect of heretics so called from their founder Apelles, who lived about the middle of the second century, and had been originally a disciple of Marcion. The belief of the Apelleans appears to have been a variation of that of the Marcionites; and both took their rise from the Gnostics. They are said to have, as well as the Marcionites, held the Manichæan dogma of the good and evil principles; but what principally marked them was their doctrine upon the subject of the incarnation of Jesus Christ. They said that his body was neither real, as commonly supposed, nor only apparent or shadowy, as Marcion taught; that it was formed not of flesh and blood, but of air, and that, as it had been received in his descent to the earth, so it was cast off and dissolved again into air in his ascent to heaven. Besides thus denying that Christ took his body with him to heaven, they also denied the general doctrine of the resurrection of the body. They are accused moreover of denying the authority of the Old Testament. Apelles and his heresies are mentioned by Augustine, Epiphanius, Tertullian, and Eusebius. [HERESY.]

APHE'LION, from the Greek ἀπὸ, *from*, and ἥλιος, *the sun*, means that point of a planet's orbit which is farthest from the sun. Its opposite point is the PERIHELION, from περὶ, *near to*, and ἥλιος, *the sun*, which is the nearest point to the sun.



Let S represent the sun, S A B the earth's orbit, or plane of the ecliptic, and S A a parallel to the line in which the earth's equator cuts the ecliptic, from which line all heliocentric longitudes (that is, measured round the sun) are measured in the direction of the earth's motion, represented by the arrow. Let C D E be a part of the orbit of a planet, S E the longest line which can be drawn through S, then E is the aphelion of the planet. If a plane S E G be drawn perpendicular to the ecliptic, the angle A S G is the heliocentric longitude of the aphelion E.

The supposition of the planets moving in elliptic orbits round the sun is not true, unless the ellipses themselves be supposed slowly to change their positions and figures. In all the planets, except Venus, a very little more than a complete revolution must be made between two aphelia; in Venus, on the contrary, a little less. This inequality is represented by saying, that the aphelia of all the planets, except Venus, slowly increase in longitude, while the aphelion of Venus decreases. The apparent motions of the aphelia are greater than the real, since the line S A moves slowly backwards. [PRECESSION.] The apparent annual motion of the aphelia is the annual precession of the equinoxes, together with the real annual motion, except in the case of Venus, in which the apparent motion is the precession of the equinoxes *diminished* by the real motion. The apparent motion of the aphelion of Venus is like that of all the others, in the direction of the earth's motion, for though the aphelion of Venus moves backwards, the line S A does the same at a greater rate.

A'PHORISM (ἀφορισμὸς), literally "a limitation," or "a fixing of limits," and hence used by the Greek writers to express a short sentence, containing a moral precept, or a rule of practice, briefly and forcibly expressed. The term has been adopted in medicine; for instance, both Hippocrates and Boerhaave have written books entitled 'Aphorisms,' containing medical maxims, not treated argumentatively, but laid down as certain truths. For example, "Neither repletion nor hunger, nor anything which exceeds natural limits, is good." The word is similarly used in the civil law. We give the following as specimens of moral aphorisms.

"It is always safe to learn from our enemies; seldom safe to instruct, even our friends."—*Lacon.* "He will easily discern how little of truth there is in the multitude; and though they are sometimes flattered with that *aphorism,* will hardly believe the voice of the people to be the voice of God."—Brown's 'Vulgar Errors,' book i. 3.

Sayings of this description are well adapted to make an impression on the memory; but they tend to substitute authority instead of judgment as the motive of action, and may therefore be as well applied to maintain prejudices as to assert truths; to impose conventional and needless restraints, as to furnish safe rules of conduct to the inexperienced. It is with reference to this that Milton uses the word. "There is no art that hath been more cankered in her principles, more soiled and slubbered with *aphorisming* pedantry, than the art of policy."

APHRODI'TE, the goddess of love and beauty. According to Homer, she was the daughter of Zeus and Dione, one of the Nereides, or ocean nymphs: a later legend, told by Hesiod (*Theog.* 188), relates that she sprung from the foam of the sea, produced when Kronos threw into it the amputated members of his father Uranos. There was a celebrated picture of her rising from the sea (ἀναδυομένη), esteemed the master-piece of Apelles. She first came to land at the island of Cythera, and thence proceeded to Cyprus. These islands were her favourite places of resort, and many of her epithets are derived from them (Cytherea, Cypris, Paphia, &c.). She was regarded as the most beautiful of the female deities. To her, according to a legend which has been at all times a favourite with artists, for the opportunities it affords of representing varied types of female loveliness, the prize of beauty was awarded by Paris. Aphrodite was assigned in marriage to Hephæstus (Vulcan) the god of metallurgy, and there is a well-known tale of her detection in an amour with Ares (Mars) ('Odyss.' viii. 266). Hermes and Poseidon (Mercury and Neptune) were also among her favoured suitors. Her amours, however, were not confined to the gods. For her adventures with Adonis, see that article in the BIOGRAPHICAL DIVISION, vol. i. col. 42: she also bore Æneas to Anchises, a youth of the blood royal of Troy, as is largely related in the Hymn to Aphrodite, ascribed to Homer. In the Trojan war she was ranged with Apollo and Ares on the side of the Trojans, and in attempting to protect her son Æneas, was wounded by Diomed. According to the fictions of the 'Æneid,' she continued to extend her maternal care over Æneas, and brought about his establishment in Italy, and through him the Julian family derived their descent from her. To the Italians she is known by the name of Venus; a goddess, probably, of indigenous origin, but so confounded in the fictions of poets and mythologers with the Greek Aphrodite, that her original attributes have nearly disappeared.

It is supposed that the worship of Aphrodite was introduced into Greece from Syria, and that she is identical with the Phœnician goddess Astarte. It is certain that she was from the earliest times regarded as the goddess of natural fertility—the great goddess of nature, the mother of all living beings. In the ancient temples of Cyprus she was adored under the form of a conical stone. When a human form was adopted, the Grecian artists represented her as a consummately beautiful woman; but she was not represented undraped in the earlier and more devotional periods of Hellenic art. Usually she was represented enthroned and surrounded with the emblems of fertility; either fully clothed or with one breast uncovered. This last was the characteristic manner throughout the Phidian era. Up to this time Aphrodite was regarded as the protectress of virtuous love. The age of Praxiteles, a period in Greek art corresponding to the sensuous epoch of the Medici in Italian art, initiated a more voluptuous conception. Aphrodite was associated with sexual passion—the goddess of love and beauty. The religious feeling having died out among the cultivated classes, artists saw in Aphrodite only a vehicle for the representation of the most perfect beauty in the female form. The goddess was now usually represented wholly undraped, or with a robe drawn round the lower part of the body. A very common mode was to represent her either about to enter or leave the bath, the position being such as to represent feminine modesty or shame. It was upon these representations of the undraped Aphrodite that the greatest of the Greek sculptors and painters exerted their very highest skill. Such was the famous Cnidian Venus of Praxiteles. It is related that the great sculptor having been commissioned by the inhabitants of Cos to make them a statue of Aphrodite, executed two; one draped according to the prescribed form, the other nude. The latter was infinitely the more beautiful; but they chose the former, as more consistent with their notion of their deity. The naked statue was, however, eagerly purchased by the inhabitants of Cnidus, who built for its reception a temple open on all sides; and so great became its renown, that strangers flocked to the island from all parts of Greece to see it. Nicomedes, King of Bithynia, is said to have offered to release the Cnidians from the entire public debt of their city in exchange for their statue, but they refused his offer. What was the ultimate fate of this famous statue is not known. Some authorities have fancied that the celebrated figure known as the Venus de' Medici is, if not the Cnidian Aphrodite, at least an ancient copy of it; but this is very improbable. There is a bronze coin of the city of Cnidus, of which a good impression is in the cabinet of the Louvre, which has on one side a figure of Aphrodite, who has undraped herself for the bath, a portion of her drapery being held in her left hand, and resting on a vase; and this figure may be reasonably presumed to be a copy of that which the citizens so highly esteemed. Much more nearly accordant with this figure than the Venus de' Medici, is a statue of Venus in the gardens of the Vatican, which, though certainly not the Aphrodite of Praxiteles, is now held by most authorities to be an ancient copy of it. (Muller, 'Archäol. der Kunst,' § 127.) Though inferior as a work of art, and wanting in the refinement of the Medicean Venus, this statue has still something of a grander and loftier character. From the time of Praxiteles Aphrodite was represented more and more as simply a beautiful woman—gracefulness, tenderness, voluptuousness, *naïveté*, or a languishing sensuality, being the character imparted by expression, form, and pose according to the feeling of the artist or the desire of the patron. To this later period belong the earliest representations of the sea-born Aphrodite, or Venus Anadyomene. By Praxiteles and later Greek artists heteræ noted for their beauty were often represented in the character of Aphrodite; and there still exist several portrait statues of ladies of the Imperial families of Rome as Venuses, by Græco-Roman sculptors: some of them examples of almost the lowest stage of the decline of art.

In sculpture, but still more frequently on gems, Aphrodite is represented grouped with Eros; with the Charites; with Adonis; alone, or with the other goddesses before Paris. On vases, gems, and terra-cottas, she is seen persuading Helen to fulfil her promise to Paris; carried through the air on a swan; in a shell among nereids, &c. One picture of Aphrodite by Apelles has been mentioned; another which he left imperfect, was so much esteemed that no artist dared to complete it. The peculiar attribute of Aphrodite is the cestus (κεστὸς ἱμὰς, 'Il.' xiv. 214), or embroidered girdle, which had the power of inspiring love for the person who wore it. Her favourite animals were the swan, the sparrow, and the dove; her favourite plants, the rose and myrtle. The bird called inux, much used in amatory magic, was also sacred to her.

Representations of Aphrodite are to be found in most collections of ancient sculpture. Of several of the most esteemed in the public galleries of Europe, there are excellent casts in the Crystal Palace at Sydenham. In the sculpture galleries at the British Museum, will be found six or seven statues or torsi of Aphrodite of very considerable value. A small terminal statue closely veiled (in the third Græco-Roman saloon), "has been thought to represent the Venus Architis of the Phœnicians," but the correctness of this suggestion is very doubtful. An undraped statue of heroic size, in excellent preservation, represents Aphrodite preparing for the bath, with a vase and drapery by her side, and is a variety of the Cnidian type. Three of the others are undraped; one, of heroic size, the right hand and left arm alone modern, is half-draped, of the class mentioned above.

Of the existing statues of Aphrodite, that known as the Venus de' Medici is so much the most celebrated—being, indeed, one of the most famous, if it be not actually one of the finest, relics of ancient art—that a somewhat more particular account of it seems to be required. It stands in the apartment of the Imperial gallery at Florence, which is called the Tribune (Tribuna). It is said to have been found in the villa of Hadrian, near Tivoli, in eleven pieces, and was sometime afterwards carried to Florence in the pontificate of Innocent XI., about the year 1680. It is all ancient, with the exception of the right arm, the lower half of the left arm, some small piecings about the statue and its accessories, and the plinth. On the plinth is inscribed the name and country of the artist who made the statue: Cleomenes, the son of Apollodorus, of Athens—**ΚΛΕΟΜΕΝΗΣ ΑΠΟΛΛΟΔΩΡΟΥ ΑΘΗΝΑΙΟΣ ΕΠΩΕΣΕΝ**. This inscription was copied from that of the original plinth, which was broken. Its authenticity has been questioned, but on very insufficient grounds: Thiersch fixed the period of Cleomenes, for various reasons, to be about 200 years B.C., or certainly before the destruction of Corinth, B.C. 148. Flaxman also judges from its style that it was made after the time of Alexander the Great, and he seems to have considered it a copy of the celebrated Venus of Cnidus, by Praxiteles, an opinion expressed by Meyer, Winckelmann, and other critics, but, as we have said, apparently without sufficient grounds. Neither the time nor place of its discovery is positively known; but it stood, in the 16th century, in the Medici Gardens at Rome: the forum of Octavia at Rome is also said to have been the place of its discovery. It was taken by the French to Paris, but was restored to Florence in 1815.

It is a small figure, 4 feet 11¼ inches high without the plinth; is of Parian marble, and stands upon the left leg, which is strengthened by a dolphin with its head downwards, upon which two little cupids are sitting, called Eros and Anteros. The statue is of small but beautiful proportions, and all the parts are exquisitely rounded, but the face has little expression and not much beauty. The ears are pierced, and at one time bore ornaments; the hair was gilded, and on the upper part of the left arm there is the mark where probably a bracelet was fixed.

(Winckelmann, *Geschichte der Kunst des Alterthums*; *Museum Florentinum*; Gerhard, *Vat. Mus.*; Larcher, *Mém. sur Vénus* (1775); Scharf, in Wordsworth's *Greece*; Thiersch, *Ueber die Epochen der Bildenden Kunst*; Visconti, *Oeuvres Diverses*, vol. iii.; Hirt, *Mythol. Bilderbuch*, vol. iv.; Müller, *Arch. der Kunst*, §§ 374—378, and references therein.)

APIIN ($C_{24}H_{14}O_{13}$), the name given by its discoverer, M. Braconnot, to a peculiar principle in parsley, obtained from it by solution in water. In cold water and alcohol it is nearly insoluble, but dissolves readily in either of them when heated, the solutions obtained gelatinising as they cool. The solution has a yellow colour. Apiin is soluble in the alkalies and in lime-water; the solutions are yellow, and when an acid is added, apiin is precipitated in a gelatinous state. When it is boiled with dilute acids, apiin undergoes a peculiar modification. If a small quantity of sulphuric acid be added to a boiling solution of apiin, it soon becomes turbid, and is converted into a thick yellowish fluid. On filtration after cooling, and saturation of the acid with chalk, a small quantity of sugar remains in solution; the portion precipitated becomes of a yellowish-white colour after washing and drying, and weighs but little less than the apiin submitted to experiment; it is neutral, inodorous, insipid, and insoluble in cold water, but it dissolves in boiling water or alcohol; the solutions do not gelatinise on cooling, but precipitate in white opaque flocculi.

Apiin dissolves in concentrated sulphuric and hydrochloric acids, and is precipitated from them by water in the state above described. M. Braconnot inclines to the opinion that this is pure apiin, and that that which gelatinises is a compound of apiin with one of the substances which the acids convert into sugar, an operation after which the apiin is exhibited in its proper character. Apiin produces a characteristic action with protosulphate of iron, producing with it a blood-red colour, which is so intense that about 16 grains of it dissolved in five gallons of water visibly colour it. The apiin which does not gelatinise produces the same effect: a solution of it in boiling water gives a blood-red precipitate with a solution of the salt of iron. With nitric acid apiin yields carbazotic acid and some traces of oxalic acid.

APIRINE, a dubious alkaloid, said by M. Bizio to be contained in the nut of the *Cocos lapidea*. Its composition is unknown.

APIS, a sacred bull, whose station and temple were at Memphis in Egypt. His Egyptian name was Heri, and he was regarded as the living son of the god Phtha. He must be distinguished from Mneuis, the sacred bull of Heliopolis. The real or true Apis was known from among all other bulls by certain marks, which are mentioned by Herodotus and Pliny (iii. 28; viii. 46). His birth is commonly described as miraculous; though produced from a cow, his conception was caused by the descent of lightning, or the influence of the moon's beams. When the bull Apis died, or had been put to death after living the prescribed number of years (according to some authorities), a successor was diligently sought for, and, when found, was installed in his temple of Memphis with all due solemnity. The cow was not eaten in Egypt, but the bull was used as food; yet no bull could be slaughtered till it had been first ascertained that it had none of the marks which characterised a sacred bull. When this was ascertained satisfactorily, the priests put a seal or mark on the animal, to signify that it might be slaughtered: no unstamped bull could be slaughtered, under pain of death. The object of the regulation was probably the raising of an income by a tax on slaughtered animals: there might possibly be other reasons also. (Herod. ii. 38.)

The worship of Apis existed at least as late as the reign of Septimus Severus. We hear of Greeks and Romans of rank paying their respects to the bull of Memphis, in which curiosity and superstition appear to have been blended. Alexander the Great, when he visited Memphis, sacrificed to all the gods, and Apis among the rest. The Persians, on the other hand, regarded the worship of the bull with disgust, and Cambyses insulted the Egyptians by stabbing their deity. Germanicus Cæsar, when he visited Egypt in the reign of Tiberius, went to see Apis at Memphis. It was a favourable sign when the animal would take food from the hand of his visitor, and the reverse was looked upon as presaging misfortune. The bull refused what the hand of Germanicus offered, and the Roman general died shortly after at Antioch. Strabo describes the Apis and his temple in the following terms, at the time of his visit to Egypt (xvii. p. 807): "Memphis contains a temple of Apis, who is the same as Osiris. The bull Apis is kept in an apartment (σηκὸς), and is regarded as a god: he is quite white on the forehead and some other parts of the body, but in every other part black. By these marks they always decide which bull is to be the successor of Apis when he dies. In front of the apartment is an inclosure, in which there is another apartment for the bull's mother. They allow the sacred bull to come into this court or inclosure at certain times, and chiefly for the purpose of being shown to strangers." The bull Apis, according to Herodotus (iii. 29), was embalmed when he died; but if he lived beyond a given number of years, he was slaughtered and buried secretly. If he died a natural death within the specified time, he was buried with much solemnity in the temple of Serapis, at Memphis. Lucas says (vol. i. p. 345, 'Voyage fait en 1714') that he observed bulls' heads in several niches of the catacombs of Abousir: he also found a bull embalmed, and in a great chest, on which the head of the animal was represented; the case, he says, was gilded and painted. (See also 'Abd-Allatif,' De Sacy, p. 201.)

The deity Apis was probably a symbol of the Nile (Jablonsky, 'Panthéon,' Apis), or of the earth and fertility, as the cow also was in the Egyptian, and still is in the Hindoo mythology. The god Sivas, in the Indian mythology, has his sacred bulls, which are characterised by certain marks, and a colossal bull of stone is often an ornament of his temples. The bull (but not the cow) is still an object of worship in India. Colossal human-headed bulls, it will be remembered, are very prominent in Assyrian sculpture.

In Egyptian art Apis is represented as a pied bull, wearing on his head the solar disc. There are several representations of him in the British Museum: see vases 628, &c., in the Egyptian Gallery; figures in Cases 8 and 9 in the First Egyptian Room, &c. The tendency of the Israelites to fall into the idolatrous worship of the bull or cow is seen from the history in Exodus, xxxii.; and at a later period, Jeroboam, who had spent some time in Egypt, set up two calves, one at Dan and the other at Bethel, and established temples and priests, probably in honour of Apis and Mneuis respectively. (1 Kings xii.; compare Hosea, chap. x.)

APLANATIC LENS from the Greek *a*, *without*, and πλάνη, *deviation* or *aberration*) is one which should be capable of so refracting all the rays which, diverging from or converging to one point in the axis, are incident upon it, that after being transmitted through it they may converge to or diverge from one other point in the same axis.

A single lens bounded by parallel surfaces cannot be rendered aplanatic. But for the sake of correcting another defect, that of *chromatic aberration*, the object-glasses of telescopes are made compound, consisting of a lens of crown and one of flint glass, and such a combination besides being *achromatic*, can be rendered at the same time aplanatic for parallel rays. [OPTICS.]

APOCALYPSE. The word apocalypse (ἀποκάλυψις) signifies literally *uncovering*, *unveiling*, and is used in the New Testament to express especially an extraordinary revelation of the will of God. In this sense the apostle Paul speaks of his "preaching Christ according to the *revelation* (κατὰ ἀποκάλυψιν μυστ.), of the mystery, which was kept secret since the world began, but now is made manifest, by the commandment of the everlasting God made known to all nations for the obedience of faith."—Rom. xvi. 25, 26. Compare also 1 Cor. xiv. 6, where we find that when the Christians assembled, every one had a psalm, a doctrine, a tongue, a revelation (apocalypse), or an interpretation. In these and similar passages the gift of teaching, of interpreting, and of announcing future events is distinguished from the revelation (*apocalypse*) of the council of God to the spirit of the receiver.

But the word apocalypsis is used in a still more confined sense, to express especially the prophetical revelation of the future development of the Messiah's kingdom. Works which describe future conflicts between the power of the Messiah and the opposing powers of Satan, unbelief and superstition, form the apocalyptical literature. The revelations in these works communicate visions in symbolical language. The *apocalyptical* is a branch of the *prophetical* literature. Every *apocalyptical* book is prophetical, but every prophetical book is not apocalyptical.

Apocalyptic writings develope that future kingdom of the Messiah which constitutes an essential part of the Biblical doctrine in the Old as well as in the New Testament. Apocalyptic, as well as profane, literature, has its epochs and periods of flourishing and of decay; and it is divided into canonical and apocryphal branches.

The first epoch is the Jewish. The book of Daniel is the prototype of all subsequent apocalypses. The fundamental idea of Jewish apocalyptics is the first advent of the Messiah in order to lay the foundation of his kingdom. In the Jewish apocalyptics, everything concerning the Messiah is future.

The second, or the Christian, epoch, of apocalyptic literature begins after the development of Christ's kingdom; consequently, the Christian apocalyptics are clearer than the Jewish. The Jewish apocalyptics still continued after the first advent, as long as the ideas about the Messiah retained great vigour among the Jews; but they degenerated into apocryphal imitations of earlier apocalypses. These apocryphal apocalypses of later Jews were often interpolated by Christians. The decay of the Jewish apocalyptics after the first advent was necessary; because Christianity is the only true continuation of Biblical Judaism. The stream of Jewish apocalyptics is lost in the sands of the Talmud. Some account of Jewish apocryphal apocalypses have been given under the articles ENOCH, EZRA, ISAIAH, in the BIOGRAPHICAL DIVISION of the ENGLISH CYCLOPÆDIA, and a further account will be given under PATRIARCHS, in the present Division.

In the history of the Apocalypse, we have to consider who was the author of the work who calls himself at the commencement of the first chapter: "Johannes a servant of the Lord." Some critics have asserted that this description which the author gives of himself is a proof that the Apocalypse was not written by the apostle St. John, but by another servant of the Lord, who would not assume any apostolic dignity; and, further, that in the usual title of the book (Ἀποκάλυψις Ἰωάννου τοῦ θεολόγου) he is not called St. John the apostle, but only John *the divine*, or the theologian. But most critics suppose that the present title to the Revelations can only refer to that apostle who wrote more explicitly about the divine *logos* (θεοῦ λόγος) than any other of the evangelists. Whoever compares the phraseology, imagery, and doctrine of the Apocalypse with that of the gospel and the epistles of St. John, will, indeed, find a great difference. The Greek style of the Apocalypse is strongly tinctured with Hebraisms, and its imagery is bold. The style of the gospel and the epistles approaches more nearly to the classic Greek, and is almost without imagery.

Polycarp, bishop of Smyrna, a successor of one of those pastors to whom the seven apocalytical letters in chap. ii. and iii. were addressed, was a disciple and friend of St. John the apostle: and Papias, bishop of Hierapolis near Laodicea, was, according to the statement of Irenæus ('Adv. Hær.' v. 33), "a hearer of John and a friend of Polycarp." Polycarp and Papias were highly esteemed authors. Polycarp's letter to the Philippians is still extant, but of the writings of Papias some fragments only have been preserved. In Polycarp's letter to the Philippians the Apocalypse is not mentioned; but his disciple Irenæus acknowledges its authenticity, and appeals to the testimony of those who had seen the face of St. John.

We have the testimony of the two Cappadocian bishops, Andreas and Arethas of Cæsarea, who lived in the last quarter of the 5th century, that Papias recognised the inspiration and authenticity of the Apocalypse. Andreas says, at the conclusion of his introduction to his commentary on the Apocalypse, "It is unnecessary to make many words about the inspiration of the Apocalypse, since those blessed men, I mean Gregory the theologian and Cyril, and besides these the more ancient also, Papias, Irenæus, Methodius, and Hippolitus, testify to its credibility." Arethas being later, repeats nearly the same statement in the preface to his own commentary. Papias died, according to the Alexandrine Chronicle, A.D. 163; therefore he must have been very young when he heard St. John, who died about A.D. 98.

Justinus Martyr, who flourished between A.D. 130-160 ,and was nearly contemporary with Polycarp and Papias, was born in Palestine, and acquainted with Alexandria, Rome, and Asia Minor. At Ephesus he held his famous dialogue with Trypho the Jew, which is still extant. Justinus Martyr quotes in this dialogue Jer. lxv. 17, &c.; Gen. ii. 17; Ps. lxxxix. 4, to support his doctrines about the millennium, and adds, that John the apostle, in the Apocalypse, likewise prophesied, that the believers in Christ should dwell in Jerusalem 1000 years before the general resurrection and final judgment should take place.

Melito, bishop of Sardes, to which town one of the apocalyptical letters is directed, belonged to the Biblical critics of the 2nd century, and wrote, according to Eusebius, "on the devil and the Apocalypse of John." Jerome says, in effect, the same.

Probably at the conclusion of the 2nd century, Theophilus, bishop of Antioch, wrote against the heresy of Hermogenes. This work is lost, but Eusebius, who read it, testifies that Theophilus took some proofs (μαρτυρίας) from the apocalypse. Theophilus seems also to use apocalyptical language in his work ('Ad Autolycum,' ii. 28); "the demon (devil) is also called dragon (δράκων)." Hence we infer that the Apocalypse was known in the second century, and influenced the language of the Christians.

Eusebius mentions likewise that Apollonius (who was, according to the book 'Prædestinatus,' which was written in the 5th century, bishop at Ephesus in the 2nd century) quoted the Apocalypse against the Montanists themselves, although these heretics derived their errors especially from this part of the New Testament.

But the most important testimony in favour of the Apocalypse is that of Irenæus, who died bishop of Lyons, A.D. 202. Irenæus, in his work against heretics, quotes long passages from the Apocalypse of John, whom he calls expressly the "disciple of Jesus" and "the recipient of the revelation." This presupposes that its canonical character was then generally recognised. Irenæus defends the apocalyptical number 666 against the spurious 616, by stating that all warranted old manuscripts contained 666, which number was also supported by the testimony of those who saw the face of John. Irenæus modestly confesses his own inability to explain this number, and says: "If the name of antichrist were to have been openly proclaimed in our days, it would have been declared by him who saw the revelation, for it was seen not a very long time ago, but almost in our own age, namely, at the conclusion of Domitian's reign." This testimony is important, because Irenæus was born in Asia Minor, where the Apocalypse was published; and he grew up in friendly intercourse with Polycarp of Smyrna. Irenæus knew the friendly circle of St. John, and the accounts which were in vogue among his disciples. Irenæus had a very extensive acquaintance with the most distinguished Christians in the east and west, and took a lively interest in the religious differences and theological debates of the second century; consequently, we have reason to say, that Irenæus was a qualified witness. There can be no doubt that he believed the Apocalypse was written by John. Irenæus mentions that the authenticity of St. John's gospel was attacked by some, but he mentions no opposition to the Apocalypse.

The letter by which the Christian congregations at Vienne and Lyon report to those in Asia and Phrygia the persecutions suffered under Marcus Aurelius, A.D. 177, proves likewise that the Apocalypse was then much read and generally recognised in Gaul and Asia. Irenæus was presbyter at Lyon when this letter (see Eusebii 'Hist. Eccles.' v. 1—3) was written, and, perhaps, it was drawn up by him or under his direction. The numerous Greeks who migrated from Asia Minor into Gaul probably took with them the Apocalypse.

The third century is the most interesting in the history of the Apocalypse. The disputes against the Montanists raised, among other theological questions, that concerning the authenticity of the Apocalypse. [MONTANISTS.] Tertullian, in his Montanistical writings, constantly appeals to the Apocalypse, and presupposes its genuineness. (Marc. 4, 5.)

It is very important that the spiritualising Origen not only mentions the Apocalypse as being written by John ('Comment. in Ev. Joannis,' ed. Lommatzsch, tom. i. lib. 6), but says very decidedly in his Commentary, that John, who reclined on the breast of Jesus, wrote the Apocalypse. Origen classified the books then used by Christians into genuine, spurious, and of uncertain authority, and numbers the Apocalypse among the genuine canonical books.

Origen was the greatest biblical critic of the 3rd century; and it is an important fact that, in investigating the canonical limits of the New Testament, he did not meet, either in the schools of Alexandria, or in his numerous theological peregrinations, with any sufficient reason for doubting the apostolical authority of the Apocalypse. In spite of opposition from a sect called the Alogi, who asserted that the Apocalypse was an unintelligible and irrational fabrication of Cerinthus, it maintained its authority to the middle of the 3rd century in churches far distant from each other, and it was used in theological researches and ecclesiastical transactions as a holy writing of the apostle St. John. But the Syrian national church, which was established either at the conclusion of the 2nd or the beginning of the 3rd century, omitted in the Peshito the second and third epistles of John, the second of Peter, the epistle of Jude, and the Apocalypse. These parts were added to the Syrian New Testament in or after the 6th century. But Theophilus of Antioch in the 2nd, and Ephraem Syrus in the 4th century, quote the Apocalypse, and ascribe it to John. Hence we perceive that the Apocalypse, although wanting in the Peshito, was recognised among the theologians of the Syrian church. (Compare 'Lengerke de Ephraemi Syri Arte Hermeneutica,' p. 5—8.)

During the 4th century the Apocalypse was used in the oriental church by Athanasius, Basilius Magnus, Gregorius Nyssenus, Didymus, Ephraem Syrus, and others. But Cyrillus of Jerusalem, who died A.D. 386, in his fourth Catechesis, advises his catechumens to read only those writings of both Testaments which were received by the church, and to neglect the apocryphal publications. Cyrillus gives a list of these canonical writings, in which the Apocalypse is omitted. But his fifteenth Catechesis seems to contain allusions to the apocalyptical phraseology.

The canon of the synod of Laodicea, which was held about A.D. 363, rejects the Apocalypse from the ecclesiastical canon; and so likewise the eighty-fifth of the apostolical canons, which belong, perhaps, to the 4th century.

Gregorius Nazianzenus says, in his verses on the genuine books of the inspired Scripture, after having mentioned all the other books of the New Testament except the Apocalypse, "Thou hast them all. If there is another besides these, it belongs not to the genuine." But the same Gregorius quotes, in his other writings, the Apocalypse as if he considered it genuine, and he is mentioned by Andreas and Arethas among those who recognised its inspiration and canonical character. Therefore, it is probable that the Apocalypse was reserved to the use of the clergy, who, remembering the Montanistic abuses, endeavoured to get the Apocalypse out of the hands of the laity without denying its genuineness. By this conjecture an apparent contradiction is solved.

The general ecclesiastical tradition as to the apostolical origin of the Apocalypse continued uninterrupted to the middle of the third century, except by the opposition of the Alogi. But Dionysius, a disciple of Origen and bishop of Alexandria, who died A.D. 265, though he admitted the Apocalypse to be above his comprehension and the work of an inspired man, gave various reasons for supposing it not to be written by the apostle John. These reasons were subsequently reproduced in substance by Erasmus, as we shall presently mention; and indeed, every later opposer has repeated the same arguments.

The synod of Toledo, A.D. 633, speaks of "many who do not receive the authority of the Apocalypse, and despise it so much, that they do not preach it in the church of God;" but with these despisers the synod makes short work, saying, "the authority of many councils, and the decrees of the Roman bishops, prescribe that it is of John the Evangelist, and appoint that it is to be received among the Divine books." "If, henceforth, any one does not receive it, or does not preach from it between Easter and Pentecost, at the time of mass, he shall have the sentence of excommunication."—(Harduin, 'Act. Con.' tom. iii. 584.)

The synod indicates the then prevailing opinion, which continued undisturbed during the middle ages. Isidorus of Seville, who died 636, described in his work, 'De Officiis Ecclesiasticis,' the New Testament canon exactly as the church considered it henceforth to be established and closed. According to Isidorus, the Apocalypse concludes, as being truly apostolical, the whole canon. But it is remarkable, that the 'Decretum Aquisgranense,' by Charlemagne, A.D. 789, cap. 20, decrees, that according to the synod of Laodicea, only canonical writings should be read in the church. The canon of Laodicea is added, in which the Apocalypse is omitted. 'Corpus Juris Germ.' ed. Walter, tom. ii. p. 1, p. 77, seq. But it appears from Augusti's 'Denkwürdigkeiten aus der Christlichen Archäologie,' b. vi. p. 113, &c., that the Apocalypse continued to be publicly read in the Western church.

During the middle ages, the anticatholic sects, as well as orthodox divines, appealed to the canonical authority of the Apocalypse, although they differed widely in its interpretation; but with the Reformation began another period in the history of the Apocalypse.

Erasmus ('In Annotationibus in Novum Testamentum,' 1516) reminded his contemporaries of the former doubts, and repeated them more fully in the edition of 1527. He states that from the title, 'Johannes Theologus,' the frequent repetition of John's name, the difference of style, and the manner in which the author speaks of his own visions less modestly than Paul (2 Cor. xii. 1, seq.) who relates them as if they happened to another, we might feel inclined to ascribe the Revelations not to John the Evangelist, if the general consent, and especially the authority of the church, had not already settled its genuineness. Nevertheless he relates, apparently with predilection, the opinions of Dionysius, and the uncertainty of Eusebius whether it belonged to the Homologoumena (the admitted), or the Antilegomena (the disputed).

What Erasmus had cautiously whispered into the ears of the learned Carlstadt and Luther proclaimed boldly to the people. Carlstadt, in his book, 'Welche Bücher Biblisch seint,' 1520, p. 4, divides the New Testament into three classes, the last of which contains the Epistle to the Hebrews, the two Epistles of Peter, the three Epistles of John, the Epistle of Jude, and the Apocalypse; and he adds, that, among all books of the third order, the Apocalypse is the least valuable, because, he says, it was not received in the days of Hieronymus by all Christians; secondly, the title is not Apocalypsis of John the Apostle, but of John the Theologian. Thirdly, its style and manner differ from those of John the Apostle. "But," says Carlstadt, "I will this and the other books of the third order not reject, but only point out the difference." In the preface to the Apocalypse, in the first edition of his German Testament, A.D. 1522, Luther writes: "In this book of the Revelation I leave every one to his own opinion, and I will bind none by my view and conclusion. I say only what I feel. In this book more than one thing is wanting, so that I consider it to be neither apostolical nor prophetical. First, the Apostles deal not in visions, but prophesy in clear and dry words, as do Peter, Paul, and Christ himself in the Gospel. It befits the apostolic office to speak clearly, without imagery, about Christ and his doing. But there is no prophet in the Old Testament, much less in the New, who so entirely deals in visions and imagery; so that I deem it only equal to the fourth book of Ezra, and indeed cannot perceive that it was dictated by the Holy Ghost.

"It appears too much that the author should recommend his own in preference to other holy books, which are much more important, and that he commands and threatens God would take from him whosoever would take anything from the Apocalypse; and again, that they should be blessed who keep what is written therein, although nobody knows what it is, much less can he keep it, and it is just as much as if we had it not. There are also many nobler books which we have to keep. Many of the fathers have in former days rejected this; and although St. Hieronymus, with high sounding words, asserts that it is beyond all praise, and contains as many secrets as words; he cannot prove it, and various passages of his praise are too mild (namely, towards this book). Finally, everybody may think of it what his own spirit permits him (what he pleases). My spirit cannot accommodate itself to this book, and it is sufficient cause for me not highly to esteem it, that Christ is neither taught nor known in it, which, before all things, an apostle ought to do, because he says (Acts i.), 'Ye shall be my witnesses.' Therefore I adhere to those books which give me Christ clearly and purely." This preface of Luther was repeated in all editions until A.D. 1534.

The opinions of the reformer influenced the Lutheran theology during the sixteenth century so much, that it became habitual to divide the New Testament into canonical and apocryphal books. To the canonical books only was ascribed an absolute authority in matters of faith; and the Apocrypha, to which the Apocalypse was referred, were considered as subsidiary sources of information. (Compare Oeder, 'Christlich freye Untersuchung,' pp. 51, 313; Hartwig's 'Apologie der Apokalypse,' th. iii. pp. 35, 48; Storr's 'Neue Apologie,' p. 7. et seq.; and especially Bleek's 'Einleitung in den Brief an die Hebräer,' p. 449, &c.)

In the disputation at Bern, A.D. 1528, one of the Roman Catholic interlocutors declared that the Apocalypse was written by St. John, and that wherever the Christian church caused the biblical books to be printed, the Apocalypse was among them; but Zwingli replied, it could not be proved historically that the Apocalypse was written by the Evangelist. Another Roman Catholic interlocutor complained that the Protestants would not admit the testimonies from the books of Tobit, Baruch, Maccabees, and of the Apocalypse: to whom Oecolampadius and Zwingli replied, that the Protestants did not absolutely reject the Apocrypha, but they could not admit their authority in the important matter of faith, and they had not been generally received by the old church. (See Zwingli's 'Werke von Schuler und Schulthess,' 2 b. i. Abth. pp. 87, 169, &c.) Thus it appears that Zwingli, Oecolampadius, and Bucer, who was present at the disputation of Bern, agreed with Luther and his followers in their estimate of the Apocalypse.

The reformers of Geneva, Calvin and Beza, seem to be more favourable to the Apocalypse. They quote it often without mentioning the Lutheran classification of canonical and apocryphal books of the New Testament. Calvin uses, in his 'Institutio Relig. Christianæ,' the Apocalypse as canonical and apostolical, but does not interpret it in his 'Commentarii,' and thus obtained the often-echoed praise of Scaliger; "Calvin was wise not to write on the Apocalypse." Beza defends, in his 'Prolegomena to the New Testament,' its authenticity against Erasmus, but adds, that if it were not of St. John, he would ascribe it to St. Mark, on account of the similarity of style. On the authority of these reformers the Apocalypse was sanctioned as genuine in the 'Confessio Helvetica Posterior,' the Thirty-nine Articles of the Church of England, the 'Confessio Gallica,' and 'Conf. Belgica,' and zealously expounded by Theodori Bibliandri ('Explicatio Apocalypseos,' p. 8, Basel, 1549,) and by Artopœus (Francfurt, 1549), and Heinrich Bullinger, who defends it against Erasmus and Luther ('Cent Sermons sur l'Apocalypse,' Genève, 1565). Hyperius (in his 'Methodus Theologiæ,' p. 48, Basel, 1574), did not conceal that its authenticity had been doubted by some, but he declares it to be canonical on the authority of the most ancient fathers. So the theory and practice of the so-called reformed (Calvinistic) church were in the sixteenth century, decidedly opposed to those of the Lutheran.

The Socinians leaned more towards the reformed than to the Lutheran view. Faustus Socinus ('De Auctoritate Scripturæ Sacræ,' opp. i. 268) declares the Apocalypse to be genuine.

Towards the middle of the eighteenth century, the doubts about the authenticity of the Apocalypse were revived first in England by a Deist, namely, the unknown translator of 'The New Testament, in Greek and English, containing the Original Text,' &c., dedicated to the Lord Chancellor, Peter King, London, 1729; and with more penetration by the anonymous author of the 'Discourse, Historical and Critical, on the Revelation ascribed to St. John.' It is now known that this Discourse was written by Firmin Abauzit, the famous librarian at Geneva, a friend of Bayle and Newton, at the request of W. Burnet. It was originally written in French, under the title 'Discours sur l'Apocalypse.' The original was printed, contrary to the wish of Abauzit (who died in 1767), in the edition of his 'Œuvres Diverses,' London, 1770. Abauzit's essay gave a new impulse to these critical investigations; and it induced Dr. Leonhard Twells to write his defence of the Apocalypse in the third part of his 'Critical Examination of the late Text and Version of the New Testament in Greek and English,' 1732; which contains the first essay of a solid defence of the Apocalypse by internal and external arguments. T. C. Wolf inserted an abridged translation of this work in his 'Curæ Phil. et Crit.' vol. v., p. 387. The excellent work of Twells, which silenced the adversaries of the Apocalypse in England, became known in Germany, where, after thirty years, the combat was renewed.

There was a time when the philologists of Germany generally did not recognise the æsthetical value of the Apocalypse, being influenced by the opinions of Oeder, Semler, and his followers. Herder and Eichhorn, equally learned, without any predilection for orthodoxy, but with more tact than Semler and his school, showed that the despisers of the Apocalypse had only manifested their own want of taste, when they denied the æsthetical value of the Apocalypse; and thus, without being orthodox, Eichhorn facilitated a decision favourable to orthodoxy. Herder observed, that every Christian poet who had a spark of real poesy, enjoyed the Apocalypse; that the best hymns of the middle ages, on Jesus, Mary, the church, and the kingdom of God, are crowned with apocalyptical flowers; that Dante, Petrarch, and Milton were imitators of the Apocalypse.

There is in the Apocalypse neither the plastic beauty of the antique, nor the picturesque beauty of our western modern poesy; the oriental poetry loves immensity. The apocalyptical imagination opens heaven and hell, and, rising high above human and terrestrial forms, breaks through the limits of humanity and temporal existence. It calls down the heavenly Jerusalem, dimly shadowed forth by the things temporal. The poetry of the Apocalypse is that of infinity, of destruction, and of endless power.

Bretschneider, Bleek, De Wette, Ewald, Scholt, Lücke, have written against the authenticity of the Apocalypse. Their works contain further developments of the old arguments of Dionysius.

Hänlein, Schmidt, Kleuker, Hug, Eichhorn, Feilmoser, Lange, Bertholdt, Guerike, Olshausen, are modern defenders of the authenticity of the Apocalypse; to whom we may add among the English, Lardner, and his epitomisers, Dean Woodhouse, the Rev. Hartwell Horne, and others.

The most recent German opposers fairly grant, that the external testimonies are decidedly in favour of the authenticity, but they assert that these testimonies are overcome by the internal philological character of the work.

The Apocalypse has been attacked and defended with greater zeal than any part of the New Testament, because its contents excite a very strong interest either in favour or against this conclusion of the whole Bible. The fundamental idea of the Apocalypse, which Luther and other opposers of the Revelations did not understand, is the following: As Plato, in his books Περὶ Πολιτείας, considers the state to be an exact transcript of individual man, so St. John, taking yet a higher step, tells us in the Apocalypse that similar events, which happen in the life of individuals, shall also take place in the infinity of the whole universe. Professor Stuart of Andover, in the United States, in his Commentary on the Apocalypse, has very ably controverted the arguments of the opposers of its authenticity, and has successfully proved its right to admission among the canonical books, though his theory of the right interpretation of the book is more doubtful.

As the redemption of Christ saves the whole man,—spirit, soul, and body,—so Jesus Christ saves also the universe from sin and consequent perdition. The Apocalypse teaches by a sublime imagery, what the other apostolical writings more obscurely indicate; namely, that there shall be a period in which the spirit of the Lord shall not only operate in secret by governing the hearts of believers, but a period in which it shall entirely conquer, prevailing against all opposition, and shall finally establish a kingdom of universal peace and justice here on earth.

The leading idea, then, of the Apocalypse consists in the complete victory of what is good, and of Paradise regained, or re-established on earth.

APO'CALYPTIC KNIGHTS (Cavalieri dell' Apocalisse) were a secret society, formed A.D. 1693, professedly for the defence of the Roman Catholic church against Antichrist. The founder of the Apocalyptic order was Agostino Gabrino, the son of a merchant at Brescia. When, on Palm Sunday, 1693, in the church of St. Peter at Rome, the antiphony of Ps. xxiv. was sung: 'Quis est iste rex gloriæ?' 'Who is that king of glory?' Agostino Gabrino stepped forward with a drawn sword among the ecclesiastics, crying out, 'Ego sum rex gloriæ,' 'I am king of glory.' In a similar manner he disturbed public worship in the church of St. Salvator, and was, therefore, confined in a madhouse. A woodcutter belonging to the Apocalyptic knights laid information before the Inquisition against his order; by this tribunal the order was suppressed in 1694, and the knights confined in prison. About eighty knights, most of whom were tradesmen and labourers, wore constantly a sword at their side, even during menial occupations, and a star upon their breast. This star had seven corners, and a tail, and was surrounded by a golden thread, which circle represented the terraqueous globe. The tail of the star represented the sword seen by St. John in the Apocalypse. This order has been accused of an intended rebellion against the papal government and the higher ranks. Agostino Gabrino, called monarch of the Holy Trinity, intended to introduce polygamy, and his knights were to marry pure virgins only. The history even of such a set of madmen is not without its uses: ignorance and fanaticism will, in all ages, produce the same fruits. (Tenzel, 'Monatliche Unterredungen' for the year 1694, pp. 672-677, and of 1697, p. 883, &c.; Ersch and Gruber's 'Ency.')

APOCRENIC ACID. [CRENIC ACID.]

APO'CRYPHA (ἀπόκρυφοι βίβλοι) are such books as contain secrets and are kept in secret, from ἀποκρύπτειν, to conceal; consequently the term referred to those writings of the Gnostics and other sects which contained the knowledge of those mysteries which were communicated to their partisans only. These books are now known under the name of *pseudepigraphi*, (that is, 'books with false titles,') as the books of Adam, Enoch, the three patriarchs, &c. These volumes formed a kind of heretical canon in opposition to the orthodox canon, and hence arose the signification of the name Apocrypha, which now means *not canonical*, or not belonging to those writings which form the canon of the Holy Scriptures.

The name Apocrypha is especially given to those additions which were introduced into the Septuagint translation of the Old Testament, from whence they were transferred into the Vulgate and many subsequent translations. They are undoubtedly of early date, and are supposed to have been rejected by the first council of Nice in A.D. 325, or rather that the other books then received the sanction of the church, but no list of the books decided upon as authentic is given in the canons then issued. The reformers separated the Apocrypha from the Old Testament, and Luther placed them between the Old and the New Covenants, under the title of Apocrypha, or books which are not to be esteemed equal to the Holy Scriptures, but are still profitable to the reader. In opposition to the reformers, the Apocrypha were declared to be canonical by the council of Trent. Hence all translations which follow the Vulgate have the Apocrypha interspersed with the other writings which are admitted by all Christians to be canonical. The Bibles published by Protestants on the continent place separately—the additions to Esdras; the book of Tobit; Judith; rest of Esther; Wisdom of Solomon; Ecclesiasticus; Baruch, with the epistle of Jeremiah: the song of the Three Children; Susanna; Bel and the Dragon; the Prayer of Manasseh; the books of the Maccabees. About the year 1821, a debate arose in the British and Foreign Bible Society about the propriety of printing the Apocrypha together with the Holy Scriptures. About 1826, it was decided that the Apocrypha should not be circulated by the British and Foreign Bible Society. Nevertheless the disputes of the two opposite parties were continued for several succeeding years, and many pamphlets were published by both parties, until the apocryphalists were finally defeated by the anti-apocryphalists. Besides the Apocrypha, which form a kind of appendix to the Old Testament and belong to the literature of the later Jews, there are a number of other apocryphal writings of the Old and New Testaments, which have been collected by Fabricius in the 'Codex Pseudepigraphus Veteris Testamenti,' and the 'Codex Apocryphus Novi Testamenti,' and more completely by Thilo in the 'Codex Apocryphus Novi Testamenti,' Lipsiæ, 1832. Most of the apocryphal additions to the New Testament were collected and published in an English translation by William Hone, in 1820.

APOGE'E, from ἀπὸ, *from*, and γῆ, *the earth*, an astronomical term applied to the apparent orbits of the sun and moon, signifying the points of those orbits which are at the greatest distance from the earth. It is opposed to PERIGEE, which means the point nearest to the earth. For general considerations connected with this term, see APHELION, substituting the earth in place of the sun.

The sun is in its apogee when the earth is in its aphelion, and the motion of the solar apogee is the same as that of the earth's aphelion. The motion of the lunar apogee is more complicated. At new or full moon, its longitude is increasing: at the quarters it is decreasing. But the increase, on the whole, is greater than the decrease: so that, on the average, the apogee increases its longitude daily by 6′ 41″, or describes a whole revolution in about nine years. In the 'Nautical Almanac' will be found the time when the moon is in her apogee and perigee for every month. For example, we find that in February, 1859, the moon is in apogee at twenty-seven days seventeen hours (meaning seventeen hours after noon on the 27th, or five in the morning on the 28th, civil reckoning). On referring to the moon's right ascension for that time, we find it to be nineteen hours, twenty-four minutes, fifty-two seconds.

APOGLUCIC ACID. [GLUCIC ACID.]

APOLLO, one of the principal gods of the Grecian heaven, also named Phœbus, and in Homer and Hesiod most commonly called Phœbus Apollo (Φοῖβος Ἀπόλλων). He was the presiding deity of archery, prophecy, and music, and in later times of the sun: but in the early poets above-mentioned, the sun (Helios) is a different personage, and of different extraction, the son of Hyperion and Theia. ('Theog.' xviii. 371: see also the adventures of Ulysses in the island of Thrinakia, where the oxen of the sun, not of Apollo, are always spoken of.) According to Herodotus (ii. 156), Apollo is the same with the Egyptian Horus, the son of Dionysus and Isis. The Grecian deity was the son of Zeus and Leto (Jupiter and Latona). His mother, when the time of travail drew nigh, wandered through the earth, unable to find a place which would give her rest; for every land, and river, and mountain, feared too much the wrath of Hera (Juno), the jealous queen of heaven, to receive her. At last Delos, which was then a floating island driven about the Ægean sea, and called Asteria, afforded her a place of repose, and Apollo was born. He immediately proclaimed his functions to the assembled goddesses who watched his birth. "The harp, the curved bow be mine, and I will proclaim to men the unerring counsel of Zeus." ('Hymn to Apollo,' v. 131.) Thenceforward Delos was fixed. Leto promised, in return for the shelter afforded, that her son should honour that humble island above all other places; and it was always held especially sacred to him, and the principal seat of his worship. This story is beautifully related in the Homeric hymn above quoted, and in the hymn to Delos by Callimachus. Apollo is a leading personage in mythological fiction, and a favourite with the poets, who have engaged him in a great variety of adventures. He was the president and protector of the muses. He is usually represented in the prime of youth and manly beauty, with long hair, his brows bound with the sacred bay-tree (*Daphne*), bearing either the lyre, or his peculiar weapon, the bow. In later times he usurped the presidency of the healing art from its earlier deity, Paieon; hence Æsculapius was said to be the son of Apollo. The hawk, the raven, the swan, the grasshopper (*cicada*), were his favourite animals. His principal temples were at Delos, Delphi,—at both which places his oracles were in the highest repute—Tenedos, Patara, Claros, &c.; and from these he derives a great variety of distinctive epithets. He has many others peculiar to himself, which principally refer to his skill in archery, or may be interpreted to contain some allusion to the sun; as far-shooting, silver-bowed, golden-haired, golden-sworded, light-producer, &c. Müller, in the second book of his 'Dorians,' and in his 'Archäologie der Kunst,' § 359, has endeavoured with great ingenuity and learning to show that the fundamental idea of Apollo was that he was, in his essence, a god of health and order, the protector of the good, the averter and the destroyer of evil, and that of these, the various powers and attributes ascribed to him are mere ramifications. "He was conceived," as Müller remarks, "as purifying by propitiatory sacrifices, tranquillising the mind by music, and directing by prophecies to a higher order of things." On the whole, the idea conveyed by the worship of Apollo was the most elevating of any in the Grecian theology.

The word Phœbus is apparently connected with a Greek root, signifying *light*; but the origin and meaning of the word Apollo are entirely unknown. In later writers, and by the Latins, who do not appear to have had an ancient sun-god of their own, Apollo and the sun are confounded. It is observable, however, that Ovid, in the stories of Phaeton, and Clytie, which have especial reference to him in his character of the sun, always uses the word Sol, not Phœbus or Apollo, except once (ii. v. 399) at the conclusion of the former (Met. ii. 1. iv. 190). In Homer and Hesiod, as we have said, the two are clearly distinct. It is maintained, however, by some mythologists, and among them by Buttmann, that originally Apollo and Artemis were the sun and moon, and that the later writers who assigned to those deities the presidency over the two great luminaries, only revived the original belief which had fallen into disuse. (Buttmann, 'Mythologus,' v. i. ap.; Keightley.)

In the most flourishing periods of Greek art, Apollo was regarded as the consummation of manly, as Aphrodite was of feminine beauty. In the earliest times, at Delphi and Athens, Apollo Agyieus was worshipped under the form of a conical stone. The early pillar statues were decorated with a lyre or with arms, according as they were dedicated to the tranquillising or the avenging deity. When Apollo came to be represented under a human form it was, before the time of Phidias, either as a youth of majestic beauty, or of a riper age and with a grave, earnest, or severe countenance. At this time he was represented both with and without drapery. Pliny mentions a bronze statue of Apollo outside the Parthenon, as one of the finest works of Phidias; and it may be taken for granted that the Apollo of Phidias was the perfection of physical and intellectual beauty and dignity. By Praxiteles, Scopas, and their contemporaries, greater slenderness and elegance of form was given to the god. The face was made more oval, the masculine characteristics were scarcely developed: altogether something of refinement, softness, and delicacy was substituted for the simple grandeur of the earlier form.

The statues of Apollo may be broadly divided, according to the principle of Müller, into those of the contending, or the appeased and reposing god ('Archäol.' § 361). In the one class he carries the bow, or is otherwise distinguished as an avenging or a protecting deity; in the other the lyre is a common characteristic. Sometimes he is represented in the Pythian costume. On vases, gems, coins, and sarcophagi, Apollo is very frequently figured grouped with other deities: with Marsyas; with Hyacinthus; with Daphne; on the swan; destroying the family of Niobe, and in various other ways; for throughout the cycle of Greek art, Apollo was a prime favourite with artists. As of Aphrodite, every European museum contains numerous ancient representations of Apollo. In the British Museum there is an undraped marble statue, of heroic size and of early date; a colossal foot, 2 feet 11 inches long; a bronze statue about 2 feet high; and several representations on rilievi, vases, coins, &c.

The most celebrated of the existing statues of Apollo, is that known as the *Apollo Belvidere*, which was found at Capo d'Anzo, in the ruins of ancient Antium, about twelve leagues from Rome, in 1503. It was purchased by Pope Julius II., before his elevation to the pontificate; and was placed by him in the Belvidere of the Vatican, whence it derives its present name. It has been said to be the work of Agasias the Ephesian, but no certain indications of the sculptor are to be traced. It is now believed to have been made under the emperors, and as some think by the order of Nero himself; from the folds of the cloak, and other indications, it is probably a copy of a bronze statue. Be that as it may, it is one of the finest specimens of sculpture extant. It is a standing figure, more than seven feet high, and represents the god naked, except the cloak which is fastened round his neck, and hangs over the extended left arm. The left hand and the right forearm were lost, and were restored by Giovanni Angelo da Montorsoli, a pupil of Michael Angelo: so that the original action of the figure can only be conjectured. It is supposed, however, to represent Apollo as the destroying god, "the lord of the unerring bow," but as to the precise intention of the sculptor authorities differ; the received opinion was that Apollo was represented at the moment of having discharged an arrow at the serpent Python, watching the effect of his weapon: and accordingly, in the restoration, part of a bow was placed in the left hand. But Feuerbach ('Der Vaticanische Apollo,' Nürnberg, 1833) believes that it was intended to represent Apollo chasing away the Furies. Again, it has been suggested (by Hirt and Wagner), and with great probability, that it represented the god as the destroyer of the children of Niobe: and various other interpretations have been proposed. A serpent, the emblem of the healing art, is fixed on the stump of a tree, which gives stability to the figure. Byron's fine description of it ('Childe Harold,' iv. 161) is well known.

APOLLO'NICON, the name given to a chamber organ of vast power, supplied with both keys and barrels, built by Messrs. Flight and Robson, of St. Martin's-lane, London, and first exhibited by them at their manufactory, in 1817. The Apollonicon was either self-acting by means of complicated machinery, or could be played on in the usual manner, by means of keys. The music, when the organ was worked by machinery, was *pinned* on three cylinders or barrels, of about two feet eight inches long, each acting on a distinct division of the instrument; and these, in their revolution, not only admitted air to the pipes, but regulated and worked the stops, forming, by an instantaneous action, all the necessary combinations. The key-boards were five in number; the central and largest comprising five octaves, and the smaller ones—two on each side the larger—two octaves each. To the central key-board were attached a swell, and some compound pedals, enabling the performer to produce all the changes and variety of effect that the music might require. The instrument had also a key-board comprising two octaves of other pedals, operating on the largest pipes. These six key-boards were detached from the body of the organ, so that the performers sat with their backs to the instrument, and, consequently, with their faces to the audience. There were

1900 pipes, the largest twenty-four feet in length, and one foot eleven inches in aperture, sounding the G, two octaves below the first line of the base: the highest pipe gave the A in altissimo, two octaves above the second space in the treble. The number of stops was forty-five, and these in their combinations afforded good imitations of the various wind instruments used in an orchestra. Two drums were also inclosed in the case, and struck by a curious contrivance in the machinery. A tolerably correct estimate of the capabilities of this instrument may be made, when it is stated that it performed Mozart's overtures to the 'Zauberflöte,' 'Figaro,' and 'Idomeneo;' Beethoven's to 'Prometheus;' Weber's to 'Der Freischütz' and 'Oberon;' Cherubini's to 'Anacreon,' &c., without omitting a single note of the score, and with all the fortes and pianos, the crescendos and diminuendos, as directed by the composers.

Considered as a self-playing instrument, the Apollonicon was provided with two revolving cylinders, studded like that of a barrel organ.

The Apollonicon was five years in building, and cost 10,000*l.* During many years it attracted the notice of professional and amateur musicians, both by its automatic and its keyed action. At length, however, some of the mechanism became disordered; and as the commercial return for the vast expense incurred had scarcely been adequate, the instrument was withdrawn from public gaze, and perhaps no longer exists. Some of the details in this article will be rendered more intelligible by referring to ORGAN.

APOLOGE'TICS (*theologia apologetica*, apologetik) is the designation given in Germany to that branch of divinity which is most intimately connected with logic, metaphysics, and general history, and has for its object a systematic arrangement of those internal and external evidences by which Christians are enabled scientifically to justify the peculiarities of their faith. The name is derived from a Greek adjective *apologéticos* (ἀπολογητικός).

Since Christianity was opposed from the beginning by men who denied its high origin and its intellectual superiority, circumstances demanded on the part of Christians a compliance with the express injunction of the apostle Peter, "Be ready always to give an answer (πρὸς ἀπολογίαν, for an *apology*) to every man that asketh you a *reason* of that hope which is in you." (1 Pet. iii. 15.) Separate apologies have the same relation to apologetics that separate mathematical treatises have to the science of mathematics.

The science of apologetics was not the offspring of literary vanity; it was unknown till the attacks of the adversaries of Christianity assumed a learned and scientific character. In the first centuries of our æra, whilst most opposers asserted that the Christian religion was the cause of famine and earthquakes; and that Christian worship consisted in eating children, drinking human blood, committing incest, and adoring the head of an ass, or some such abominations, separate apologies were sufficient for the refutation of these absurd charges. The name is of still later origin than the science of apologetics. The word *apologetik* was universally adopted after Gottlieb J. Planck had used it. (See his 'Einleitung in die Theologischen Wissenschaften,' 1794-8, vol. i. pp. 231-362.) As the fundamental idea of mathematics is that of quantity; of jurisprudence, that of right; of æsthetics, that of the beautiful; so the fundamental idea of apologetics is that of supernatural revelation. The apologetics contain a further development of one part of dogmatics or doctrine, which is called bibliology. Apologetics teach how to defend the fundamental ideas of Christianity against unbelievers; polemics teach how to attack those who, admitting the Christian revelation to be true, err in particulars.

The science of apologetics treats of the

I. Possibility of revelation.

1. Logical possibility. Logical refutation of those who, like John Toland, Edelmann, and Rousseau, considered the idea of revelation to be self-contradictory.

2. Theological possibility. Metaphysical refutation of those who considered the idea of supernatural revelation to be repugnant to the attributes of God, impartial justice, general love, and immutability.

3. Anthropological possibility. Refutation of those who, like Immanuel Kant, deny the ability of man to perceive the supernatural.

II. Necessity of revelation, to be demonstrated by historical and ethnographical induction, especially by the history of philosophy.

III. Reality of revelation, demonstrated by a development of the internal evidence of the peculiar Christian doctrines, and confirmed by the historical credibility of the Gospel history.

Apologetics, though based upon the Gospel, constantly require a new adaptation to the times for which they are written. There are many good apologies, but apologetics are yet in their infancy. Among the societies, foundations, donations, &c., which have an apologetic character, may be mentioned the Bampton Lectures at Oxford, Hulse's foundation of the Christian Advocate at Cambridge, the London Society for promoting Christian Knowledge, with all similar societies.

APOLOGIES OF THE FATHERS are writings in defence of Christianity, composed from the beginning of the second to the sixth century. The opposers of Christianity generally attacked the moral character of the Christians rather than their doctrines. The fathers of the church, with the view of refuting the doctrines of heathenism and the false accusations against the followers of Jesus, composed *Apologies*, which were partly addressed to all well-informed heathens, partly written on particular occasions, and addressed to emperors in order to convince them of the injustice and folly of persecutions.

The apologies of Quadratus and Aristides are lost. Justinus Martyr describes, in two apologies, how he sought for truth in various systems of philosophy until he found it in the Gospel. In his Dialogue with the Jew Tryphon, Justinus Martyr appeals to the prophecies of the Old Testament. The apologies of Justinus contain many materials for the history of philosophy. Athenagoras defended the Christians against the charge of atheism, incest, infanticide, and other abominations with which they were charged. Tatianus, Theophilus of Antioch, and Hermas, proved the absurdity of paganism and the contradictions of philosophers, in order to show the necessity of revelation.

After these Greek apologists of the second century followed, among the Latins, Tertullian, who, in his 'Apologeticus,' eloquently shows how the faith and holiness of Christians were especially manifested under persecutions; and Minucius Felix, who, in his eloquent dialogue, 'Octavius,' introduces the representatives of various parties, whose arguments are overcome by the truth of the Gospel. Cyprian wrote 'De Idolorum Vanitate,' or, On the Absurdity of Idolatry. These apologists of the second century did not defend the systems of certain schools, but only the truth of Christianity.

In the fifth century the doctrines of the Gospel were systematised by Origen among the Greeks and Arnobius among the Latins, in order to defend them successfully against the attacks of Celsus, Porphyrius, Hierocles, and Julian, which were directed not only against the morals of the Christians, but also against their history and their doctrines. These writers compared the miracles of Jesus with those of Pythagoras and Apollonius of Tyana, and questioned the credibility of the Evangelists. They recognised the leading facts of the Gospels, but endeavoured to prove contradictions in minor points. The objections are answered in the eight books of Origen against Celsus, who wrote his attack on Christianity about one hundred years before it was replied to by Origen. But the greatest apologist among the fathers is Eusebius, whose historical and chronological works have an apologetical tendency, and whose evangelical preparation (προπαρασκευὴ εὐαγγελικὴ, or Εὐαγγελικῆς ἀποδείξεως προπαρασκευὴ) contains, in fifteen books, the introduction to his Evangelical Demonstration (εὐαγγελικὴ ἀπόδειξις), in twenty books. The first ten books of this work are still extant, in which he demonstrates the harmony of the Old with the New Testament, the moral dignity of Jesus, the sublimity of his plan, the rectitude of his disciples, and the absurdity of those who ascribed another plan to the disciples than that which they professedly followed. Eusebius examines, in a little publication against Hierocles, the life of Apollonius of Tyana by Philostratus, and shows the contradictions of the biographer, the knavery of this notorious individual, and how his performances differed from the miracles of Christ. The works of Athanasius and Chrysostomus contain apologetical materials. Cyrillus of Alexandria wrote ten books in reply to the Emperor Julian. Theodoret wrote twelve sermons under the title, 'Ἑλληνικῶν θεραπευτικὴ παθημάτων ἢ εὐαγγελικῆς ἀληθείας ἐξ Ἑλληνικῆς φιλοσοφίας ἐπίγνωσις, in which he gathers the arguments for Christian truth from the writings of the heathens, and compares the Greek philosophers with Moses, the prophets, and the apostles. The most important apologetical works among the Latins are the seven books of Arnobius ('Adversus Gentes') against the heathen; the seven books of Lactantius, 'Institutionum Divinarum;' the twenty-two books of St. Augustin, 'De Civitate Dei;' the catalogue of St. Jerome, by which he refutes the objection that no distinguished individuals embraced the Gospel ('Catalogus Virorum Illustrium'); and, finally, 'Orosii libri septem Historiarum adversus Paganos,' in which he refutes the assertion that plague, famine, earthquakes, and other horrible events were consequences of the Gospel. The science of apologetics has made progress in the same ratio in which the attacks upon Christianity became more systematic.

The following translations and editions will be interesting to English readers. Justin the philosopher, commonly called Justin Martyr, died about A.D. 165. His 'Apologia prima pro Christianis,' published by Dr. Grabe, Oxon., 1700; 'Apologia Secunda,' by Hutchinson, Oxon., 1703; 'Justin Martyr's Full Account of the Christian Worship, Baptism, and the Lord's Supper, with Notes of Dr. Grabe and Mr. Whiston;' 'Dialogus cum Tryphone Judæo,' London, 1722, 8vo.; 'The Apologies of Justin M., Tertullian, and M. Felix, with the Commentary of Vincentius Lirinensis,' by Reeves, 1709 and 1716,—an unfaithful translation. 'The Dialogue with the Jew,' by Brown, London, 1755, is an excellent translation, and very scarce in the book-market. Minutius Felix, of the third century, author of 'A Dialogue between Cæcilius a Heathen and Octavius a Christian,' is well translated by Sir David Dalrymple.

APOLOGUE, synonymous with fable (ἀπόλογος, *fabula*, fable), "a novel story contrived to teach some moral truth." (Johnson.) "It would be a high relief . . to hear an *Apologue*, or fable, well told, and with such humour as to need no sententious moral at the end to make the application." (Shaftesbury, 'Characteristics,' vol. iii., 'Miscell.,' iv. c. 1.) It is essential to an apologue that the circumstances told in it should be fictitious. Some have gone so far as to say that they must involve an impossibility, as in Æsop's fables, where we find beasts and inanimate things made to think and speak.

APO'LOGY (ἀπολογία), a Greek word, originally signifying a defence made in a court of justice by or for a person accused. (See the titles of several of the extant Greek orations.) The word ἀπολογεῖσθαι, to 'apologise,' to 'make a defence,' was the corresponding verb. There is extant a small piece attributed to Xenophon, entitled the 'Apology of Socrates;' and another, with the same title, by Plato. The word apology was adopted by the Christian fathers. [APOLOGIES.] At the present day it is only used in ordinary language in one sense—that of "asking pardon or excuse for some offence." But even in modern times the word has occasionally been used in the early Christian sense, as by Bishop Watson, in his treatise entitled an 'Apology for the Bible,' and by Barclay, in his 'Apology for the Quakers.'

APOPHTHEGM (ἀπόφθεγμα), a Greek word signifying 'a thing spoken out,' and, in its more technical sense, a pithy saying calculated to arrest the attention. "Certainly apophthegms are of excellent use. Cicero prettily called them *salinas*, salt-pits, that you may extract salt out of, and sprinkle it where you will. They serve to be interlaced in continued speech. They serve if you take out the kernel of them, and make them your own." (Bacon.)

We may take the following as examples of apophthegms:—"Bigotry murders religion, to frighten fools with her ghost."—'Lacon.' "We ask advice, but we mean approbation."—Ibid. Plutarch made a collection entitled 'The Apophthegms of Kings and Generals,' and dedicated it to the Emperor Trajan. Many of these apophthegms would be classed in modern times among anecdotes. The following is an example; it is one of the apophthegmata placed under the head of Alexander:—"An Indian was taken prisoner who had a very high reputation for archery, and was said to be able to shoot an arrow through a ring. Alexander bade him exhibit a specimen of his skill, and on his refusal, the king in a passion ordered him to be executed. On his way to his death, the man remarked to those who were taking him, that he had not practised for several days, and was afraid of missing his mark. Alexander hearing of this, admired the man, and, setting him loose, made him great presents, because he preferred death to the loss of his reputation." (Wyttenbach's edit., vol. i. p. 718.)

The Lacedæmonians were noted for affecting the apophthegmatic mode of speech; and Plutarch has collected their sentences also under the title of 'Laconica.'

APO'PHYGE, a term applied by architects generally to a concave surface lying between or connecting two flat surfaces not in the same plane, and particularly to a slight concavity which is almost invariably found to terminate the shaft of an Ionic or Corinthian column both above and below,—immediately above the uppermost fillet of the congeries of mouldings called the base, and under the moulding or mouldings of the hypotrachelium or necking. In the latter case, the apophyge is distinguished in the two positions as the lower and the upper. The more familiar English term for the same thing is the *escape*, or *scape*; and in French, the apophyge is termed the *congé*. Apophyge is from a compound Greek word signifying a *flying off*. [COLUMN.]

APOPHYLLIC ACID ($C_{16}H_{7}NO_{8}$, HO) is obtained from narcotine. It crystallises with or without water; in the latter case the crystals have the form of rhombic octohedrons, which are colourless. The cleavage faces have a pearly lustre resembling apophyllite, and hence the name bestowed on this acid. The crystals lose water, when heated, even under water, and become white without altering their form; they contain 9 per cent. of water, and are but little soluble in water. A saturated boiling solution yields long prismatic crystals on cooling, which do not effloresce; the acid which crystallises from a solution that has not been boiled has the cubo-octohedral form, and contains water.

This acid has a slightly acrid and astringent taste; it reddens litmus-paper, and it is insoluble in alcohol and in ether. The salts which it forms with bases are soluble: the ammoniacal salt crystallises in tables, and is very soluble; the salt of silver, formed by double decomposition, is after a certain time deposited in stellated crystals, which gradually increase in size; they explode at a moderate heat with the same violence as oxalate of silver; the residue is as black as charcoal, and after combustion leaves metallic silver.

APOPLEXY, from ἀποπληξία, a sudden blow, a deprivation of power and motion, &c. *Morbus attonitus, sideratio, percussio*, &c., are synonymous terms. In the animal body two sets of functions perfectly distinct from each other are combined, the *organic* and the *animal*; the organic include the various functions by which the structure of the body is built up and its integrity maintained, and the animal include the functions of sensation and voluntary motion. [LIFE.] The disease termed apoplexy is an affection of the animal functions, the organic remaining comparatively unimpaired. It is the loss of sensation and voluntary motion, while respiration, circulation, secretion, and the other functions of organic life continue to be performed, though not indeed without more or less disorder.

Of all the diseases to which the human body is subject, there is none which is commonly conceived to attack so suddenly, and to kill so rapidly. What is usually called the attack is indeed sudden; but the disease itself, so far from being sudden, is generally even slow in its progress, giving distinct and repeated indications of its presence and of its course. The signs by which the apoplectic constitution is denoted, the *premonitory signs* of the disease as they are termed, it is of the utmost importance to observe, because judicious measures adopted at this stage will almost always avert an attack, or render an attack mild which would otherwise have been mortal. There are few other diseases over which both the physician and the patient have so much control: the patient by the general management of himself, in removing the constitutional predisposition to it; and the physician by active remedies when the attack is instant, in effecting what the general management may have proved inadequate to accomplish. Prevention is often practicable; but when the attack has once come on, life is in imminent peril: the most judicious and powerful remedies, though resorted to instantly, and employed with the greatest skill, are commonly unable to avert death; and even when they do succeed, the functions of the brain and the general health have usually sustained so severe a shock, that life is no longer worth possessing.

In general, the premonitory symptoms are steady in their nature, uniform in their course, and so obvious that all may perceive and understand them. Considered individually, they may appear numerous and diversified; but they are really so much alike, that they all obviously belong to one class.

Among the premonitory symptoms, the most remarkable are the following, which are here enumerated in the order of their importance and frequency.

1. Drowsiness. This feeling may exist in every degree, from unusual dulness of mind to an uncontrollable propensity to sleep.

2. The next premonitory symptom is giddiness. Giddiness is more alarming than drowsiness, and would never fail to produce a conviction of danger, but that giddiness often arises from other causes; for example, from a disordered state of the stomach.

3. Connected with these two important symptoms are a number of subordinate sensations, such as frequent yawning, dulness of hearing, imperfect or disordered vision, noise in the ears, motes or sparks before the eyes, repeated sneezing, occasional hiccup, and the like.

4. Pain in the head. The intensity of the pain may vary from the slightest uneasiness to the most intolerable headache.

5. Last in the train comes a symptom which is more important than any of the preceding, because it demonstrates their true nature, and shows that the actual attack is instant; namely, paralysis, whatever its form or degree, whether it assume the shape of inability to articulate distinctly, or to write steadily, or to walk firmly, or in reading to fix the eye on the right line, or in talking or laughing to keep the mouth in the natural position, or in deglutition to swallow without unusual difficulty, or without exciting cough. If with this loss of muscular power there be at the same time a sense of pricking over the skin, or a numbness in the limbs or fingers, or difficulty in voiding the urine, or distortion of the face or mouth, dropping of the eyelid, stammering, unsteadiness in the gait, and so on, the attack may be considered as having actually commenced.

Of these premonitory symptoms one alone may be present, or two may be combined, or several may co-exist or may follow each other in rapid succession. The period of their duration, before the attack supervenes, is different in every individual case. Sometimes there elapse only a few hours; more frequently several days; occasionally many weeks. When they are present, no man is safe from a fatal attack for a single instant.

With regard to the attack itself, the phenomena are different according to its intensity. There are, indeed, various modes or forms of the disease which are mainly matters of degree: nevertheless, these diversities are not only very striking in their own nature, but in a practical point of view are highly important, because the remedies appropriate to the one are not suited to the other, at least without such modifications as, in point of fact, to render them different remedies.

For all practical purposes it will be sufficient to comprehend the various forms of the disease under four heads, namely, first, that in which the attack is sudden and violent; secondly, that in which the attack is comparatively slight at the commencement, but progressively increases in severity; thirdly, that in which the attack commences with apoplexy and terminates in paralysis; and, fourthly, that in which the attack commences with paralysis and terminates in apoplexy.

1. The sudden and violent form constitutes the *apoplexia fulminans* of the older authors; the *apoplexia fortissima* of more modern writers; and the *apoplexie foudroyante* of the French. In this form of the disease the patient is struck senseless and motionless instantaneously: he falls down and lies utterly deprived of all the functions of the animal life. The organic functions in the mean time go on, but in an unnatural and disordered manner. The respiration is slow, deep, and accompanied with that peculiar noise which is called stertor; the pulse is fuller, stronger, and slower than natural; the urine and fæces are passed without consciousness; the skin is covered with a cold and clammy perspiration; foam flows from the mouth; the face is flushed, tumid, and sometimes even livid. Death may take place in a few minutes, or a few seconds, or not until the end of the first, or even the second, day; but life is seldom protracted beyond the second day. Now and then the prompt and vigorous employment of the appropriate remedies saves life even in this form of the disease; but if they fail to restore consciousness in a few hours, they commonly fail altogether, and death almost always happens when the paroxysm continues undiminished during twenty-four hours.

On examining the state of the brain after death from this variety of the disease, the blood-vessels of every part of the cerebral substance and of the delicate membranes that invest it, are found gorged with blood; there is also sometimes an effusion upon its surface, beneath its membranes, and within its cavities, of the thinner portion of the blood called serum, while, in many cases, pure blood itself is poured out on various parts of the brain from some ruptured vessel. Occasionally no morbid appearance can be detected sufficient to account for the attack, or for death, the consequence of it.

2. In the second form of the disease, in which the attack is less violent in the commencement, but progressively increases in severity, the loss of sensation and voluntary motion is neither sudden nor complete, or, if it be so, the abolition of these functions is only of momentary duration. Instead of stupor and coma, the patient is seized with a sudden and violent attack of headache, attended often with sickness and vomiting. The pain of the head is sometimes so severe that the patient sinks down under it, pale, faint, and exhausted, occasionally with a slight convulsion; but from this state of depression he recovers rapidly, still however remaining weak, faint, and chilly, with a quick and feeble pulse, a sunk countenance, and occasional vomiting. This state having continued from one hour to three, or more, the heat increases, the pulse acquires strength, the face becomes flushed, the sunk expression of the countenance disappears, and torpor or stupor rapidly supervenes, the patient appearing dull and heavy, answering questions slowly and with difficulty, and sinking at last into a state of profound coma. From the first invasion of the attack to the coming on of perfect coma, the period may vary from one hour to three days and more. This form of the disease is at least equally dangerous with the preceding, and, in fact, generally proves fatal.

On examining the state of the brain after death from this variety, there are found extensive effusions of blood; softening of the substance of the brain; sometimes ossification (conversion into bone) of portions of its membranes; but far more constantly ossification of the coats of its blood-vessels, which organic change in the structure of the blood-vessels diminishes their strength, renders them incapable of resisting the current of the blood and of carrying on the circulation, and thus predisposes them to rupture.

3. The third form of the disease commences with a distinct apoplectic paroxysm, which terminates in paralysis. When the apoplectic symptoms disappear, some part of the body is found to be paralysed; it may be the muscles of the face, giving rise to various kinds of distortion; or the muscles of the limbs, occasioning inability to move the affected member; or the muscles of one side of the body, producing what is called *hemiplegia*; or the muscles of one half of the body, *paraplegia*. In the great majority of cases the speech is more or less affected, the power of articulation being either wholly lost or greatly impaired. Often the sensibility seems unimpaired, the patient endeavouring to express himself by words or signs; but, at other times, the mind itself is indistinct, confused, rambling, and incoherent. Occasionally in this form of the disease, the apoplectic state disappears rapidly, while the paralysis remains for years. Sometimes the paralysis slowly diminishes until suddenly another apoplectic attack supervenes, leaving the paralysis greater than before; at other times the paralysis continues undiminished for days, months, and years, until a second, or a third, or a fourth apoplectic paroxysm at length destroys the patient. In the few cases in which there is a perfect recovery from the paralysis, the mind is always slow in recovering its energy, and often never regains it.

On examining the state of the brain after death from this variety, there is commonly found an extravasation of blood into a defined cavity formed in the substance of the brain, constituting what is termed an apoplectic cell; but although this be the most ordinary form in which the blood is effused in this variety of the disease, yet there may also be a general extravasation of it, as in the other varieties, or mere effusion of serum; or softening of the cerebral substance, or ossification of the membranes, or of the blood-vessels, or several of these morbid conditions may be combined.

4. In the fourth and last form of the disease, in which the attack commences with paralysis and terminates in a complete apoplectic paroxysm, the premonitory symptoms are in general very distinctly marked. Drowsiness, giddiness, disordered vision, impaired memory, and pain of the head especially, commonly precede the attack. While the brain is thus affected, the limbs about to become paralytic are troubled with pricking, tingling, numbness, weakness, and cramp. These local ailments progressively increasing, the limbs at length become decidedly paralytic, and the paralytic state having continued for an indefinite period, an apoplectic paroxysm supervenes, often preceded and denoted by spasms or convulsions in the unparalysed limbs. The coma, which forms a part of the apoplectic paroxysm, sometimes comes on gradually, and is manifestly progressive in intensity, the patient at first being capable of giving a coherent answer when strongly roused, but by degrees the loss of sensation becomes more and more complete, until at last the stupor passes into a state of total insensibility, from which there is no recovery. Now and then the patient recovers from the apoplectic state, and slowly regains the condition he was in previously to the apoplectic attack; more frequently, on the contrary, the paralytic affection increases, and another apoplectic seizure quickly supervenes, which proves mortal.

In some cases the morbid appearances that present themselves on inspection of the brain after death from this variety, differ in no respect from those which have been described as belonging to the preceding form; but the most frequent and characteristic morbid change is the softening of some portion of the substance of the brain. This softening of the cerebral substance is the result of inflammation, which is generally not acute in its nature, and is slow in its progress. The vessels belonging to this softened portion lose their vitality, and allow the red particles of the blood to pass through them, so that the part morbidly changed is not only soft but red, from the infiltration of blood through the diseased blood-vessels.

From this account of the phenomena of the disease, and of the morbid changes apparent in the brain in fatal cases, we are enabled to form an accurate conception of the pathological condition of the brain in apoplexy. Two of the conditions essential to the performance of the functions of the brain, are a supply of a certain quantity of blood, flowing with a certain impetus, and freedom from pressure. Without a certain portion of blood flowing with due impetus, the functions of the brain fail; with more than a certain portion, or with the velocity of the current quickened or retarded beyond a certain point, they equally fail; and when the pressure induced by either of these states exceeds a certain degree, they also immediately cease. The substance of the brain is tender and delicate, and abounds beyond all other organs with blood-vessels. It is of a soft and yielding nature, but it is inclosed in a firm, unyielding case. Coupling this fact with the phenomena of the circulation, it is easy to conceive how almost its entire mass, and still more readily how particular portions of it, may become subject to undue pressure, and how, as an inevitable consequence, the functions of the brain may become deranged. Any cause which quickens or which retards the circulation through it may produce this effect: for example, a preternatural distension of the arteries with blood, or a preternatural intensity in their action, and a consequent increased impetus of the circulation; or, on the contrary, a relaxation of the veins, a preternatural turgescence of them from a too great quantity of blood poured into them, and a consequent retardation of the circulation through them. Either from a too great velocity or intensity of the circulation in the arterial vessels, or from too great distension of the veins in consequence of an impeded flow of the blood through them, the thinner portion of the blood or serum may be poured out upon the brain, which in this manner may become subject to undue pressure. In consequence of either of these diseased states, the coats, whether of the arteries or veins, may suddenly give way and break, and the blood poured out upon the brain from the ruptured vessels may exert such a pressure upon it as instantly to destroy its functions. Again, tumours occasionally form in the brain, which progressively increase in magnitude, and at length exert such a degree of pressure upon the cerebral substance, as is no longer compatible with the performance of its functions. Disease of the heart also is known to affect the circulation in the brain, and is present in a large number of apoplectic cases.

Prognosis.—When once an attack has come on, even though it be slight, it places the individual in imminent danger; both because it greatly increases the predisposition to a recurrence of the paroxysm, and because, when it does not destroy life, it gives a shock to the constitution which is seldom entirely repaired, and never without much time and most judicious management. In the paroxysm the immediate danger is proportioned to the profoundness of the coma, the degree of stertor, the slowness and laboriousness of the respiration, and the frequency and intermission of the pulse. Other unfavourable signs are, delirium, convulsions, paralysis, involuntary and unconscious discharge of the urine and fæces, and above all, the continuance of the paroxysm without material diminution of its severity after the judicious employment of powerful remedies. When the respiration is exceedingly slow and laborious—when the pulse sinks to such a degree than it can be scarcely felt, and when the head, chest, and limbs are covered with a cold, clammy sweat, dissolution is near. On the other hand, the favourable signs are, mildness of the paroxysm, diminution of the symptoms after the exhibition of the appropriate remedies, and more especially restoration to consciousness, return of the power of voluntary motion, with a calm and soft pulse, a gentle, warm, and general perspiration, and a spontaneous flow of blood from the nose, the rectum, and so on.

Causes.—The causes of the disease are either predisposing or exciting. The *predisposing* causes are: 1. Sex. It is decidedly more common in the male than in the female, because the male is more exposed to the exciting causes, and nothing so surely generates a predisposition to the disease, as the long-continued operation of an exciting cause. 2. Age. It may occur in childhood and youth: it is indeed rare in the former, but it is not uncommon in the latter; still, however, the great majority of cases without doubt occur at the more advanced stages of life. The period commonly conceived to be that in which it most frequently occurs, is the interval between forty and seventy. Out of sixty-three cases, two were between twenty and thirty years of age; eight from thirty to forty; seven from forty to fifty; ten from fifty to sixty; twenty-three from sixty to seventy; twelve from seventy to eighty; and one from eighty to ninety years. 3. Conformation of the body. The large head, short neck, full chest, sanguine and plethoric temperament, have from time immemorial been considered as forming the apoplectic constitution; and though the disease may and often does occur in the very opposite states of the system, yet there cannot be a question that the conformation of the body just described is peculiarly favourable to the formation of that pathological condition of the brain on which, as we have seen, the malady depends. 4. Mode of life. Luxurious living, especially combined with sedentary habits, is a most powerful predisposing cause. 5. Suppression of accustomed evacuations, namely, the suppression of the piles or of discharges from the skin, whether from the sudden disappearance of eruptions, the result of natural disease, or the drying up of a seton or issue. 6. Mental states. Violent emotion: cases continually occur in which persons drop down suddenly in a fit in a paroxysm of anger. Long-continued anxiety is almost as powerful an exciting cause as luxurious living. It is the common opinion that the studious are more prone to this disease than other classes; but this notion is ill-founded, for the evidence is complete that moderate intellectual labour is not only in a high degree conservative of the general health, but that it is more especially preventive of that peculiar condition of the brain on which apoplexy depends. The condition of all others most conducive to apoplexy is that in which at a somewhat advanced age the food habitually taken is large in quantity and rich and stimulating in quality, at the same time that the intellectual faculties are little excited; while the history of lawyers, judges, and philosophers would indicate a remarkable exemption from this disease in all its forms. To these predisposing causes may be added disease of the heart, and a degeneration of the blood-vessels of the brain.

The predisposing causes, of whatever nature, act either by favouring an habitual determination of blood to the brain, or by impeding its return from this organ, or by impairing its vital energy, while they favour a plethoric state of its vessels. Such a condition of the brain having been formed, the slightest exciting cause is often sufficient to produce an attack.

Among the most powerful *exciting* causes are intemperance in eating and drinking, violent emotions of mind, whatever determines the blood with undue impetus to the brain or impedes its return from it, such as great muscular exertion, dependent posture of the head, tight ligature around the neck, the use of the warm bath, and the like.

Both sets of causes, the predisposing and the exciting, bring about a paroxysm either by diminishing the vital energy of the brain, or by producing undue pressure on its substance.

Treatment.—The treatment of this disease must obviously vary with the pathological condition of the brain on which it depends. The skill of the physician consists in detecting what that pathological condition is, and in exactly adapting his remedies to it, which must differ widely, according as he is called to treat a threatening or an actual paroxysm, or to prescribe for a patient subsequent to an attack. To enter into a discussion of the different remedies suited to the manifold states of the brain, and of the system, in the various forms and stages of this malady, would require a larger space than can be allotted to it in this work. There are not many parts of his science in which the physician is required to make such nice and difficult distinctions, and in which life so completely depends on the accuracy of his discrimination. At one time the vital energy of the brain is so far exhausted as of itself to threaten the total abolition of its functions; at another time the arterial action or the venous congestion is so great as to threaten an immediate effusion of serum or a large extravasation of blood. For states so opposite, opposite remedies must of course be required; but the difficulty at all times is to interpret the outward signs aright. If, together with the premonitory symptoms which have been enumerated, namely, drowsiness, giddiness, headache, and so on, there be a flushed countenance, a dull or suffused eye, a hot skin, a strong or full pulse, the abstraction of blood may be indispensable to the preservation of life; but if, on the other hand, the countenance be pallid and sunk, the pulse full, and the skin cool, the smallest blood-letting may utterly exhaust the vital energies of a brain already greatly depressed, and the only chance of averting death may be the judicious employment of stimulating remedies. It is in clearly pointing out distinctions like these, and in guiding to the selection of the remedy appropriate to each, that science is the salvation of life. But such too are precisely the cases in which no skill on the part of the physician can succeed without the steady co-operation of the patient. The physician duly weighing the premonitory signs may foresee the impending danger, and give warning of it, and prescribe precisely the medicine and REGIMEN fitted to avert it; but if these are either altogether neglected, or only partially followed, the disease will hold on its course and life be lost. And this loss of life is deplorably frequent from the neglect on the part of the patient of the appropriate remedies in the primary stage of the disease, when such remedies may be employed with almost certain success; and the same is true from the neglect of such remedies in the stage subsequent to an apoplectic paroxysm, although in this stage the best-concerted measures have a much less chance of securing their object.

It is only necessary to add here, that whenever a person is seized with a fit of apoplexy, he should be carried into a large room, the freest possible circulation of fresh air should be promoted around the body, which should be placed in the horizontal posture, with the head, however, considerably raised, all bandages should be taken from about the head and neck, and especially from about the neck; and a medical man should be sent for instantly. Every observer of such a case should bear in mind that the loss of life may be the consequence of the loss of a minute.

APOSEPIDINE. [LEUCINE.]

APOSTLES (ἀπόστολοι, messengers, ambassadors, missionaries) were according to Luke vi. 13–16, those twelve disciples whom Jesus chose from the number of his followers to be his companions, and whom he commissioned to preach his doctrines, first among the Jews only (Matt. x. 5; Luke ix. 2), and after his resurrection to the Gentiles also (Matt. xxviii. 19; Mark xvi. 15). Jesus said concerning apostles, "As my Father hath sent me, even so send I you. He breathed on them and said, Receive ye the Holy Ghost. Whose soever sins ye remit, they are remitted unto them; and whose soever sins ye retain, they are retained." (John xx. 21–23.) The list of the apostles occurs Matt. x. 2; Mark iii. 16, &c.; Luke vi. 14, &c. The names of the apostles are, "Simon, who is called Peter, and Andrew, his brother; James, the son of Zebedee, and John, his brother; Philip and Bartholomew; Thomas, and Matthew, the publican; James, the son of Alpheus; and Lebbeus, whose surname was Thaddeus; Simon the Canaanite; and Judas Iscariot, who also betrayed him." After the death of Judas Iscariot, 120 disciples being assembled, Peter recommended the choice of another apostle. "Of these men which have companied with us all the time that the Lord Jesus went in and out among us, beginning from the baptism of John, unto that same day that he was taken up from us, must one be ordained to be a witness with us of his resurrection. And they appointed two, Joseph, called Barsabas, who was surnamed Justus, and Matthias. And they prayed, and said, Thou, Lord, which knowest the hearts of all men, show whether of these two thou hast chosen, that he may take part of this ministry and apostleship, from which Judas by transgression fell, that he might go to his own place. And they gave forth their lots, and the lot fell upon Matthias; and he was numbered with the eleven apostles." (Acts i. 15–26.) To these twelve apostles was afterwards added Saul, whose name among the Greeks was Paul, called to be an apostle of the Gentiles through the will of God. (Gal. i. 1; Col. i. 1; Rom. xi. 13; Acts ix.) By the instrumentality of St. Paul, the Gospel was most effectually propagated. Barnabas (Acts xiv. 14), being an apostolic missionary, is mentioned in the following manner:—"And when the apostles Barnabas and Paul heard," &c. From this passage we infer that the title *apostle* was not exclusively given to the immediate disciples of Jesus. (Comp. Acts xiv. 4; Rom. xvi. 7.)

APOSTLES, ACTS OF. [ACTS OF THE APOSTLES.]

APOSTOLIC FATHERS are those teachers of the Christian Church who distinguished themselves during the first two centuries, and derived their Christian knowledge from personal acquaintance with the apostles, such as Barnabas, Clemens Romanus, Ignatius of Antiochia, Hermas, and Polycarpus, of whom notices will be found in the BIOGRAPHICAL DIVISION of the ENGLISH CYCLOPÆDIA.

APOSTO'LICI, were imitators of the apostolic life mentioned by Epiphanius. ('Hæres.' 67.) In the middle ages they were called Cathari. Some of them indulged Manichæan speculations, and others distinguished themselves only by their obedience to the moral doctrine of the New Testament. The latter, called Apostolic Brothers, were very numerous on the banks of the Lower Rhine, about the middle of the 12th century. We learn from a letter written A.D. 1146, in which Everwin, ecclesiastical provost of Steinfelden, exhorts St. Bernhard, of Clairvaux, to confute these heretics, that they rejected oaths, infant baptism, fasts, ceremonies, worship of saints, purgatory, masses, second marriages, the power of the pope, &c. Some of them were brought before the ecclesiastical court of the archbishop of Cologne, and defended themselves by biblical quotations. After a disputation of three days, being still unconverted, the people dragged them to the flames, in which they died manfully.

Another apostolic brotherhood was founded by Gerhard Sagarelli of Parma, about A.D. 1260. This brotherhood Pope Nicolas IV. endeavoured to suppress by various decrees of 1286 and 1290. Nevertheless Sagarelli and his adherents spread through Italy, Germany, France, and Spain. They went about accompanied by women singing, and preaching especially against the corruptions of the clergy. In 1294, two brothers and two sisters were burnt alive at Parma. Sagarelli abjured his heresy, but was burnt in 1300 for having relapsed. From this time Dolcino of Milan became the head of this party, who predicted the sudden downfall of the Romish church. Dolcino divided the development of Christianity into four dispensations, the last of which began with his apostolic order. Dolcino escaped from the inquisitors into Dalmatia, but returned to Italy in 1304. He fortified, with 1400 followers, a mountain in the diocese of Novara, near the village Balmara, and plundered, for his support, the adjacent country. In 1306 he fortified the mountain Zebello, in the diocese of Vercelli, and fought against the troops of the bishop, until he was compelled by famine to surrender in 1307. Dolcino and his companion Margaretha of Trent, were burnt with many of their followers. These Apostolici rejected the authority of the Pope, oaths, capital punishments, &c. Some Apostolic Brothers are mentioned A.D. 1311, near Spoleto; and A.D. 1320, in the south of France. The synod of Lavaur, 1368, mentions them for the last time.

APO'STROPHE (ἀποστροφή). A turning away, "a sudden change in our discourse, when, without giving previous notice, we address ourselves to a person or thing different from that to which we were addressing ourselves before." (Beattie, 'Elements of Moral Science.') The term is also used, less properly, for an address to some absent or inanimate object, as in 'Julius Cæsar,' Act iii. Sc. I.

> O pardon me, thou bleeding piece of earth,
> That I am meek and gentle with these butchers.

It is also used to express the contraction or division of part of a word, as *boro'* for *borough*, *learn'd* for *learned*. This practice of division, intolerable in a language already overburdened with consonants, was much more frequent in the writers of a century, or a century and a half ago, than now; and seems to have been affected to give an air of negligence and familiarity to their style. It ought seldom to be used except in verse, and very sparingly there. The comma, by which the final *s* of the genitive case is separated from the word, is also called an apostrophe, as in "Israel's monarch."

APOTHECARIES, COMPANY OF, one of the incorporations of the city of London. In England, in former times, an apothecary appears to have been the common name for a general practitioner of medicine, a chief part of whose business it was, probably in all cases, to keep a shop for the sale of medicines. In 1345, a person of the name of Coursus de Gangeland, on whom Edward III. then settled a pension of sixpence a day for life, for his attendance on his Majesty some time before while he lay sick in Scotland, is called in the grant, printed in Rymer's 'Fœdera,' an apothecary of London. But at this date, and for a long time after, the profession of physic was entirely unregulated. It was not till after the accession of Henry VIII. that the different branches of the profession came to be distinguished, and that each had its province and particular privileges assigned to it by the law. An Act of Parliament was passed in the third year of that king (1511), by which, in consideration, as it is stated, of "the great inconvenience which did ensue by ignorant persons practising physic or surgery, to the grievous hurt, damage, and destruction of many of the king's liege people," it was ordered that no one should practise as surgeon or physician in the city of London, or within seven miles of it, until he had been first examined, approved, and admitted by the Bishop of London, or the Dean of St. Paul's, who were to call in to assist them in the examination, "four doctors of physic, and of surgery other expert persons in that faculty." In 1518, the physicians were for the first time incorporated, and their college founded, evidently with the view that it should exercise a general superintendence and authority over all the branches of the profession. In 1540, the surgeons were also incorporated and united, as they continued to be till the beginning of the present century, with the barbers. The two associations thus established appear, however, to have very soon begun to overstep their jurisdiction. It was found necessary, in 1543, to pass an Act for the toleration and protection of the numerous irregular practitioners, who did not belong to either body, but who probably formed the ordinary professors of the healing art throughout the kingdom. In this curious statute, the former Act of 1511 is declared to have been passed, "amongst other things, for the avoiding of sorceries, witchcraft, and other inconveniences;" and not a little censure is directed against the licensed and associated surgeons for the mercenary spirit in which they are alleged to have acted, while much praise is bestowed upon the unincorporated practitioners for their charity in giving the poor the benefit of their skill and care, and for the great public usefulness of their labours generally. The import of the enactment is expressed in its title, which is, "An Act that Persons being no common Surgeons may minister outward Medicines." The persons thus tolerated in the administration of outward medicines, of course comprehended those who kept shops for the sale of drugs, to whom the name of apothecaries was now exclusively applied. The acceptation of the name, as thus confined, may be gathered from Shakspere's delineation of the apothecary in 'Romeo and Juliet' (published in 1597), as one whose business was "culling of simples," who kept a "shop," the "shelves" of which were filled with "green earthen pots," &c., and who was resorted to as a dealer in all sorts of chemical preparations.

It is evident, however, that persons dealing in drugs and simples, who would thence be supposed to know more of their qualities than their neighbours, must have been often applied to for advice. There is a curious chapter, added to an edition of R. Recorde's 'Urinal of Physik,' stated to have been written in the reign of Elizabeth, by a physician. and bearing the date, apparently as a reprint, of 1662. The title of the book is, 'A Detection of some Faults in Unskilful Physicians, ignorant and careless Apothecaries, and unknown running Chirurgeons.' After some complaints of unlearned physicians, he gives 'seven articles,' which he had submitted to the Bishop of Salisbury, in which city he dwelt, for the reformation of matters. The first is, that no physician be allowed to practise without a licence from some university or the bishop of the diocese. The second is, "that no chirurgeon should practise his chirurgery unless he could read and write, and have knowledge of the simples belonging to his art. And that he presume not to let blood, or undertake any hard cure, without the physician's counsel, if he may conveniently have it." This "chirurgeon" seems not to differ much from a general practitioner. The third article recommends that no apothecary be permitted to "minister of his own head, or ordain any purgation or other composition of physic for any man." The remaining articles recommend that a court of physicians should examine, convict, and punish any offenders against these regulations. According to the physician's own account, the apothecaries—perhaps, however, only in Salisbury—took very high ground, and had their pretensions recognised by at least some physicians. He says, "What maketh many apothecaries now-a-days to set so little by the physician? This is one chief cause: they play the physicians themselves; they give and minister medicines of their own device (God wot a mad device) indifferently unto all men; yea, and the more ignorant they are, the bolder they be; for who is so bold as blind Bayard? Many of them will not stick to look in waters, and not be ashamed, even in the physician's presence, to ordain this or that medicine for any kind of disease. If any physician do gently admonish them of the faults, and specially of giving medicines after their own brain, they will say that they may as well prescribe medicines as physicians do sometimes use to make them." He adds, in another part of his account of the apothecaries, "it were good also that no kind of poison should be pounded or dissolved in any mortars occupied daily for the shop, for thereof hath chanced much evil." Carelessness, it would seem, is not the growth of to-day.

The apothecaries of London were at length incorporated by James I. on the 9th of April, 1606, and united with the Company of Grocers. They remained thus united till the 6th of December, 1617, when they received a new charter, forming them into a separate company, under the designation of the Master, Wardens, and Society of the Art and Mystery of Apothecaries of the City of London. This is the charter which still constitutes them one of the city companies, although various subsequent Acts of Parliament have materially changed the character of the society.

It appears to have been only a few years before the close of the 17th century, that the apothecaries, at least in London and its neighbourhood, began generally to prescribe, as well as to dispense medicines. This encroachment was strongly resisted by the College of Physicians, who, by way of retaliation, established a dispensary for the sale of medicines to the poor at prime cost, at their hall in Warwick Lane. A paper controversy of great animation rose out of this measure; but the numerous tracts which were issued on both sides are now all forgotten, with the exception of Garth's burlesque epic poem, entitled 'The Dispensary,' first published in 1697. The apothecaries, however, may be considered as having made good the position they had taken; although for a considerable time their pretensions continued to be looked upon as of a somewhat equivocal character. In 1703, the House of Lords decided, in the case of William Rose (we quote from the 'London Journal of Medicine' for May, 1850), "that the duty of an apothecary consisted not only in compounding and dispensing, but also in directing and ordering the remedies employed in the treatment of disease."

Addison, in the 'Spectator,' No. 195, published in 1711, speaks of the apothecaries as the common medical attendants of the sick, and as performing the functions both of physician and surgeon. After mentioning blistering, cupping, bleeding, and the inward applications employed as expedients to make luxury consistent with health, he says, "The apothecary is perpetually employed in countermining the cook and the vintner." On the other hand Pope, in his 'Essay on Criticism,' published the same year, has the following lines in illustration of the domination which he asserts to have been usurped by the critic over the poet:—

> 'So modern 'pothecaries, taught the art
> By doctors' bills to play the doctor's part;
> Bold in the practice of mistaken rules,
> Prescribe, apply, and call their masters fools.'

Nor, indeed, did the apothecaries themselves contend at this time for permission to practise as medical advisers and attendants any further than circumstances seemed to render it indispensable. In a cleverly written tract in their defence, published in 1724, and apparently the production of one of themselves, entitled 'Pharmacopolæ Justificati; or the Apothecaries vindicated from the Imputation of Ignorance, wherein it is shown that an Academical Education is nowise necessary to qualify a man for the Practice of Physic,' we find the following opinion expressed (p. 31), "As to apothecaries practising, the miserable state of the sick poor, till some other provision is made for their relief, seems sufficiently to warrant it, so long as it is confined to them." We may here observe, that the custom of persons being licensed by the bishops to practise medicine within their dioceses continued to subsist at least to about the middle of the last century. It is exclaimed against as a great abuse in a tract entitled 'An Address to the College of Physicians,' published in 1747.

It has been stated in various publications, that the order of dealers in medicines, known as chemists or druggists, first made their appearance about the end of the last century. As they very soon began to prescribe as well as to dispense, the rivalry with which they were thus met was as eagerly opposed by the regular apothecaries, as their own encroachments had in the first instance been by the physicians. In certain resolutions passed by a meeting of members of the Apothecaries' Company on the 20th of November, 1812, among other causes which are asserted to have of late years contributed to degrade the profession, is mentioned the intrusion of pretenders of every description; "Even druggists," it is said, "and their hired assistants, visit and administer to the sick; their shops are accommodated with what are denominated private surgeries; and, as an additional proof of their presumption instances are recorded of their giving evidence on questions of forensic medicine of the highest and most serious import!" But in all this the druggists really did no more than the apothecaries themselves had begun to do a hundred years before. We doubt, too, if the first appearance of these interlopers was so recent as has been assumed. We find a tract, printed on a single folio leaf 'at the Star in Bow Lane in 1683,' entitled 'A Plea for the Chemists or Non-Collegiats,' in which the author, Nat Merry, stoutly defends the right of himself and the other manufacturers of chemical preparations to administer medicines, against the objections of the members of the Apothecaries' Company, who seem to have been themselves at this time only beginning to act as general practitioners. And in 1708, we find a series of resolutions published by the Court of Apothecaries, in which they complain of the intrusion into their business of foreigners—that is, of persons not free of the company. Their charter, though it appeared to bestow upon them somewhat extensive privileges, had been found nearly inoperative from the omission of any means of executing its provisions, and of any penalties for their infringement. In 1722, therefore, an Act of Parliament was obtained by the company, giving them the right of visiting all shops in which medicinal preparations were sold in London, or within seven miles of it, and of destroying such drugs as they might find unfit for use. This Act expired in 1729; and although an attempt was made to obtain a renewal of it, the application was not persevered in. But in 1748 another Act was passed, empowering the Society to appoint ten of their members to form a Court of Examiners, without whose licence no one should be allowed to utter medicines in London, or within seven miles of it. It was stated before a Committee of the House of Commons, that there were at this time about 700 persons who kept apothecaries' shops in London, not one-half of whom were free of the company. But this Act probably had the effect of putting the unlicensed dealers down; which may account for the common statement, that no such description of dealers ever made their appearance till a comparatively recent period. In an Introductory Essay prefixed to the first volume of the 'Transactions of the Associated Apothecaries and Surgeon Apothecaries of England and Wales,' (8vo, London, 1823), in which it is admitted that anciently "the apothecary held the same situation which appertains, or ought to appertain, to the present druggist, who arose," it is affirmed, "about thirty years ago," the following remark is added: "For some time previous to that period, indeed, certain apothecaries existed, who purely kept shop, without prescribing for diseases: but very few of these existed even in London; for in the memory of a physician lately dead, there were not more, as he stated, than about half-a-dozen persons in London, who kept what could be called a druggist's shop."

Until a comparatively recent period the jurisdiction of the Company of Apothecaries did not extend beyond the metropolis and its immediate neighbourhood. But in 1815, an Act of Parliament was passed, which placed the Society in altogether a new position, by giving to the Court of Examiners, then increased to twelve members, the sole right of examining and licensing apothecaries throughout England and Wales. It was enacted, that after the 1st of August in that year, no person not so licensed should practise as an apothecary, except such only as were already in practice. It was also made imperative that candidates for examination should have previously served an apprenticeship of at least five years with a member of the company.

The history of the steps taken to procure this Act is very minutely detailed in the Essay prefixed to the 'Transactions of the Associated Apothecaries and Surgeons,' already referred to. The application was commenced, and indeed principally carried through, by this private society; the Colleges of Physicians and Surgeons, and the Apothecaries' Company themselves, having declined joining in it. The Act, however, fell in one material respect very far short of the design entertained by its projectors, inasmuch as the opposition of the chemists and druggests rendered it necessary to introduce a clause into it exempting that class of dealers altogether from its operation.

From the circumstance that in country places, with very few exceptions, no person can practise medicine without keeping a supply of drugs for the use of his patients, or in other words, acting as an apothecary, this statute gave to the Society of Apothecaries the complete control of the medical profession throughout England. Every general practitioner had not only to purchase his licence, but to serve a long apprenticeship with a member of the company. The price of a licence to practise in London or within ten miles of it, was ten guineas, and in any other part of the country, six guineas. The penalty for practising without this licence was twenty pounds. It was expressly declared in the Act that the Society may appropriate the moneys which they thus receive in any way they may deem expedient.

It is right to state that the parties by whom the Act was sought, did not originally contemplate the giving of these extensive powers to the Apothecaries' Company. In one of their first reports, dated the 5th of December, 1812, the committee of management express themselves as of opinion "that the management of the sick should be as much as possible under the superintendence of the physician;" and it was then proposed that a new and a distinct privileged body should be created to examine and license practitioners, composed of members of all the different branches of the profession. This scheme, however, was abandoned when both the Colleges of Physicians and Surgeons refused to co-operate in getting it carried into effect.

Before this Act came into operation a large proportion of the medical practitioners in country places throughout England were graduates of the Universities of Edinburgh, Glasgow, and Dublin, or licentiates of the Royal Colleges of Surgeons of these cities, or of that of London, none of whom obtained their degrees or certificates without passing through a long course of study and a rigorous examination. Persons thus qualified were admitted as surgeons in the army and navy, and into the service of the East India Company; but they were no longer allowed to act as country practitioners in England. This privilege could only be obtained by a service of five years in the shop of a practitioner who was a member of the Company of Apothecaries, and by undergoing an examination in London before the Court of Examiners.

In April, 1835, the Court of Examiners issued new regulations for raising still higher the qualifications of candidates for the licence of the company, and it has been further raised at intervals since. Every candidate whose attendance on lectures commenced on or after the 1st of October, 1858, must now have attended the following lectures and medical practice during not less than three winter and two summer sessions: each winter session to consist of not less than six months, and to commence not sooner than the 1st nor later than the 15th October; and each summer session to extend from the 1st of May to the 31st of July.

First Winter Session.—Chemistry, anatomy, and dissections.

First Summer Session.—Materia medica and therapeutics, botany, and practical chemistry, which is to include a specific course of instruction in the laboratory, and an opportunity of acquiring a knowledge of the various reagents for poisons.

Second Winter Session.—Anatomy, physiology, dissections, principles and practice of medicine, and clinical medical practice, which must be attended during the full term of eighteen months; twelve months in an hospital connected with a recognised medical school, and six months at a recognised hospital or dispensary, if more convenient.

Second Summer Session.—Clinical practice of medicine, with the same conditions as in the winter session; midwifery, and diseases of women and children, with attendance on not less than twenty cases; forensic medicine and toxicology; and demonstrations on morbid anatomy.

Third Winter Session.—Clinical lectures, seventy-five, which may be commenced in the second summer session, but the attendance must be certified; clinical medical practice, as before; and demonstrations on morbid anatomy.

The above course of study may be extended over a longer period than three winter and two summer sessions, provided the lectures and medical practice are attended in the prescribed order and in the required sessions. The examination of candidates for certificates to practise as apothecaries is divided into two parts. The first examination, which may be passed after the second winter session, if the candidate has completed his nineteenth year, embraces Latin, including the pharmacopœia and physicians' prescriptions; anatomy; physiology; general and practical chemistry; botany; and materia medica. In the second, after the third winter session, the five years' pupilage being completed, the subjects are: practice of medicine and pathology; midwifery, including the diseases of women and children; and forensic medicine and toxicology. For a certificate of qualification to act as an assistant to an apothecary in compounding and dispensing medicines, the examination will be in translating physicians' prescriptions, and the 'Pharmacopœia Londinensis'; and in pharmacy and materia medica.

In the statement issued by the Company of Apothecaries in May, 1844, they say: "The increased number of medical students attending lectures in conformity with the regulations led to the increase of medical teachers, and not only did new schools spring up in the metropolis, but, under the auspices of the Court of Examiners, public schools of medicine were organised in the provinces: and at the present day Manchester, Liverpool, Birmingham, Leeds, Bristol, Hull, Sheffield, Newcastle, and York, have each their public school, at which the student may pursue and *complete* his medical education." It is added that "no mean proportion of those whose examination has given evidence of the highest professional attainment, have been pupils of the provincial schools." The influence of the regulations of the Court of Examiners on the medical profession is very great. The opinion of very eminent members of the medical profession before a select committee of the House of Commons in 1834, as to the manner in which the Apothecaries' Company had performed the duties devolving upon them as an examining body, is decided in its approbation.

Notwithstanding this reform, a strong feeling of dissatisfaction continued to prevail in many quarters, at the exclusion from the right to practise of all persons except those who have served an apprenticeship of five years with an apothecary, and a bill was brought into the House of Commons in 1832 to remove this disability. It was withdrawn in consequence of some difference of views as to a minor point among the parties by whom it was promoted. The object was not to take the right of examination and licence from the Court of Examiners of the apothecaries, but to permit the licentiates of the Scotch and Irish Universities, and of the Colleges of Surgeons, to practise in England, as well as those who have the diploma of the Apothecaries' Company.

From this time the agitation for a reform of the regulations respecting the professors of medicine was almost incessantly continued.

In almost every session of Parliament a bill, and sometimes more than one, was introduced for this purpose; but the difficulty of reconciling the various views of the three branches of physicians, surgeons, and apothecaries, prevented any of them from becoming law. At length, in 1858, an Act was passed (21 & 22 Vict. cap. 90), by which a Medical Council was appointed for the whole of the United Kingdom, to consist of one person chosen from each of the following bodies: The Royal Colleges of Physicians and Surgeons of London; the Apothecaries' Society of London; the Universities of Oxford, Cambridge, Durham, and London; the Colleges of Physicians and Surgeons of Edinburgh; the Faculty of Physicians and Surgeons of Glasgow; the Universities of Aberdeen and Edinburgh (one); the Universities of St. Andrew's and Glasgow (one); the King's and Queen's College of Physicians in Ireland; the Royal College of Surgeons in Ireland; the Apothecaries' Hall of Ireland; the University of Dublin; the Queen's University in Ireland; and six persons (four for England, and one each for Scotland and Ireland) to be nominated by Her Majesty in Council. This Medical Council were chosen or nominated for five years, with provision for filling up vacancies, and to them were entrusted the power of examining candidates for the practice of medicine, to whom they are to award certificates according to their qualifications, and in the department they have chosen. The Council are empowered, in order to afford facilities for examination, to appoint Branch Councils, to whom are deputed full functions for examining and granting certificates in various localities, and such have been appointed in Edinburgh and Dublin. Every person receiving a certificate is to have his name and qualification published in an annual register, and only such as are registered are capable of filling any medical office in the army or navy, or in any hospital or infirmary, or of medical officer to a Poor Law Union; and unless so registered, cannot recover in a court of law any charge for medicine or attendance, which, if registered, he is enabled to do; and no certificate, as from a medical practitioner, is to be valid, unless such practitioner is registered. All persons on the register are empowered to practise in any part of the United Kingdom or the colonies, according to the qualification in the register. The General Council have the right of prescribing the course and degree of stringency in the examination, and may interfere to prevent candidates being accepted from places where a proper course of previous study has not been pursued. Persons on the register are exempted from serving on juries, from all corporate, parochial, ward, hundred, and township offices, and from serving in the militia. Fees are payable on examination and being placed on the register, and penalties are imposed upon fraudulently procuring admission on the register, or for falsely pretending to be on it. The General Council are also to cause to be compiled, and to publish, a 'British Pharmacopœia,' "with a list of medicines and compounds, and the manner of preparing them, and the true weights and measures by which they are to be prepared and mixed." But nothing in the Act is to apply to the trades of chemists and druggists or of dentists.

The Apothecaries rank as the fifty-eighth in the list of City companies. Their arms are, azure, Apollo in his glory, holding in his left hand a bow, in his right an arrow, bestriding the serpent Python; supporters, two unicorns: crest, a rhinoceros, all *or*; motto, "Opiferque per orbem dicor." They have a hall in Water Lane, Blackfriars, at which medicines are sold to the public; and where all the medicines are prepared that are used in the army and navy. They also possess a garden, to which every medical student in London is admitted, of above three acres in extent, at Chelsea, in which exotic plants are cultivated. The ground was originally devised to them, in 1673, for sixty-one years at a rent of five pounds, by Charles Cheyne, Esq., lord of the manor of Chelsea, and afterwards granted to them in perpetuity, in 1721, by his successor Sir Hans Sloane, on condition that they should annually present to the Royal Society, at one of their public meetings, eighty specimens or samples of different sorts of plants, well-cured and of the growth of the garden, till the number should amount to two thousand. This they have done, and the specimens are preserved by the Royal Society. They still observe an old custom of making every summer a number of herbalizing or simpling excursions to the country, which are now, we believe, so conducted as to be valuable botanical lessons to the apprentices or pupils by whom the members of the society are accompanied on these occasions. The society gives every year a gold and a silver medal to the best-informed students in botany, who have attended their garden.

APOTHEO'SIS (ἀποθέωσις, a deification, literally, a god-making), the enrolment of a mortal among the gods. The mythology of Greece is full of instances of this: it is sufficient to call to mind Minos, Hercules, and other heroes, who received divine honours. It was one of the doctrines of Pythagoras, that good men after death were raised into the order of gods. To exalt fellow-men to this extent, however, was foreign to the disposition of republican states; and, therefore, though the Greeks always held in high respect the heroes of ancient times, we hear of no deifications from the time when a republican form of government became prevalent in Greece, until the spirit of independence was broken, and the Greeks became as obsequious to kings and princes, as they had formerly been unbending. There is, however, an example to the contrary recorded by Herodotus (v. 47): The people of Egeste built an *heroum* to Philippus, though he fell in battle against them, and offered sacrifices to him, as Herodotus himself testifies; it was on account of his beauty that he was deified. Alexander, according to some rather doubtful stories, not only claimed divine parentage, but a divine nature while on earth; and the compliment of deification was commonly paid to the princes of the various dynasties who succeeded to his empire. On the coins of the Seleucidæ we often find the word "God" (Θεός). In Rome, also, we find Romulus raised to the rank of a god; but there are no instances of Romans admitted to the rank of deity, from the expulsion of Tarquin, until the empire of the Cæsars. Julius Cæsar was worshipped as a god after his murder. Augustus, while yet alive, was declared the tutelary god of all the cities of the empire, and the succeeding emperors after death were enrolled among the numerous tenants of heaven. It is to the death and reception of Julius Cæsar into heaven, that the 5th Eclogue of Virgil is by some supposed to refer.

The term *Apotheosis*, however, is more especially used to signify the ceremony by which the Roman emperors were admitted, if we may use the expression, after death to divine honours. This is minutely described by Herodian (lib. iv. c. 3), and the passage presents so curious a picture of the absurdities into which an idolatrous religion betrayed its votaries, that we translate it here: "It is the custom of the Romans to deify those of their emperors who die, leaving successors; and this rite they call *apotheosis*. On this occasion, a semblance of mourning, combined with festival and religious observances, is visible throughout the city. The body of the dead they honour after human fashion, with a splendid funeral; and making a waxen image in all respects resembling him, they expose it to view in the vestibule of the palace, on a lofty ivory couch of great size, spread with cloth of gold. The figure is made pallid, like a sick man. During most of the day senators sit round the bed on the left side, clothed in black; and noble women on the right, clothed in plain white garments, like mourners, wearing no gold or necklaces. These ceremonies continue for seven days; and the physicians severally approach the couch, and, looking on the sick man, say that he grows worse and worse. And when they have made believe that he is dead (ἐπὰν δὲ δόξῃ τετελευτηκέναι), the noblest of the equestrian and chosen youths of the senatorial orders take up the couch, and bear it along the Via Sacra, and expose it in the old forum. Platforms like steps are built on each side: on one of which stands a chorus of noble youths, and on the opposite, a chorus of women of high rank, who sing hymns and songs of praise (ὕμνους καὶ παιᾶνας) to the deceased, modulated in a solemn and mournful strain. Afterwards they bear the couch through the city to the Campus Martius; in the broadest part of which, a square pile is constructed entirely of logs of timber of the largest size, in the shape of a chamber, filled with faggots, and on the outside adorned with hangings interwoven with gold and ivory images and pictures. Upon this, a similar, but smaller chamber is built, with open doors and windows, and above it, a third and fourth, still diminishing to the top, so that one might compare it to the light houses, which are called *Phari*. In the second story they place a bed, and collect all sorts of aromatics and incense; and every sort of fragrant fruit or herb or juice; for all cities and nations and persons of eminence, emulate each other in contributing these last gifts in honour of the emperor. And when a vast heap of aromatics is collected, there is a procession of horsemen and of chariots around the pile, with the drivers clothed in robes of office, and wearing masks made to resemble the most distinguished Roman generals and emperors. When all this is done, the successor to the empire applies a torch to the building; and others set fire to it on every side, which easily catches hold of the faggots and aromatics. And from the highest and smallest story, as from a pinnacle, an eagle is let loose to mount into the sky as the fire ascends; which is believed by the Romans to carry the soul of the emperor from earth to heaven: and from that time he is worshipped with the other gods." Compare with this description Dion's account (book 74), of the funeral ceremonies of Pertinax.

In conformity with this practice, it is common to see on medals struck in honour of an apotheosis, an altar with fire on it, and an eagle taking its flight into the air. Several representations of real or supposed apotheoses have been preserved in ancient gems and sculptures; of which the most celebrated is the apotheosis of Homer, formerly in the Colonna palace at Rome, but now in the Townley Gallery of the British Museum. This monument shows, in the lower compartment, the interior of a temple, and thence upwards the process of the apotheosis. This work of art has been illustrated by some of the most eminent of modern scholars. Montfaucon has published the apotheosis of Romulus in the third volume of the supplement to his 'Antiquities'; and there is an apotheosis of Augustus, on an onyx eleven inches by nine, in the Imperial Library at Paris.

APO'TOME, in ancient Greek music (from ἀπὸ, *from*, and τέμνω, *to cut*), the remainder of a whole tone when diminished by a *limma* [LIMMA], or smaller semitone, the ratios being 2187 and 2048. The Greeks were aware that the tone-major could not be rationally divided into two equal parts; they therefore divided it into a greater and less semitone, which they called *apotome* and *limma*, the difference whereof is a *comma*. [COMMA.] Under the heads TONE, and SCALE, MUSICAL, OF THE GREEKS, will be found further information concerning the ancient manner of dividing the octave.

APPARA'TUS SCULPTO'RIS, or the Sculptor's Workshop, a constellation formed by Lacaille. It is situated in that region of the heavens immediately to the eastward of the large star Fomalhaut, or a Piscis Australis, and hardly rises above the horizon in our hemisphere. It is bounded by Cetus and Aquarius on the north, Fornax Chemica on the east, Piscis Australis on the west, and Phœnix on the south. There are no bright stars in this constellation. The following is a classified enumeration of those which are visible to the naked eye :—

Magnitude	Number of Stars.
5	4
5·5	8
6	28
Total number of stars	40

APPARENT (in Astronomy). When it is necessary or convenient to reduce an observed phenomenon, either by clearing it of the effects of any optical delusion, or substituting for it the phenomenon which would have been observed at some more commodious station, that which is actually observed is called the *apparent* phenomenon, in opposition to that which results from correction or reduction, which is called the *real* or *true* phenomenon.

APPARENT MAGNITUDE, the angle under which any line appears at the eye; that is, the angle made by lines drawn from its extremities to the eye. [MAGNITUDE.]

APPARENT MOTION, the velocity and direction in which a body appears to move, when the spectator himself is in motion, without being conscious of it. For further detail see MOTION.

APPARITION. The mind affects the body; the body affects the mind; and some insight may be obtained into the disordered states of the mind, by considering the physical conditions which are necessary to sound thought.

It is not true, as is commonly supposed, that we see with the eye, and hear with the ear, and taste with the tongue. The true seat of these sensations is the brain, and the eye, the ear, the tongue, are organs adapted to receive impressions from external objects, which impressions are transmitted from the organs by an appropriate apparatus to the brain, where they become sensations. When an object is presented to an organ of sense, it produces a change in the nerves of that organ. This change is conveyed by the nerves to the brain; a corresponding change is occasioned in the brain, and through the brain in the mind; and it is this change in the mind which is expressed by the term sensation. Ideas, on the contrary, are copies of sensations, renovations of prior feelings, in general differing from sensations in being less intense.

The functions of the brain, then, are sensation, and, if the analogous term be allowed, ideation, together with the action and re-action of these two states on each other, known under the name of intellectual operation. The main instrument by which intellectual operation is carried on is what is termed association. It is a property of the mind to combine and unite the sensations and ideas it receives in such a manner, that, after this combination or union has been once formed, if any one of these sensations and ideas be revived, the single sensation or idea so revived will immediately call up to view all the sensations and ideas that had previously been connected with it; and this power of association, as long as its action is sound, is observed to operate in a uniform and determinate manner. For example, when sound, association excites ideas in a certain order, generally in the order of sensation. Thus, if the sensations A B C were impressed upon the mind in the order of those letters, B will re-excite not A, but C. Association, when sound, operates by exciting ideas with a certain degree of velocity. If the rapidity of the succession of the trains of ideas pass beyond a certain point, instead of distinct there is confused thought. Association, when sound, operates by exciting ideas with a certain degree of vivacity. Sensation is not produced, unless the external object be applied to the organ of sense with a certain degree of force; while, if propelled against it with too great an impetus, instead of specific sensation, it excites only pain. In like manner, unless the trains of ideas recalled by association possess a certain degree of vivacity, they present to the mind an indistinct assemblage of images; if, on the other hand, they are too vivid, they are equally incapable of forming the elements of sound thought.

In order that the brain may carry on these operations, that is, in order that it may receive the impressions conveyed to it by the nerves from the organs of sense, in order that it may convert these impressions into sensations, and in order that it may duly combine and revive them, it must be in a sound state. The chief agents which maintain the brain in a sound state are its organic nerves, and its circulating vessels. Like every other organ, the brain is maintained in a healthy condition by the process of nutrition. [NERVOUS SYSTEM, NAT. HIST. DIV.] Disease may take place in the substance of the brain, and this disease may assume a variety of forms far too great to be enumerated here, the slightest of which may be incompatible with the production of sound thought. If, on the other hand, the flow of blood through its circulating vessels be deranged, the process of thought may be equally disordered. Stop the flow of blood to the brain altogether, insensibility will follow instantly; fainting will supervene, and this state will be quickly succeeded by death, unless the vital current be re-admitted. Quicken the circulation beyond a certain point, insensibility equally follows; and, though the preternatural velocity of the circulation should stop short of inducing insensibility, it may yet disturb the ordinary process of thought in an infinite variety of modes.

Now there is scarcely a single disease which is not capable of disturbing, in a greater or less degree, the action of the organic nerves of the brain; but the maladies which most commonly and remarkably disturb the functions of these nerves, are certain diseases of the abdominal viscera, particularly of the alimentary canal, and more especially of that portion of it which forms the stomach; certain diseases of the liver, and of the mesenteric glands, and of the urinary and reproductive organs. In like manner excitation or depression of the action of the blood-vessels of the brain, beyond a certain point, uniformly disorders sensation and all the mental operations. Striking illustrations of both are afforded by the effect of many physical agents, as well as of natural diseases. Of the first, the effects of the inhalation of nitrous oxide affords an example. When nitrous oxide is received into the lungs, the pulse is increased in strength, fulness, and velocity. A corresponding change takes place in the mental impressions. Sensation becomes more vivid; the sensibility to touch increases; luminous points dazzle the eye; the hearing is more acute; recollections, generally of a pleasing nature, and of uncommon intensity, pass rapidly through the mind. One individual compares his feelings, under the influence of this gas, to those which he experiences when witnessing an heroic scene upon the stage; another likens them to the emotions he felt when, on the occasion of the commemoration held at Westminster Abbey in honour of Handel, he heard seven hundred instruments playing at one time.

The inhalation of ether, chloroform, and amylene, produces also analogous effects. These substances have, in fact, been employed to the extent of depriving the brain of its consciousness, so that it is no longer aware of external sensations, and suffers no pain. [ANÆSTHETICS.]

The inhalation of malaria, the poison which produces fever, affords an equally striking illustration of the modification of sensation, and of all the subsequent operations of the mind, by a cause affecting the nerves and blood-vessels of the brain. Febrile miasma is a depressing, nitrous oxide a stimulating, agent; the effect of the former on the brain ought therefore to be the reverse of the latter, and, accordingly, on receiving into the lungs the febrile miasma, the pulse becomes oppressed and weak; languor and lassitude pervade the limbs; the countenance becomes pale, the surface cold; headache, giddiness, and sometimes vomiting supervene, while the mind is feeble, dull, dejected, incapable of the effort of attention, and utterly unable to control or even to connect the trains of gloomy and distressing images which terrify the imagination. "Some circumstances had occurred," says a physician who carefully observed the phenomena which attended the progressive derangement of his own mind under the influence of fever, "to render me anxious and dispirited; of these I took an exaggerated and gloomy view. I had been studying during several months with unusual severity. One day in the cold weather of January, after having been occupied many hours in the practical duties of my profession, I returned home fatigued. Great as was my bodily exhaustion, the depression of my mind was still more remarkable. My head ached, and unable to study or to attend to any professional engagement, I lay on the sofa and attempted to read, chance having thrown in my way the American novel called the 'Water Witch.' I became interested in the story, but the pain and confusion of my head increasing, I requested a friend to read to me, my own eye continually wandering from the page. The progress of the fever was rapid; its chief force fell upon the organ that had been recently over-excited, the brain; and delirium came on early, and somewhat suddenly. Immediately before I became decidedly delirious, I received an invitation to the soirées given by the Duke of Sussex to the members of the Royal Society. The friend I asked to return an answer expressive of my regret that I should be unable to attend on account of illness, used, as I conceived, an expression not strictly correct: this verbal inaccuracy, I thought, was construed into wilful falsehood; the matter was brought before this assemblage of learned men, who unanimously declared that it ought to exclude me from the society of honourable men, and that I should no more be admitted amongst them. This announcement was brought me from the palace, accompanied with martial music, but of a more solemn and impressive kind than I had ever heard before, in which was predominant the sound of bells, soft, and as if of silver tone. Remonstrance was vain: the decision of which I succeeded in obtaining a reconsideration, was confirmed; this confirmation was brought me in the same manner as the first announcement, accompanied with the same kind of music, only still more solemn and impressive. I saw no person forming the band of musicians, but occasionally I heard very distinctly their measured step. I now thought myself an abandoned and lost being; and the apprehension that every one about me hated and sought occasion to destroy me, took possession of my mind. My physicians, my nurses, my dearest friends, were in league with a malignant spirit, which assumed the shape of the demon of the 'Water Witch.' By an object of my tender affection, who was anxiously watching over me, but in whom I now saw only the willing agent of the demon, I was betrayed, and through this treachery the malignant spirit obtained entire possession of me. No sooner was I in the power of the demon than she began to suggest to me the commission of crimes abhorrent to my nature, and at last there fixed upon my mind the impression that I had really been guilty of the crimes, by the vivid picture of which my imagination had been disturbed. I pass over the hurricanes and storms I encountered, evidently suggested by the descriptions in the novel I had just been reading: on the sudden subsidence of these I thought I stood before an invisible tribunal. I felt a solemn consciousness that an all-seeing eye was on me; while there was visible to me only a portion of the deck of the Water Witch, and very obscurely the shadow of my malignant accuser. Not the crimes falsely laid to my charge, but the actual events of my life, even the events of childhood and youth, long forgotten, were now called up with extraordinary vividness; all the circumstances of place, person, dress, language, and attitude, such as had actually accompanied them, being revived. Of each of these events I was compelled to give a true account, an invisible hand recording every syllable that fell from my lips, and a secret power obliging me to utter the words which expressed the exact truth. During this ordeal I saw the countenances of dear friends, and of secret and open enemies, those that had long been dead, as well as those that were still living; the former cheering me by their attitudes and words, the latter scowling upon me and assuming menacing postures, but uttering no sound. And now again I felt myself under the power of the demon, by whose uncontrollable agency I was compelled to accuse myself of the crimes of her own suggesting; and while suffering the bitter anguish of self-reproach, and expecting some fearful punishment, I again saw my dearest friends, with their innocent and happy countenances, engaged in occupations with which associations of a highly pleasurable nature had been formed in my mind, but whom I could not make sensible of my presence, and with whom I was doomed to hold affectionate intercourse no more. After this I have no remembrance of anything that passed, until conscious of the return of some obscure and vague recollections. I had the impression that some calamity had befallen me; but I felt as if a soft and refreshing breeze were blowing gently upon me; and soon I found myself in a vast ocean, in a beautifully-constructed vessel, with a fresh and invigorating breeze, sailing rapidly along a coast presenting the most magnificent and lovely scenery; and at length the vessel entered gallantly a port unknown to me, but the strand was crowded with human beings with happy faces, and still happier voices. I had returned from a long voyage, but I could not make out where I had been. I felt hungry and fatigued; and now, for the first time, I recognised the individuals of my family, after having been violently delirious upwards of a fortnight, during the last three days of which time I lay in a state of total insensibility, my physicians and friends expecting every moment to be the last."

Whoever will consider carefully the mental phenomena produced by the different and opposite conditions of the brain, the one produced by the operation of physical agents, the other arising under the influence of disease, will have no difficulty in conceiving the origin of spectral illusions, either with the consciousness that they are illusions, or with a temporary or permanent persuasion that they are real existences, and whether arising from external or internal causes, or from both combined.

The case of Nicolai, the celebrated bookseller of Berlin, affords a curious illustration of the long continuance of vivid spectral illusions, without the slightest belief of the real existence of the apparitions. "In a state of mind completely sound, and after the first terror was over, with perfect calmness," says this remarkable man, "I saw, for nearly two months, almost constantly and involuntarily, a vast number of human and other forms, and even heard their voices.

"My wife and another person came into my apartment in the morning, in order to console me, but I was too much agitated by a series of incidents, which had most powerfully affected my moral feeling, to be capable of attending to them. On a sudden, I perceived, at about the distance of ten steps, a form like that of a deceased person. I pointed at it, asking my wife if she did not see it? It was but natural that she should not see anything. My question therefore alarmed her very much, and she immediately sent for a physician. The phantom continued about eight minutes. I grew at length more calm, and being extremely exhausted, fell into a restless sleep, which lasted about half an hour. The physician ascribed the apparition to a violent mental emotion, and hoped there would be no return; but the violent agitation of my mind had in some way disordered my nerves, and produced further consequences, which deserve a minute description.

"At four in the afternoon, the form which I had seen in the morning re-appeared. I was by myself when this happened, and being rather uneasy at the incident, went to my wife's apartment, but there likewise I was persecuted by the apparition, which however at intervals disappeared, and always presented itself in a standing posture. About six o'clock there appeared also several walking figures, which had no connection with the first. After the first day the form of the deceased person no more appeared, but its place was supplied with many other phantasms, sometimes representing acquaintances, but mostly strangers: those whom I knew were composed of living and deceased persons, but the number of the latter was comparatively small. I observed the persons with whom I daily conversed did not appear as phantasms—these representing chiefly persons who lived at some distance from me.

"These phantasms seemed equally clear and distinct at all times, and under all circumstances, both when I was by myself and when I was in company, and as well in the day as at night, and in my own house as well as abroad; they were however less frequent when I was in the house of a friend, and rarely appeared to me in the street. When I shut my eyes, these phantasms would sometimes vanish entirely, though there were instances when I beheld them with my eyes closed; yet, when they disappeared on such occasions they generally returned when I opened my eyes. I conversed sometimes with my physician and my wife of the phantasms which at the moment surrounded me. They appeared more frequently walking than at rest, nor were they constantly present. They frequently did not come for some time, but always re-appeared for a longer or a shorter period, either singly or in company, the latter however being most frequently the case. I generally saw human forms of both sexes, but they usually seemed not to take the smallest notice of each other, moving as in a market-place, where all are eager to press through the crowd; at times however they seemed to be transacting business with each other. I also several times saw people on horseback, dogs, and birds. All these phantasms appeared to me in their natural size, and as distinct as if alive, exhibiting different shades of carnation in the uncovered parts, as well as different colours and fashions in their dresses, though the colours seemed somewhat paler than in real nature. None of the figures appeared particularly terrible, comical, or disgusting; most of them being of an indifferent shape, and some presenting a pleasing aspect.

"The longer these phantasms continued to visit me, the more frequently did they return; while at the same time they increased in numbers about four weeks after they had first appeared. I also began to hear them talk. These phantasms sometimes conversed among themselves, but more frequently addressed their discourse to me; their speeches were commonly short, and never of an unpleasant turn. At different times there appeared to me both dear and sensible friends of both sexes, whose addresses tended to appease my grief, which had not yet wholly subsided; their consolatory speeches were in general addressed to me when I was alone. Sometimes however I was accosted by these consoling friends while I was engaged in company, and not unfrequently while real persons were speaking to me."

Of the natural constitution of his mind, Nicolai states: "My imagination possesses in general *a great facility in picturing.* I have, for example, sketched in my mind a number of plans for novels and plays, though I have committed very few of them to paper, because I was less solicitous to execute than to invent. I have generally arranged these outlines when in a cheerful state of mind I have taken a solitary walk, or when travelling I have sat in my carriage, and could only find employment in myself and my imagination. Constantly, and even now, do the different persons whom I imagine in the foundation of such a plot *present themselves to me in the most lively and distinct manner, their figure, their features, their manner, their dress, and their complexion, are all visible* to my fancy. As long as I meditate on a fixed plan, and afterwards carry it into effect, even when I am interrupted and when I must begin it again at different times, all the acting persons *continue present in the very same form* in which my imagination at first produced them. I find myself frequently in a state between sleeping and waking, in which a number of pictures of every description, often of the strangest forms, show themselves, change, and vanish. In the year 1778 I was afflicted with a bilious fever, which at times, though seldom, became so high as to produce delirium. Every day, towards evening, the fever came on, and if I happened to shut my eyes at that time, I could perceive that the cold fit of the fever was beginning, even before the sensation of cold was observable. This I knew by the distinct appearance of coloured pictures, of less than half their natural size, which looked as in frames. They were a set of landscapes, composed of trees, rocks, and other objects. If I kept my eyes shut, every minute some alteration took place in the representation. Some figures vanished and others appeared. But if I opened my eyes, all was gone; if I shut them again, I had a different landscape. In the cold fit of the fever, I sometimes opened and shut my eyes every second, for the purpose of observation, and every time a different picture appeared, replete with various objects, which had not the least resemblance to those that appeared before. These pictures presented themselves without interruption, as long as the cold fit of the fever lasted. They became fainter as soon as I began to grow warm; and when I was perfectly so, all were gone. When the cold fit of the fever was entirely past, no more pictures appeared; but if on the next day I could again see pictures when my eyes were shut, it was a certain sign that the cold fit was coming on."

This is a remarkable instance of spectral illusion manifestly arising from a physical cause, in a person of a philosophical turn of mind, able to refer the illusions to their real source, and therefore to maintain his consciousness of their true nature. It was otherwise with John Beaumont, the author of a 'Treatise on Spirits and Apparitions,' who was a man of hypochondriacal disposition, and who, while labouring under this bodily disease, saw hundreds of imaginary men and women about him, and in whose real existence he came to be a firm believer. Among the spirits that visited him, there were two who became his constant attendants, and who called each other by their names: several spirits would often call at his chamber, and ask whether such spirits lived there, calling them by their names, and they would answer, they did. One spirit which came for several nights together, and rung a little bell in his ear, told him that his name was Ariel. The two spirits that constantly attended him were ladies of a brown complexion, about three feet in stature; they had both black loose net-work gowns, tied with a black sash about the middle; and within the net-work appeared a gown of a golden colour, with somewhat of a light striking through it. "These women told me they would kill me if I told any person in the house of their being there, which put me in some consternation, and I made a servant sit up with me four nights in my chamber, before a fire, it being in the Christmas holidays; telling no person of their being there. One of these spirits in woman's dress lay down upon the bed by me every night; and told me, if I slept, the spirits would kill me, which kept me waking for three nights. In the mean time, a near relation of mine went (though unknown to me) to a physician of my acquaintance, desiring him to prescribe me somewhat for sleeping, which he did, and a sleeping potion was brought me, but I set it by, being very desirous and inclined to sleep without it. The fourth night I could hardly forbear sleeping, but the spirit, lying on the bed by me, told me again I should be killed if I slept; whereupon I rose, and sat by the fire-side, and in a while returned to my bed; and so I did a third time, but was still threatened as before; whereupon I grew impatient, and asked the spirits what they would have?—told them I had done the part of a Christian, in humbling myself to God, and feared them not; and rose from my bed, took a cane, and knocked at the ceiling of my chamber; a near relation of mine lying then over me, who presently rose and came down to me, at two o'clock in the morning; to whom I said, you have seen me disturbed these four days past, and that I have not slept —the occasion of it was, that five spirits, which are now in the room with me, have threatened to kill me if I told any person of their being here, or if I slept; but I am not able to forbear sleeping longer, and acquaint you with it, and now stand in defiance of them: and thus I exerted myself about them; and, notwithstanding their continued threats, I slept very well the next night, and continued so to do, though they continued with me above three months, day and night."

We have seen that some minds, such as that of Nicolai, have a strong natural tendency to form vivid pictorial images of everything that interests them; in others, there is a like tendency to the intense renovation of past impressions. "I remember," says Dr. Ferriar, "that, about the age of fourteen, if ever I had been viewing any interesting object in the course of the day, such as a romantic ruin, a fine seat, or a review of a body of troops, as soon as evening came on, if I had occasion to go into a dark room, the whole scene was brought before my eyes, with a brilliancy equal to what it had possessed in daylight, and remained visible for several minutes. I have no doubt that dismal and frightful images have been often presented to the mind in the same manner after scenes of domestic affliction or public horror." Certain states of the body, and certain affections of the mind, powerfully predispose to the intense renovation of past impressions, however those impressions have been induced, and whatever their nature, the immediate exciting cause of the renovation being often some external object acting upon the senses or upon the imagination under circumstances favourable to the illusion. A large class of spectral illusions are referable to this head, of which the following may be taken as an example. A gentleman was benighted, while travelling alone, in a remote part of the highlands of Scotland, and was compelled to ask shelter for the evening at a small lonely hut. When he was to be conducted to his bed-room, the landlady observed, with mysterious reluctance, that he would find the window very insecure. On examination, part of the wall appeared to have been broken down to enlarge the opening. After some inquiry, he was told that a pedlar, who had lodged in the room a short time before, had committed suicide, and was found hanging behind the door in the morning. According to the superstition of the country, it was deemed improper to remove the body through the door of the house; and to convey it through the window was impossible, without removing part of the wall. Some hints were dropped that the room had been subsequently haunted by the poor man's spirit. My friend laid his arms, properly prepared against intrusion of any kind, by the bed-side, and retired to rest, not without some degree of apprehension. He was visited in a dream by a frightful apparition, and, awaking in agony, found himself sitting up in bed, with a pistol grasped in his right hand. On casting a fearful glance round the room, he discovered by the moonlight a corpse dressed in a shroud, reared erect against the wall close by the window. With much difficulty he summoned up resolution to approach the dismal object, the features of which, and the minutest parts of its funeral apparel, he perceived distinctly. He passed one hand over it, felt nothing, and staggered back to bed. After a long interval, and much reasoning with himself, he renewed his investigation, and at length discovered that the object of his terror was produced by the moonbeams, forming a long, bright image, through the broken window, on which his fancy, impressed by his dream, had pictured, with mischievous accuracy, the lineaments of a body prepared for interment. Powerful associations of terror, in this instance, had excited the recollected images with uncommon force and effect.

The peculiarity of constitution expressed by the term predisposition, whether corporeal or mental, is not only deeply implicated in the production of a general tendency to the formation of these phantoms, but it often determines even the specific character which each assumes. Since the predisposition varies in each individual, the same morbid cause may conjure up images the most diversified. The inhalation of nitrous oxide commonly excites vivid images of a pleasing nature, accompanied with grateful sensations; but in some cases it presents to the imagination frightful pictures, and produces on the system painful effects; and, for the same reason, the morbid cause, whatever it be, which gives rise to spectral illusions, may in one excite soothing and delightful visions, and in another hideous and appalling spectres. The daughter of Sir Charles Lee "saw, about two of the clock in the morning, the apparition of a little woman between her curtain and her pillow, who told her she was her (deceased) mother: that she was happy, and by twelve of the clock that day she should be with her. Whereupon she knocked up her maid, called for her clothes, and when she was dressed she went into her closet, and came not out again till nine, and then brought with her a letter, sealed, to her father; brought it to her aunt, the Lady Everard, told her what had happened, and desired, that as soon as she was dead it might be sent to him. She desired that the chaplain might be called to read prayers; and when prayers were ended, she took her guitar and psalm-book, and sat down upon a chair without arms and played and sang so melodiously and admirably, that her music-master, who was then there, admired at it. And near the stroke of twelve, she rose and sat herself down in a great chair with arms, and fetching a strong breathing or two, immediately expired." In this case, a spectral illusion occurring in a tender and susceptible frame, produced such a powerful impression upon the imagination, as absolutely to destroy life. The contrast to this is the case of the sturdy assessor to the Westminster Assembly, who received a visit from the arch-fiend himself, and whom he treated with a cool contempt, which must have astonished his Satanic majesty. "The devil, in a light night, stood by his bedside. The assessor looked awhile, whether he would say or do anything; and then said, 'If thou hast nothing to do, I have;' and so turned himself to sleep."

There are many cases on record which directly prove that there is often the closest possible connection between the very shape which these phantasms assume and the images which have previously occupied the mind. A writer in the 15th volume of Nicholson's 'Philosophical Journal,' who was haunted with the apparition of frightful spectres, and who was at length struck with some connection between these images and his previous thoughts, states, that he tried the experiment, whether, by fixing his meditation upon other objects, he could not make these assume the place of the phantasms which persecuted him; that with this view, while the faces were flashing before him, he reflected upon landscapes and scenes of architectural grandeur; that accordingly, after a considerable interval of time, a rural scene of hills, valleys, and fields appeared before him, which was succeeded by another and another, in ceaseless succession; that the manner and times of their respective appearance, duration, and vanishing, did not sensibly differ from those of the faces; that the scenes were calm and still, without any strong lights or glare; that, after a time, these figures changed entirely, and consisted of books, parchments, or papers, containing printed matter. The writer adds, "I was now so well aware of the connection of thought with these appearances, that, by fixing my mind on the consideration of manuscript instead of printed type, the papers appeared, after a time, only with manuscript writing, and afterwards, by the same process, instead of being erect, they were all inverted or appeared upside down. The intelligent and philosophical Nicolai saw nothing but men and women, in their natural form and aspect, horses, dogs, and birds: the illusions of superstitious minds consist of angels or devils, which assume all sorts of fantastic shapes. Remigius, who was a commissioner for the trial of witches in Lorrain, and who boasts that, in the course of fifteen years, he had condemned 900 criminals to the stake, paid particular attention to the form, features, and dress of demons; yet his statements clearly show that they did not vary from the gross sculptures and paintings of the middle ages, and that recollected images only were present to the persons labouring under the delusions for which they suffered death. They are said to be black faced, with sunk but fiery eyes; their mouths wide, and smelling of sulphur; their hands hairy, with claws; their feet horny and cloven. "A devil would appear like an angel, seated in a fiery chariot; or riding on an infernal dragon, and carrying in his right hand a viper; or assuming a lion's head, a goose's feet, and a horse's tail; or putting on a raven's head, and mounted on a strong wolf; with innumerable other fantastic shapes of a similar description. These mysterious and frightful images were not only made familiar to the imaginations of the people, but even to their very senses. They could go neither into their dwellings nor their temples without seeing them; they were sculptured on the walls of the church, they were carved on the wainscots of the domestic halls, and the air and the earth were peopled with them; there was not a hill nor a valley, not a wood nor a grove, not a fountain nor a stream, in which they were not seen and heard, and communed with. No place was void," says Burton, "but all full of spirits, devils, or other inhabitants; not so much as a hair breadth was empty in heaven, earth, or water above or under the earth." "Our mothers' maids," observes Reginald Scot, "have so terrified us with an ugly devil, having horns on his head, fier in his mouth, and a tail in his breach, eies like a bacon, fangs like a dog, claws like a beare, a skin like a niger, and a voice roaring like a lion, that we start and are afraid when we hear any one cry *baugh!*"

What wonder that these hideous phantoms should make an indelible impression on weak and ignorant minds, and exert an influence even over strong and cultivated understandings, which their better reason could not at all times resist! What wonder when, from corporeal disease, sensations and ideas were rendered preternaturally intense, or the vivacity of ideas was so increased as to overpower actual impressions, that these spectres should be seen in solitude, and heard in the storm; should dance before the eye, and whisper in the ear; should assume a menacing aspect in the dreams of the guilty, and come with the cherub's smile in the visions of the innocent; should be to the maniac all that existed, and to the feverish and dying what most they hoped or feared!

In regard to ghosts, it is observable that they were remarkably abundant in this country during the interregnum after the civil war in 1649. "The melancholic tendency of the rigid Puritans of that period; their occupancy of old family seats, formerly the residence of hospitality and good cheer, which in their hands became desolate and gloomy; and the dismal stories propagated by the discarded retainers to the ancient establishments, ecclesiastical and civil, contributed altogether to produce a natural horror unknown in other periods of our history." It is well known that ghosts commonly appear in the same dress they wore when living; sometimes, indeed, they are clothed all in white, but these are chiefly the "churchyard ghosts, who have no particular business, but seem to appear *pro bono publico*, or to scare drunken rustics from tumbling over their graves. Dragging chains is not the fashion of English ghosts, chains and black vestments being chiefly the accoutrements of foreign spectres, seen in arbitrary governments,—dead or alive English spirits are free." Ghosts are commonly pale, and often assume a misty or cloudy appearance, the spectral idea of colour not quite equalling in intensity the vividness of an immediate sensation. The phantoms seen by Nicolai were always of a paler colour than real beings; and when they began to diminish and disappear, their colour became fainter and fainter, until at last they appeared entirely white.

We cannot dismiss the subject of apparitions without observing, that the manner in which these phantoms have vanished before the light of knowledge affords a striking illustration of the blessings which descend even to the lowest of the people from the diffusion of the sound principles of philosophy. The powerful and capricious spirits which filled "the heavens, the earth, and the waters above and under the earth," added, in no inconsiderable measure, to the sum of human suffering. They were, in general, hideous in form, and malignant in intention; the number of the good small, that of the evil countless; and though of "soft and uncompounded essence," they might have come in what shape they chose, "dilated or condensed, bright or obscure," yet they did assume "forms forbidden," such as "retire to chaos, and with night commix;" and their visitations were much more often accompanied with "blasts from hell" than "airs from heaven." They produced powerful emotion, for the most part painful and of pernicious tendency. They afforded materials for the fiction of the poet, and the pencil of the painter; but the imagery of the one and the figures of the other were distinguished for incongruity and deformity, not for beauty and grace. Haunting the couch of sickness, in minds debilitated by disease, they often chased reason from its throne, and sometimes deprived the sufferer of life. The ignorant they terrified with false fears, and they afforded no compensation in the uniformity and efficacy with which they visited the guilty with remorse. As agents in the administration of reward and punishment they were most unjust. If they brought down vengeance on the criminal, it was not for the commission of crime, but the neglect of punctilios; and if, as guardian angels, they hovered about the pillow of the dying, they were not messengers of evil to the wicked, and ministers of grace to the good; but this "blessed troop, with faces bright like the sun, bearing garlands, and promising eternal happiness," was as disposed to waft to heaven the soul of the sinner as of the saint. By preoccupying the mind, they took off the attention from the observation of nature, and deprived it both of the power and of the disposition to discover the true solution of those physical, mental, and moral phenomena which could not wholly escape notice, and in this lies the real malignity of their influence. They incapacitated the mind for the perception of truth, disposed it for the reception of the grossest delusions of credulity, and prepared it for the admission of the most fallacious account of the sources of calamity and suffering. In the hands of the priest and the tyrant, they were potent to delude and enslave; and they did their work faithfully. The human mind will anticipate the future, and must reflect upon the past. In the former, there will always be sufficient to fear, and in the latter enough to regret, without the stimulus of fictitious terror, or the imputation of imaginary guilt. As long as the human frame can suffer, and is subject to death, the mind will require whatever light philosophy can pour upon it to preserve it from error, and whatever consolation religion can afford, to save it, at least, from misery, if not from despair. In philosophy, there is light, and in religion, consolation; and he is a friend to man who labours to secure to him these inestimable blessings, free from the admixture of ignorance and the alloy of superstition.

(*Westminster Review*, No. ii.; *An Essay towards a Theory of Apparitions*, by John Ferriar, M.D., 1813; *Sketches of the Philosophy of Apparitions, or an Attempt to trace such Illusions to their Physical Causes*, by Samuel Hibbert, M.D., 1824.)

APPARITOR, an officer employed in the ecclesiastical courts, "so called," says Burn, "from that principal branch in their office, which consisteth in summoning persons to appear;" as the canons direct that letters citatory are not to be sent by those who have obtained them, nor by their messenger, but the judge shall send them by his own faithful messenger. In 21 Hen. VIII. c. 5, as well as in the canons, apparitors are hence called summoners, or summers. The above Act restrains the number of apparitors kept by bishops, archdeacons, or their vicars or officials, or other inferior ordinaries.

Apparitor is a Roman word, and was used as a general term to signify any person who was in attendance on public functionaries (*iis apparebant*, whence the name) to execute their orders. The term accordingly includes a great variety of officers in the Roman system. Under the later Empire various magistrates and functionaries had their apparitors, whose duties and privileges are enumerated in the Justinian Code, 12, tit. 52, &c.

APPEAL (*appeller*, to accuse), in the old criminal law of England, was a vindictive action at the suit of the party injured by some heinous offence, in which the appellant, instead of merely seeking pecuniary compensation as in civil actions, demanded the punishment of the criminal.

It differed from an indictment in some material points. Being a proceeding instituted by a private person in respect of a wrong done to himself, the prerogative of the crown was not permitted to suspend the prosecution or to defeat it by a pardon. It seems to have been in reference to this peculiarity that the appeal is said to have been called by the celebrated Chief Justice Holt "a noble birthright of the subject," inasmuch as it was the only mode by which the subject could insist upon the rigorous execution of criminal justice without the risk of royal interposition on behalf of the offending party. Even a previous acquittal on an indictment for the same identical offence was no bar to the prosecution by the appellant; nor was a previous conviction a bar, where the execution of the sentence had been intercepted by a pardon. It was in the power of the appellant alone to relinquish the prosecution, either by releasing his right of appeal or by accepting a compromise.

Another remarkable feature of an appeal was the mode of trial, which in cases of treason or capital felony was either by jury or by battle, at the election of the defendant.

Where the latter form of trial was adopted, the following was the order of proceeding. The appellant formally charged the *appellee* with the offence: the latter distinctly denied his guilt, threw down his glove, and declared himself ready to prove his innocence by a personal combat. The challenge was accepted by the appellant, unless he had some matter to allege, in what was termed a *counterplea*, showing that the defendant was not entitled to the privilege of battle, and both parties were then put to their oaths, in which the guilt of the accused was solemnly asserted on one side and denied on the other. A day was then appointed by the court for the combat, the defendant was taken into custody, and the accuser was made to give security to appear at the time and place prefixed. On the day of battle, the parties met in the presence of the judges, armed with certain prescribed weapons, and each took a preliminary oath, of which the effect was that he had resorted to no unfair means for securing the assistance of the devil in the approaching contest. If the defendant was vanquished, sentence was passed upon him, and he was forthwith hanged. But if he was victorious, or was able to persist in the combat till starlight, or if the appellant voluntarily yielded, and cried *craven*, then the defendant was acquitted of the charge, and the appellant was not only compelled to pay damages to the accused, but was further subjected to very heavy civil penalties and disabilities.

Some of the details of this singular mode of trial, as reported by contemporary writers, are sufficiently ludicrous. Thus we are told that the combatants were allowed to be attended within the lists by counsel, and a surgeon with his ointments. In the reign of Charles I., Lord Rea, on a similar occasion, was indulged with a seat and wine for refreshment, and was further permitted to avail himself of such valuable auxiliaries as nails, hammers, files, scissors, bodkin, needle, and thread. (See Rushworth's 'Collections,' cited in Barrington's 'Observations,' p. 328.) We also learn from the 'Close Rolls' recently published, that parties under confinement preparatory to the trial were allowed to go out of custody for the purpose of practising or taking lessons in fencing. (See Mr. Hardy's 'Introduction,' p. 185.) The whimsical combat between Horner and Peter, in the 'Second Part of Henry VI.,' has made the proceedings on an appeal familiar to the readers of Shakspere; and the scene of a judicial duel upon a criminal accusation has been more recently presented to us in the beautiful fictions of Sir Walter Scott.

It appears probable that the trial by battle was introduced into our jurisprudence from Normandy. The 'Grand Coustumier' of that country, and the 'Assizes of Jerusalem,' furnish evidence of its early existence.

The courts of criminal jurisdiction in which it was admitted were the King's Bench, the Court of Chivalry, and (in the earlier periods of our legal history) the High Court of Parliament.

In some cases the appellant was able to deprive the accused of his choice of trial, and to submit the inquiry to a jury. Thus, if the appellant was a female; or under age; or above the age of sixty; or in holy orders; or was a peer of the realm; or was expressly privileged from the trial by battle by some charter of the king; or laboured under some material personal defect, as loss of sight or limb; in all such cases he or she was allowed to state in a counterplea the ground of exemption, and to refer the charge to the ordinary tribunal. The party accused was also disqualified from insisting on his wager of battle, where he had been detected in the very act of committing the offence, or under circumstances which precluded all question of his guilt. Indeed (if early authorities are to be trusted) it is far from clear that a criminal, apprehended *in flagranti delicto*, did not undergo the penalties of the law forthwith, without the formality of any trial at all. (See Palgrave's 'English Commonwealth,' vol. i. p. 210.) The law on this latter point formed the subject of an interesting discussion in the Court of King's Bench in the year 1818, in the case of *Ashford* v. *Thornton*, reported 1 Barn. & Ald. 405. Upon that occasion the defendant had been acquitted upon a prior indictment for the murder of a female, whom he was supposed to have previously violated. The acquittal of the accused upon evidence which appeared to many sufficient to establish his guilt occasioned great dissatisfaction, and the brother and next heir of the deceased was accordingly advised to bring the matter again under the consideration of a jury by the disused process of an appeal. The defendant waged his battle in the manner above described, and the appellant replied circumstances of such strong and pregnant suspicion as (it was contended) precluded the defendant from asserting his innocence by battle. It was, however, decided by the court that an appeal, being in its origin and nature a hostile challenge, gave to the appellee a right to insist upon fighting, and that the appellant could not deprive him of that right by a mere allegation of suspicious circumstances. The case would have proceeded in due course, if the legal antiquaries had not been disappointed of the rare spectacle of a judicial duel by the voluntary abandonment of the prosecution. In the following year an Act (59 Geo. III. ch. 46) was passed to abolish all criminal appeals and trial by battle in all cases both civil and criminal. ('Blackst. Comm.,' Mr. Kerr's ed., vol. iv. p. 376.)

The cases in which, by the ancient law, appeals were permitted, were treason, capital felony, mayhem, and larceny. Indeed, the earliest records of our law contain proofs that appeals were a common mode of proceeding in many ordinary breaches of the peace, which at this day are the subject of an action of trespass. The wife could prosecute an appeal for the murder of her husband; the heir male general for the murder of his ancestor; and in any case the prosecutor might lawfully compromise the suit by accepting a pecuniary satisfaction from the accused. Hence it was that the proceeding was in fact frequently resorted to for the purpose of obtaining such compensation, rather than for the ostensible object of ensuring the execution of justice on the offender. (See further, Hawkins's 'Pleas of the Crown,' book ii. chaps. 23 and 45; Kendal's 'Argument for Construing largely,' &c.; *Bigby* v. *Kennedy*, Sir Will. Blackstone's 'Reports,' p. 714; and the ingenious speculations of Sir F. Palgrave on the origin of trial by battle, in his work on the Commonwealth of England.)

Besides the appeal by innocent or injured parties, a similar proceeding was in certain cases instituted at the suit of an accomplice. The circumstances under which this might be done will be found under the article APPROVER.

APPEAL. The removal of a cause from an inferior court or judge to a superior one, for the purpose of examining the validity of the judgment given by such inferior court or judge, is called an appeal.

An appeal from the decision of a court of common law is usually prosecuted by *bringing error*, as it is termed, by means of which the judgment of the court below undergoes discussion, and is either affirmed or reversed in the court of error. [ERROR.]

The term appeal, used in the above sense, is by the law of England applied in strictness chiefly to certain proceedings in Parliament, in the privy council, in the courts of equity, in the Admiralty and ecclesiastical courts, and in the court of quarter sessions.

Thus, an appeal lies to the House of Lords from the decree of the Court of Chancery in this country, and in Ireland; and from the decision of the court of session in Scotland.

An appeal lies to the queen in council from the decrees and decisions of the colonial courts, and indeed from all judicatures within the dominions of the crown, except Great Britain and Ireland. [JUDICIAL COMMITTEE.] To the same jurisdiction are referred (in the last resort) all ecclesiastical and admiralty causes, and all matters of lunacy and idiotcy.

A decision of the Master of the Rolls or any of the Vice-Chancellors may be reversed or altered by the Lord Chancellor, or by the Lords Justices of the Court of Appeal in Chancery, upon a proceeding in the nature of an appeal.

An appeal lies directly from the vice-admiralty courts of the colonies, and from other inferior admiralty courts, as well as from the High Court of Admiralty, to the queen in council.

In the ecclesiastical courts, a series of appeals is provided from the Archdeacon's Court to that of the bishop, and from the bishop to the archbishop. From the archbishop the appeal lay to the pope until the reign of Henry VIII., when the supremacy being transferred to the crown, the appeal was thenceforth to certain delegates named by the sovereign. The court of delegates, appointed for each cause, to whom the sovereign *delegated* his authority, was the ordinary appellate tribunal, until the transference of their jurisdiction to the crown in council, by the statute 2 & 3 Will. IV. c. 92.

Such are the principal heads of appeal, to which we may add the appellate jurisdiction of the justices of the peace assembled at the quarter sessions, to whom various statutes have given authority to hear, upon appeal, the complaints of persons alleging themselves to be aggrieved by the orders or acts of individual magistrates.

In some cases an appeal in lieu of error is allowed from the superior courts of common law to the Exchequer Chamber, and thence to the House of Lords.

APPEARANCE. [PLEADING.]

APPLE. This fruit, which, from its hardiness and great abundance, combined with its excellent flavour, is one of the most important productions of cold climates, is, in its wild state, the austere crab-apple of the hedges. At what period it first began to acquire from cultivation the sweetness and other qualities which are peculiar to it in its domesticated state, or by what accident the tendency to amelioration was first given it, we have no means of ascertaining. All that we know is, that the apple is spoken of by Homer as being one of the fruit trees cultivated in the gardens of Alcinous and of Laertes, that it was a favourite fruit of the Romans, who had many varieties, and that it has never ceased to be an object of great interest with all northern nations.

It is a most inexplicable circumstance, that while some kinds of plants will produce a great multitude of varieties when raised from seed, and are susceptible of an almost unlimited degree of improvement, there are others of very nearly a similar nature which seem almost incapable of varying at all: and yet there are so many instances of it that the fact will not admit of doubt. Among these instances are the apple and the hawthorn: millions of millions of the latter have been raised in this country alone, and yet our gardens do not contain above half-a-dozen well-marked varieties; of the apple, on the contrary, which is, botanically, closely allied to the hawthorn, the varieties are innumerable; in the last edition of the 'Catalogue of the Garden of the Horticultural Society,' 1,400 are described; and it is probable that this is not more than half the number really known.

In the beginning, varieties, it may be supposed, were produced accidentally, owing to the peculiar tendency to change that this species of fruit possesses. A few varieties once obtained and placed in a garden, their blossoms would be certain to fertilise each other mutually, giving and taking the peculiar properties of one another: if the seeds of these were again sown, a greater degree of variation would arise; and this being repeated from generation to generation, the progeny would soon begin to differ so much from the original parents as scarcely to be recognisable. Until within comparatively a few years, varieties were procured in no other way than in this, and by constantly destroying inferior kinds as better were obtained; but since the discovery of the effect produced by fertilising one variety with another, a very rapid advance has taken place towards bringing the apple to its highest state of perfection, and the cultivator has no longer to trust to mere chance for the results of his experiments.

In procuring improved varieties of the apple, no other mode which leads to certain results has been discovered, than this of cross-fertilisation: but, at the same time, it is believed that the following circumstances ought to be kept in view: 1st, the seed from which the new variety is to be obtained should be fully formed, and 2nd, it should be taken from as perfect a specimen as it may be practicable to procure; for it has been found by experience, that any debility or defect in the parent is, in fruit trees, very apt to be communicated to their offspring. No person has been more successful in experiments of this kind than Mr. Knight, the President of the Horticultural Society, who thus describes his method of proceeding. "Many varieties of the apple were collected, which had been proved to afford, in mixture with each other, the finest ciders; a tree of each was then obtained by grafting upon a paradise stock, and these trees were trained to a south wall, or if grafted on a Siberian crab, to a west wall, till they afforded blossoms, and the soil in which they were planted was made of the most rich and favourable kind. Each blossom of this species of fruit contains about twenty chives, or males, and generally five pointals or females, which spring from the centre of the cup or cavity of the blossom. The males stand in a circle just within the bases of the petals, or flower leaves, and are formed of slender threads, each of which terminates in a small yellow ball or anther. It is necessary, in these experiments, that both the fruit and seed should attain as large a size, and as much perfection, as possible; and, therefore, a few blossoms only were suffered to remain upon each tree from which it was intended to obtain seeds. As soon as the blossoms were nearly full grown, every male in each was carefully extracted, proper care being taken not to injure the pointals or females: and the blossoms, thus prepared, were closed again, and suffered to remain till they opened spontaneously. The blossoms of the tree which it was proposed to make the male parent of the future variety were accelerated by being brought into contact with the wall, or retarded by being detached from it, so that those were made to unfold at the required period; and a portion of their pollen or farina, when ready to fall from the mature anthers, was, during three or four successive mornings, deposited upon the pointals of the blossoms, which consequently afforded seeds. It is necessary in this experiment that one variety of apple only should bear unmutilated blossoms; for where other varieties are in flower at the same time, the pollen of these will often be conveyed by bees to the prepared blossoms, and the result of the experiment will in consequence be uncertain and unsatisfactory."

"Every seed, though many be taken from a single apple, will afford a new and distinct variety, which will generally be found to bear some resemblance to each of its parents. Examples of this are presented in the Grange apple and Downton pippin, and in the Foxley apple and Siberian Harvey."

Of all the apples cultivated by our ancestors, a very small number only is known to the present generation. This may have been owing to their having gradually given way to better kinds; but, in the opinion of Mr. Knight, it is rather to be ascribed to an expenditure of their vital principle. This distinguished physiologist is of opinion, that no varieties of fruit trees are capable of remaining in perfection beyond a limited number of years: he thinks that after that period they suffer from the debility attendant upon old age, and that, although their existence may be protracted by means of grafting or budding them upon healthy stocks, yet that in the end they will entirely disappear. This opinion is founded upon the well-known fact, that the oldest varieties of the apple are now the most diseased, especially the celebrated golden pippin, which was formerly the common hardy cider-apple of the Herefordshire orchards, but which is now only preserved with difficulty in gardens. But it must be remembered, that however plausible this theory may be, it is open to several objections, among which more especially are the following: it is not impossible that the varieties alluded to by Mr. Knight were originally less hardy than those now cultivated, and that their constitutions were not adapted to the cold summers which generally prevail at the present epoch in England,—a supposition which is rendered the more probable by the circumstance, that the golden pippin still flourishes in all its pristine vigour in the island of Madeira. It may also be conjectured that neglect was a great cause of the disappearance of the golden pippin, and other kinds, from the cider orchards; for if, as is so often the case, the trees were once allowed to fall into a state of decay, then every scion taken from such trees for the purpose of propagation would carry its own debility along with it; and thus a disease, acquired in the first instance by neglect, would be perpetuated according to the well-known laws of vegetable physiology. (See Lindley's 'Outline of the First Principles of Horticulture,' p. 24, &c.)

It is not our intention in this place to enter into any detailed account of the varieties of the apple, for which we must refer our readers to works treating exclusively on such subjects, especially to the 'Guide to the Orchard and Kitchen Garden;' we shall rather confine ourselves to topics of general interest, such as the selection of varieties for small gardens or orchards, the modes of pruning and planting the trees, keeping the fruit when gathered, and propagation.

England is celebrated for the excellence of its cider; a beverage which perhaps acquires its highest degree of excellence in Herefordshire, and the neighbouring counties. In those districts, it has been found that the best varieties are the *foxwhelp*, a worn-out sort, much used for mixing with other kinds, to which it communicates strength and flavour; the *red must;* the *hagloe crab*, which, however, is only good in a dry soil, on a basis of calcareous stone, in a warm situation and season; the *grange apple;* the *orange pippin;* the *forest styre*, which is supposed to produce a stronger cyder than any other, but is not a good bearer; the *yellow Elliot;* the *Bennett;* the *Siberian Harvey; Stead's kernel;* the *friar*, which is very hardy; and above all, the *golden Harvey*, or *brandy apple*. The specific gravity of the juice of these varieties has been stated by Mr. Knight to be as follows:—

Foxwhelp	1076-1080	Yellow Elliot	1076
Red must	1064	Bennett	1073
Hagloe crab	1081	Siberian Harvey	1091
Grange	1079	Stead's kernel	1074
Orange pippin	1074	Friar	1073
Forest styre	1076-1081	Golden Harvey	1085

Besides these, the *coccagee* and the *Siberian bitter-sweet* are in much estimation.

For the kitchen, the apple is certainly, of all fruits, the most useful; and perhaps it is here that its utility to man is most conspicuous, because it proves, when cooked, a nutritious and wholesome food. In every district there is an abundance of local varieties, which are considered by their cultivators as of peculiar excellence. But for those who are anxious to possess the kinds which have been determined by comparison to be the best of all, we should recommend the following: for summer use, the *Keswick codlin* and the *Hawthornden;* for autumn, the *Wormsley pippin* and the *Alfriston;* for winter and spring, the *Bedfordshire foundling, Dumelow's seedling, Dr. Harvey, Brabant Bellefleur*, and *Gravenstein;* and for drying, the *Norfolk Beaufin*. Of all these, the Gravenstein, Alfriston, and Brabant Bellefleur are the best.

Of table apples, the varieties are endless; but by far the greater part of the local sorts, and of those commonly cultivated, is of only second-rate quality. The finest variety of all is the *Cornish gilliflower;* no other equals this in excellence, but it is unfortunately a bad bearer. Of those which combine productiveness and healthiness with the highest quality, the six following must be considered the best: *golden Harvey, old nonpareil, Hubbard's pearmain, Ribston pippin, Dutch mignonne, Court of Wick*. Finally, the best selection that could be made for a small garden, so as to obtain a constant succession of fruit from the earliest to the latest season, would be the following, which are enumerated in their order of ripening, the first being fit for use in June, and the last keeping till the end of April.

White Juneating.	Fearn's pippin.
Early Red Margaret.	Court of Wick.
White Astrachan.	Golden Harvey.
Sugar-loaf pippin.	Golden pippin.
Borovitsky.	Beachamwell.
Oslin.	Adam's pearmain.
Summer golden pippin.	Pennington's seedling.
Summer Thorle.	Hughes's golden pippin.
Duchess of Oldenburgh.	Cornish gilliflower.
Wormsley pippin.	Dutch mignonne.
Kerry pippin.	Reinette du Canada.
Yellow Ingestrie.	Skye-house russet.
Gravenstein.	Braddick's nonpareil.
Autumn pearmain.	Old nonpareil.
Golden reinette.	Court-pendu plat.
King of the pippins.	Lamb-Abbey pearmain.
Ribston pippin.	Newtown pippin.

In *pruning* the apple-tree, as indeed in all similar cases, three objects are chiefly kept in view; the first of which is to remove superfluous, or excessively vigorous shoots; the second is to admit light and air to all parts equally; and the third is to check exuberance, and thus to promote fruitfulness. The mode of proceeding in the two first cases is so obvious as not to require explanation; for the third, a few simple rules will suffice. As the apple is a tree of very hardy habits, if its branches are allowed to go unpruned, they will not produce any considerable number of lateral shoots, but will have a great tendency to keep lengthening from their terminal buds, which always produce barren and vigorous shoots; it is the lateral shoots only that are fertile, and they are so only when stunted, or in the state of what are technically called *spurs*. The mode of procedure is then obviously to destroy the terminal barren shoots, and to encourage the lateral fertile ones. This is effected by shortening back all the leading shoots every year, to a distance from their point of origin, which varies according to their strength: where they are very strong, the leading shoots should not be reduced more than within twelve or fifteen inches of their base, but when they are weaker, they may be cut to within nine inches. By this means the onward growth of the branch is momentarily arrested; the ascending sap is impelled into the lateral buds, which are thus developed, and form branches, some of which will be sure to grow so slowly as to become productive; for notwithstanding the check the branch may receive from the amputation, it will after a little while again lengthen by means of the bud nearest its extremity, and this latter will then grow so fast as effectually to hinder the new lateral shoots from acquiring much vigour. Of the lateral shoots then obtained, some will be required to form new branches, others will be preserved for fruiting, and others will at once become fruit spurs; the first will be treated as those from which they sprang, the second are to be cut down to within an inch of the bottom, which will generally cause the surrounding eyes to form fruit spurs; the third will be left until they have borne fruit, when they are cut out so as to leave only a single bud behind. In all cases, the fruit spurs, which, like the leading branches, have a tendency to lengthen, should have that tendency stopped by being cut back to the length of about three inches.

Apple-trees are *trained* in the form either of *standards, dwarfs, espaliers*, or *balloons*.

No particular care is requisite in the management of *standards* beyond providing them with a straight stem six feet high, and a head consisting of three or four healthy shoots to commence with; and afterwards keeping the branches so pruned that they do not chafe against each other in windy weather, nor overshadow each other; all the rest is generally provided for sufficiently by nature herself. They are principally employed in planting orchards, being now seldom admitted into good gardens. As these orchards are of inestimable value to the farmer and the peasant, the best mode of planting them cannot be too generally understood: we therefore select, from many others, the following method recommended by Mr. Knight. "Let a soil of good quality be selected for a nursery, which should be trenched eighteen inches deep, and planted with seedling crab stocks of one year old, each plant being placed at the distance of six feet from the others. These will be fit for grafting at two years old; and an acre of ground, thus planted, will contain about 1500 trees, and, consequently, enough to plant about forty acres, where each tree stands at twelve yards distance from others. A nursery thus planted, when the trees are seven or eight years old from the seed, will form a more productive orchard than can be obtained by any other means with which I am acquainted; and during the earlier periods of the growth of the trees, they will be rather benefited than injured if the ground be planted with potatoes, or other low-growing crops, with proper manure. During the growth of the trees in the nursery, they should not be pruned to single stems, without leaves, as is usually done in nurseries, but each should retain many small lateral branches, which will tend to make the young trees grow strong and taper in their stems, and will afford much fruit whilst the trees are very young. I would recommend the Downton pippin for an experiment of this kind, in preference to any other variety.

"At the end of eight or nine years from the time when the trees are first planted, they will have covered with their branches the whole surface of the ground, and will then begin to injure each other, if the whole be suffered to remain. At this period, therefore, every other row of trees, and at no distant subsequent period, every other tree in the remaining rows, must be taken away; and if this be done with proper care, and leaving the roots at least two feet long upon each side of the trunks, such trees may be removed with still less risk than such as are much smaller. But to insure success, it will be necessary to take off much the greater part of the lateral branches; and the holes in which the trees are to be planted must be made not less than six feet wide, and eighteen inches deep, placing the turf, if the field be pasture, in the bottom, and taking care that the trees be not planted deeper in the soil than they previously grew. Each tree will require, during the first year, a stake and a few bushes to protect it; after which, nothing more will be wanting than to wash its trunk annually with lime and water, and cow dung, to defend it from the teeth of sheep and cattle."

For garden purposes, *dwarf* apple trees are so far superior to all others, that they are now almost exclusively planted. Independently of the little space they occupy, the small degree in which they overshadow the soil, and the great facility they offer for gathering their fruit, they are generally so much beyond the influence of high winds as to have but little of their crop blown down by autumnal gales, and their fruit is also finer than on standards. No directions for their management can be given better than the following excellent observations of the author of the 'Guide to the Orchard and Fruit Garden.'

"Trees for this purpose should have their branches of an equal strength: those which have been grafted one year, or what are termed by nurserymen Maiden plants, are the best; they should not be cut down when planted, but should stand a year, and then be headed down to the length of four or six inches, according to their strength; these will produce three or four shoots from each cut-down branch, which will be sufficient to form a head. At the end of the second year, two or three of the best placed of these from each branch should be selected, and shortened back to nine, twelve, or fifteen inches each, according to their strength, taking care to keep the head perfectly balanced (if the expression may be allowed), so that one side shall not be higher nor more numerous in its branches than the other; and all must be kept, as near as may be, at an equal distance from each other. If this regularity in forming the head be attended to and effected at first, there will be no difficulty in keeping it so afterwards, by observing either to prune to that bud immediately on the inside, next to the centre of the tree, or that immediately on the outside. By this means, viewing it from the centre, the branches will be produced in a perpendicular line from the eye; whereas, if pruned to a bud on the right or left side of the branch, the young shoot will be produced in the same direction; so that if the branches formed round a circle be not thus pruned to the eyes, on the right successively, or the left successively, a very material difference will be found, and the regularity of the tree will be destroyed in one single year's pruning; which may be readily illustrated thus:—fix four branches, either in a direct line or to a circular hoop, at the distance of eight inches from each other; let the branch on the left be called *a*, the second *b*, the third *c*, the fourth *d*; head down *a* to the left-hand bud; *b* to the right, *c* to the left, and *d* to the right. When these have grown a year, those between *a* and *b*, and between *c* and *d*, will be ten inches: thus the distances now are not as eight to eight, but as six to ten; which would require two years pruning in a contrary direction to restore the head to its former regularity; and it must not be forgotten that this system of pruning will hold good in every other case.

"What has just been said has reference only to the leading shoots, which are always produced from the terminal buds when pruned, and which alone form the figure and beauty of the tree. The intermediate space must of course be provided for at the same time, having a regard to the number of branches thus employed, that they do not crowd each other. On the contrary, they must be kept thin, and perfectly open, so as to admit plenty of sun and air, without which the fruit produced will be small and good for but little: the middle of the tree, indeed, must be kept quite open from the first to the last, taking care that all the surrounding branches lead outwards, and preserve a regular distance from each other.

"*Espalier* apple-trees were formerly much used, but they are in all respects so greatly inferior to dwarfs, and so much more expensive to keep in good order, that we omit all further notice of them.

"A mode of managing apple-trees called *Balloon* training has been much recommended. It consists simply in this: you plant a common standard tree, with a stem six or seven feet high, and with five or six good equal-sized branches; to the tip of each branch is to be attached a cord which passes under a peg driven into the ground near the stem, and by means of which the branches may be gradually drawn downwards so as to become inverted, when, from the breadth of the part of the tree whence the branches diverge, and the approximation of their points, the whole assumes the appearance of a balloon. All the care that these trees require is, to have their branches kept at equal distances by means of a hoop, or some such contrivance, until they are strong enough to preserve their acquired direction, and to have all the shoots which will every year spring upwards from them carefully cut away, except such as can be brought down so as to fill up the spaces in the circumference of the balloon head. Trees thus managed produce an abundance of spurs, and when loaded with fruit are beautiful objects; like dwarfs, they occupy but little room, and their crop is not liable to be blown down; but they have this very great disadvantage, that all their buds are exposed to the sky in the spring, when they flower; consequently they are liable to suffer very much from the effect of spring frosts; so that they will scarcely ever bear, except in very favourable seasons, or in very mild and sheltered places. It is, in fact, only into gardens sloping to the south or south-west, and on the sides of valleys, that balloon apple-trees should be admitted.

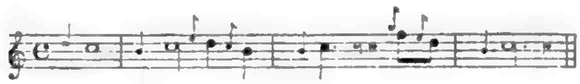
"Many different methods of *preserving* apples have been recommended, and almost every one has some favourite plan of his own. As far as our own experience goes, the best mode is to allow the fruits, after being gathered, to lie till their superfluous moisture has evaporated, which is what is technically called *sweating*; the apples should then be wiped quite dry, wrapped in tissue paper, and stowed away in jars or chests of pure silver sand which has been previously dried in an oven. They should always be taken out of the sand a few days before they are wanted, and laid in dry fern or some such substance; they then absorb oxygen, and acquire a little sweetness, which is necessary to their perfection."

The apple is *propagated* by either budding or grafting; the former practice is preferable for standards, the latter for dwarfs. The stocks that are employed are the wild crab, the doucin or English paradise, and the French paradise apple. The former should be used for standards only, as it imparts too much vigour to the scions to render them manageable as dwarfs; the French paradise should always be employed for the latter, as it has the property of stunting the shoots, and rendering them much more fertile. The doucin or English paradise stock, which is what the English nurserymen usually sell as *the* paradise stock, is intermediate in its effect between the crab and the French paradise, being less vigorous than the first and more so than the last. When there is no wish to confine the dwarf trees within a very narrow compass, this kind of stock, which is hardier than the French paradise, is the proper one to employ; but if the dwarfest trees that can be procured are the objects of the cultivator, then the latter only should be planted.

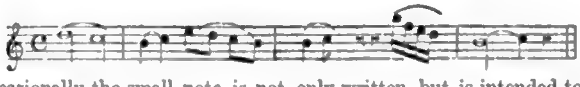
In conclusion, it is only necessary to add, that the proper season for planting the apple is in October or November, as soon as the leaves are dead or discoloured, and beginning to drop. Vegetation at that season is not altogether torpid, but goes on just enough to enable the plants to send out a few rootlets before winter, and to prepare themselves for taking advantage of the first period of growth in the succeeding spring—a period, the commencement of which is never exactly known by external indications.

APPOGIATURA (in Music), is a note of expression or embellishment, written in a smaller character than the essential notes of the melody. It is used for the purposes of emphasis, especially in recitative. The appogiatura takes its length or duration from the note it precedes, whence it usually abstracts half (except in the case of a dotted or pointed note, from which it takes two-thirds). In the following example, many varieties of the appogiatura are introduced:

As written.



As performed.



Occasionally the small note is not only written, but is intended to be performed, as a very short one. The appogiatura gives tenderness to the air, and is therefore not adapted to music of an energetic or majestic kind. In the hands of an accomplished performer, it is perhaps the most expressive and impassioned addition entrusted to his discretion; but, like other niceties, it fails in inferior hands.

APPORTIONMENT. Apportionment of rent, &c. is a term of law, signifying the dividing of a rent, annuity, or other payment recurring at fixed periods, and may be either among several persons entitled to the rent, or between the person entitled to the rent and the person or persons liable to the payment of it.

A rent issuing out of land may be apportioned in two ways; one by granting the reversion of part of the land out of which the rent issues, the other by granting part of the rent to one person and part to another. When rent is reserved upon a lease, and the lessor disposes of part of the lands in reversion, either by will or deed, the rent is apportionable, provided the lessee concur. But the lessee is not bound by any apportionment made without his consent. If the lessor or a stranger recovers any part of the land, or the lessor enters for a forfeiture upon part thereof, or the lessee surrenders a part to the lessor, the rent will be apportioned in respect to the part so recovered or surrendered and the part remaining in the hands of the lessee.

When a lessee aliens a part of the land comprised in his lease, the alienee is liable in an action of covenant for a proportional part of the rent reserved on the lease, the covenant for payment of rent being one which runs with the land; and therefore as respects him there is an apportionment of the rent. The alienation of a part of the lands does not however, any more than an assignment of the whole, discharge the original lessee from his liability upon his express personal covenant for payment of the whole rent. The right of distress for the whole rent upon every part of the land of course remains unaffected by the assignment, unless, as is sometimes done in the case of building leases, the original grantor agrees to restrict his right of distress on the lands aliened to a proportionate part of the rent.

If a man having a rent-charge issuing out of lands purchases any part of them, the rent-charge is extinct as to the whole; but if part of the land out of which the rent issues descends upon the owner of the rent-charge, the rent will be apportioned. And this will also be the case upon a partition of the lands out of which the rent issues. If a grantee of a rent-charge release all his right in part of the land charged, he extinguishes the whole rent; but if a grantee of a rent-charge release part of the rent to the grantor, the residue will remain charged on the land, for here the grantee deals with the rent only, not with the land. On the principles here stated a difficulty arises on the sale of part of lands subject to a rent-charge. Where the party entitled to the rent is willing to release the land to be sold, the mode sometimes adopted is for the owner of the rent-charge to assign it to a trustee upon trust to receive it exclusively out of the lands intended to remain charged. Another mode is for the annuitant to join in the conveyance of the lands sold, and to add a proviso that the other lands shall continue liable. This plan, however, is open to the objection that as the proviso operates as a new grant, the rent-charge becomes liable to the incumbrances of the owner of the land created before the conveyance. A third mode, sometimes adopted, is that of the owner of the rent-charge covenanting not to distrain on the lands sold, but it seems doubtful whether such a covenant does not operate as a release of the rent-charge. If the owner of the rent-charge will not concur, the only plan seems to be for the vendor to covenant with the purchaser that the lands not sold shall be exclusively liable, and give an indemnity by demise or otherwise against the rent-charge. It seems that the technical rule of law which is productive of so much inconvenience ought to be altered.

By the common law, if a lessor tenant for life died within the half-year at the end of which rent was due upon a lease not made in execution of a power, and which therefore determined on the death of the tenant for life, the half year's rent could not be apportioned, and was therefore lost both to the representatives of the lessor and to the remainder-man or reversioner, upon whom the lease was not binding.

To remedy this evil it was provided by the stat. 11 Geo. II. c. 19, § 15, that where a lessor tenant for life died before the rent-day, his executors might recover from the tenant a proportionate part of the rent then growing due, making all just allowances. But as this statute was construed to apply only to persons strictly tenants for life, and had no application to the case of a lease made by a tenant in fee or by a tenant in tail under a power, if in either of these cases the lessor died in the interval between two periods of the rent being due, the whole rent went, according to the rule of the common law, to the heir or remainder-man, and there could be no apportionment in favour of the executor. The law has now been altered by the stat. 4 & 5 Wm. IV. c. 22, the object of which is to apply the principle of equitable apportionment to all property which consists in periodical and fixed money payments.

By the first section it is declared that rents reserved on leases determining on the death of the person making them (though not strictly tenant for life), or on the death of the tenant *pur autre vie*, shall be considered as within the provisions of the above-mentioned stat. 11 Geo. II. c. 19, § 15.

By the 2nd section it is enacted that from the passing of the act all rents service reserved on any lease by a tenant in fee, or for any life interest, or by any lease granted under any power (and which leases shall have been granted after the passing of the act), and all rents-charge and other rents, annuities, pensions, dividends, moduses, compositions, and all other payments of every description in the United Kingdom of Great Britain and Ireland made payable or coming due at fixed periods under any instrument that shall be executed after the passing of the act (or being a will or testamentary instrument) that shall come into operation after the passing of the act, shall be apportioned so and in such manner that on the death of any person interested in any such rents, annuities, pensions, dividends, moduses, compositions, or other payments, as aforesaid, or in the estate, fund, office, or benefice from or in respect of which the same shall be issuing or derived, or on the determination by any other means whatsoever of the interest of any such person, he or she, and his or her executors, administrators, or assigns, shall be entitled to a proportion of such rents, annuities, pensions, dividends, moduses, compositions, and other payments, according to the time which shall have elapsed from the commencement or last period of payment thereof respectively (as the case may be), including the day of the death of such person or of the determination of his or her interest, all just allowances and deductions in respect of charges on such rents, annuities, pensions, dividends, moduses, compositions, and other payments being made; and that every such person, his or her executors, administrators, or assigns, should have such and the same remedies at law and in equity for recovering such apportioned parts of the said rents, annuities, pensions, dividends, moduses, compositions, and other payments, when the entire portions of which such apportioned parts shall form part shall become due and payable, and not before, as he, she, or they would have had for recovering and obtaining such entire rents, annuities, pensions, dividends, moduses, compositions, and other payments if entitled thereto, but so that persons liable to pay rents reserved by any lease or demise, and the lands, tenements, and hereditaments comprised therein shall not be resorted to for such apportioned parts specifically as aforesaid, but the entire rents of which such portions shall form a part shall be received and recovered by the person or persons who, if the act had not passed, would have been entitled to such entire rents; and such portions shall be recoverable from such person or persons by the parties entitled to the same under the act in any action or suit at law or in equity. It seems doubtful whether the above enactment will apply to the case of an annuity payable at certain periods and determinable at the death of the grantor, because if the annuity cease by the death of the grantor on any day before that of payment, the 'entire portion' can never become payable. It is advisable therefore to retain the usual apportionment clause in the grants of such annuities.

The 3rd and last section provides that the act is not to apply to cases in which it shall be expressly stipulated that no apportionment shall take place, nor to annual sums made payable on policies of assurance of any description.

Rights of common are apportionable in certain cases. Common of pasture where it is appendant may be apportioned either where the commoner purchases a part of the land in which he has the right of common, or upon an alienation of part of the land to which the right is appendant. In the case of common of pasture appurtenant, there will be apportionment in the second case, but not in the first. Common of estovers or piscary cannot be apportioned, neither can the rights of horsebote, haybote, &c. be appendant to the freehold.

Conditions in general cannot be apportioned by the act of the parties, though they may where a division of the estate is caused by the act of law or by the act and wrong of a lessee upon condition.

(Upon the subject of Apportionment see Cruise, *Dig.* vol ii. 36, vol. iii. 72, 302 *et seq.*)

APPRAISEMENT, from *apprécier*, *appriser*, or *appraiser*, "to set a price upon an article." When goods have been taken under a distress for rent, it is necessary, in order to enable the landlord to sell them according to the provisions of the statute 2 William and Mary, sess. i. c. 5, that they should be previously appraised or valued by two appraisers. These appraisers are sworn by the sheriff, under-sheriff, or constable, to appraise the goods truly according to the best of their understanding. After such an appraisement has been made, the landlord may proceed to sell the goods for the best price that can be procured. By the statute 48 Geo. III. c. 140, an *ad valorem* stamp duty is imposed upon appraisements.

APPRAISERS are persons employed to value property. By the statute 46 Geo. III. c. 43, it was first required that any person exercising the calling of an appraiser should annually take out a license to act as such, stating his name and place of abode, and signed by two commissioners of stamps. By the same statute a stamp duty of 6*s.* was imposed upon such licenses; and unlicensed persons were forbidden to act as appraisers under a penalty of 50*l.* The same duty was continued by the General Stamp Act, 48 Geo. III. c. 149, but by the 8 & 9 Vict. c. 76, the duty was raised to 2*l.*

APPRENTICE, from *apprendre*, to learn, signifies a person bound by indenture to serve a master for a certain term, receiving, in return for his services, instruction in his master's profession, art, or occupation. In addition to this, the master is usually bound to provide the necessary food and clothing for the apprentice, and sometimes to pay him small wages, but most commonly the master receives a premium. Formerly the word was used to denote those students of the common law in the societies of the inns of court who—not having completed their professional education by ten years' study in those societies, at which time they were qualified to leave their inns and to execute the full office of an advocate, upon being called by writ to take upon them the degree of serjeant-at-law—were yet of sufficient standing to be allowed to practise in all courts of law except the court of Common Pleas. This denomination of apprentice (in law Latin, *apprenticii ad legem nobiliores, apprenticii ad barras*, or simply *apprenticii ad legem*) appears to have continued until the close of the 16th century, after which this term fell into disuse, and we find the same class of advocates designated, from their pleading without the bar, as *outer* barristers, now shortened into the well-known term, barristers. (See Spelman's 'Gloss. ad verbum;' Blackstone's 'Commentaries,' vol. i. 23; vol. iii. 27.)

Apprenticeship appears to have been unknown to the ancients; and although it has been stated that in Rome the distribution of the citizens into companies or colleges according to their trades took place at an early period, we can discern in the Roman history no distinct traces of such a system as apprenticeship. Its origin is to be sought in the institutions of modern Europe, and it probably sprung up in conjunction with the system of associating handicraft trades in the 12th century, the natural result, perhaps, of those more general combinations of citizens or of burgesses, which were formed for the purposes of mutual protection against feudal oppression. The restraint of free competition, the assertion of peculiar privileges, and the limitation of the numbers of such as should participate in them, were the main results to which these institutions tended: and for these purposes a more obvious or effective instrument than apprenticeship could hardly be found. To exercise a trade, it was necessary to be free of the company or fraternity of that trade; and as the principal if not the only mode of acquiring this freedom in early times was by serving an apprenticeship to a member of the body, it became easy to limit the numbers admitted to this privilege, either indirectly by the length of apprenticeship required, or more immediately by limiting the number of apprentices to be taken by each master. So strict in some instances were these regulations, that no master was allowed to take as an apprentice any but his own son. In agriculture, apprenticeship, though in some comparatively later instances encouraged by positive laws, has never prevailed to any great extent, which is probably to be attributed to its origin as a part of the system of associated trades. The tendency to association, indeed, is not strong among the agricultural population, combination being, to the scattered inhabitants of the country, inconvenient and often impracticable; whereas the inhabitants of towns are, by their very position, invited to it.

Subsequently to the twelfth century, apprenticeship has prevailed in almost every part of Europe. In France, Germany, Italy, and Spain, it may be distinctly traced, and it probably existed in various other countries. It is asserted by Adam Smith, that seven years seems anciently to have been all over Europe the usual term established for the duration of apprenticeships in most trades. There seems, however, to have been no settled rule on this subject, for there is abundant evidence to show that the custom in this respect varied not only in different countries, but in different incorporated trades in the same town.

In Italy, the Latin term for the contract of apprenticeship was *acconventatio*. From an old form of an Italian instrument, given by Beier in his learned work, 'De Collegiis Opificum,' it appears that the contract, which in most respects closely resembled English indentures of apprenticeship, was signed by the father or other friend of the boy who was to be bound, and not by the boy himself, the latter testifying his consent to the agreement merely by being present.

In France, the trading associations prevailed to a great extent, under the names of "Corps de Marchands" and "Communautés." At the latter end of the 17th century, there were in Paris six "Corps de Marchands," and one hundred and twenty-nine "Communautés," or companies of tradesmen, each fraternity having their own rules and laws. Among these bodies the duration of apprenticeship varied from three to eight or ten years. It was an invariable rule in the "Corps de Marchands," which was generally followed in the "Communautés," that no master should have more than one apprentice at a time. There was also a regulation that no one could exercise his trade as a master until, in addition to his apprenticeship, he had served a certain number of years as a journeyman. During the latter term he was called the "compagnon" of his master, and the term itself was called his "compagnonage." He had also, before being admitted to practise his trade as master, to deliver to the "jurande," or wardens of the company, a specimen of his proficiency in his art, called his "chef-d'œuvre." He was then said "aspirer à la maîtrise." The sons of merchants living in their father's house till seventeen years of age, and following his trade, were reputed to have served their apprenticeship, and became entitled to the privileges incidental to it without being actually bound. These companies or associations were finally abolished at the revolution, when a perfect freedom of industry was recognised by the laws, and this, with a few exceptions, has continued to the present day. But though the contract of apprenticeship has ceased in France to be imperative upon the artisan, it has not fallen into disuse; and an Act passed the 12th of April, 1803, prescribes the rights and duties both of master and apprentice. It does not, however, lay down any particular form, and leaves the time and other conditions of the contract to be determined by the parties.

In Germany, though we find the same institution, it varies not only in the name, but has some other remarkable peculiarities. The companies there called *gilden*, *zünfte*, or *innungen*, appear to have exercised in many respects a sort of judicial control over their members, and, either on account of moral or physical defects, to have refused admission to applicants for freedom at the discretion of the elders or masters. They seem to have occasionally admitted workmen who had not served a regular apprenticeship into the lower class of members of a trade; but to become masters was only allowed to those who had gone through the regular stages of instruction. The course which continues to the present day is as follows:—The apprentice, after having served the term prescribed by his indenture (*aufdings-brief*), is admitted into the company as a companion (*gesell*), which corresponds in many respects to the French *compagnon*. Having passed through the years of his apprenticeship, called *lehr-jahre*, satisfactorily, he becomes entitled to receive from the masters and companions of the guild a certificate, or general letter of recommendation (*kundschaft*), which testifies that he has duly served his apprenticeship, and has been admitted a member of the company, and commends him to the good offices of the societies of the same craft, wherever he may apply for them. With this certificate the young artisan sets out on his travels, which often occupy several years, called *wandel-jahre*, supporting himself by working as a journeyman in his particular art or trade in the various towns in which he temporarily establishes himself, and availing himself of his *kundschaft* to procure admission into the fellowship and privileges of his brother workmen of the same craft. On his return home, he is entitled, upon producing certificates of his good conduct during his *wandel-jahre*, to become a master. In Germany, the periods of servitude have varied in different states and at different periods; in general, the term is seven years; but in some instances an apprenticeship of five or three years is sufficient.

Neither in Ireland nor in Scotland have the laws relating to associated trades or apprentices been very rigorously enforced. In the former, the same system of guilds and companies certainly existed; but, as it was the policy of the English government to encourage settlers there, little attention was paid to their exclusive privileges; and in 1672 the Lord Lieutenant and Council, under authority of an Act of Parliament, issued a set of rules and regulations for all the walled towns in Ireland, by which any foreigner was allowed to become free of the guilds and fraternities of tradesmen on payment of a fine of 20*s*. A statute containing very similar enactments was passed in 19 Geo. III. The term of apprenticeship, also, in Ireland, was of a moderate length, five years being required by 2 Anne, c. 4, for the linen manufacture, which, by 10 Geo. I., c. 2, was reduced to four years. It is asserted by Adam Smith, that there is no country in Europe in which corporation laws are so little oppressive as in Scotland. Three years are there a common term of apprenticeship even in the nicer trades, but there is no general law on the subject, the custom being different in different communities.

It is, perhaps, impossible to ascertain precisely at what time apprenticeships first came into general use in England. But that the institution is one of very old date is certain, being probably contemporaneous with the formation of the guilds or companies of tradesmen. In the statutes of the realm, however, there is no reference to such an institution for about 200 years after the guilds are known to have existed, apprentices being first incidentally noticed in an act (12 Rich. II. c. 3) passed in 1388. But that about this time apprenticeship had become extremely common is proved by a statute passed in 1405-6 (7 Hen. IV. c. 17), which contains the singular enactment, that no one shall bind his son or daughter apprentice unless he have land or rent to the value of 20*s*. by the year; the cause of which provision is stated to be the scarcity of labourers in husbandry, in consequence of the custom of binding children apprentices to trades. In the act (8 Hen. VI. c. 11) which repealed this statute in favour of the city of London, the putting and taking of apprentices is stated to have been at that time a custom of London time out of mind. The same statute was repealed (by the 11th Hen. VII. c. 11) in favour of the citizens of Norwich, and (by the 12th Hen. VII. c. 1) in favour of the worsted-makers of Norfolk; and in the former act we find the first mention of any particular term of servitude, the custom of the worsted-sheerers of Norwich being confirmed by it, which required an apprenticeship of seven years. Except in London, it does not appear that at an early period there was in England any uniform practice in this respect, but that the duration of the apprenticeship was a matter for agreement between the parties to the contract. In Madox's 'Formulare Anglicanum,' there is an indenture of apprenticeship dated in the reign of Henry IV., which is nearly in the same form as the modern instrument; and in that case the binding is to a carpenter for six years. It is, however, probable that before the statute of the 5th Eliz. c. 4, the term of apprenticeship was seldom less than seven years. In London, the period of seven years at the least was expressly prescribed by the custom as the shortest term; and Sir Thomas Smith, in his 'Commonwealth of England,' written about the time of the passing of the statute of Elizabeth, says, in reference to the previous practice, that the apprentice "serveth, some for seven or eight years, some nine or ten years, as the master and the friends of the young man shall think meet, or can agree together."

The statute of the 5 and 6 Edw. VI. c. 8, which enacts that no person shall weave broad woollen cloth, unless he have served a seven years' apprenticeship, may be adduced as a further proof that this term was fast becoming the customary one, when, by the 5th Eliz. c. 4, it was made the law of the land, and one uniform practice in all trades introduced throughout England. But neither by that statute, nor by the customs of London and Norwich, which were excepted by the act, was a longer term of apprenticeship than seven years forbidden.

The London apprentices, in early times, were an important, and often a formidable body. They derived consequence from their numbers, the superior birth of many of them, and the wealth of their masters, but particularly from their union, and the spirit of freemasonry which prevailed among them. The author of a curious poem published in 1647, entitled 'The Honour of London Apprentices,' observes, in his preface, that "from all shires and counties of the kingdom of England and dominion of Wales, the sonns of knights, esquiers, gentlemen, ministers, yeomen, and tradesmen, come up from their particular places of nativity and are bound to be prentices in London." He also mentions "the unanimous correspondence that is amongst that innumerable company."

It may be readily supposed that such a body, in the midst of a large metropolis, densely crowded with population, and frequented by strangers of all kinds, was not a little obnoxious to the police; and accordingly, we find in the 16th and 17th centuries a constant succession of tumults, and some instances of serious and alarming insurrections arising among the apprentices. Thus the fatal riot in London against foreign artificers, which took place on the 1st of May, 1517, and from which that day was called 'Evil May Day,' was commenced and encouraged by the apprentices.

In the year 1595, certain apprentices in London were imprisoned by the Star-Chamber for a riot; upon which, several of their fellows assembled and released them by breaking open the prisons. Many of these were taken and publicly whipped by order of the Lord Mayor. This caused a much more formidable disturbance; for 200 or 300 apprentices assembled in Tower-street, and marched with a drum in a warlike manner to take possession of the person of the Lord Mayor, and, upon the principle of retaliation, to whip him through the streets. Several of the ring-leaders in this riot were tried and convicted of high treason. (See 'Criminal Trials,' vol. i. p. 317.)

In the troubles of the civil wars the apprentices of London took an active part as a political body; numerous petitions were presented from them to the parliament, and they received the thanks of the House "for their good affections." Nor did they confine their interference merely to petitions, but, under sanction of an ordinance of parliament promising to them security against forfeiture of their indentures, they were inrolled into a sort of militia. They also took part in the restoration, and in the reign of Charles II. they were frequently engaged in tumults. The last serious riot in which they were concerned took place in 1668. On this occasion they assembled themselves tumultously together during the holidays, and proceeded to pull down the disorderly houses in the city. For this exploit, several of them were tried and executed for high treason.

In 1681, when Charles II. was desirous of strengthening his hands in every way against the corporation of London, he thought it necessary to endeavour to secure the favour of the apprentices, and sent them a brace of bucks for their annual dinner at Sadler's Hall, where several of his principal courtiers dined with them. The apprentices, however, were divided in opinion; for there were numerous petitions from them both for and against the measures of the court.

Subsequently to this time their union appears to have been gradually dissolved, and we do not find them again acting together in a body. After they had ceased, however, to form a separate class, the laws which had called them into existence, though partially repealed as to some trades, continued generally in force; nor was it until a very late period that the progress of more liberal opinions finally put an end to them. But the exclusive spirit which had dictated them was so far modified by the spirit of English liberty, that the monopolies upheld by them were never so strictly enforced, nor the evil of them so much felt in this country as on the continent. For not only were the apprentice-laws condemned by the liberal and speculative philosopher, but they found no favour in the courts of law. They were frequently reprobated by judges and legal writers; and Lord Mansfield denounced them as being "against the natural rights of man, and contrary to the common law rights of the land." Acting upon this view of the impolicy of the system, the decisions of the courts tended rather to confine than to extend the influence of the statute of Elizabeth, and thus the operation of it was limited to market-towns, and to those trades which were actually in existence at the time it was passed. And although in consequence of this doctrine, many absurd anomalies and inconsistencies were introduced, yet the exclusion of some manufactures, and particularly of the principal ones of Manchester and Birmingham, from the operation of the act, had probably a favourable effect in causing it to be less strictly enforced even against those who were held to be liable to it. It was proved by a mass of extremely interesting evidence produced before a committee of the House of Commons in 1814, that the provisions of the statute of Elizabeth neither were, nor could be, carried into effect in our improved state of trade and manufactures. An alteration in the law could therefore be no longer delayed. And though the question was brought before the legislature on a petition praying that the 5th Eliz. c. 4, might be rendered more effectual, the result was the passing of an act (54 Geo. III. c. 96) by which that statute, so far as it enacts that no person shall exercise any trade without having served a seven years' apprenticeship to it, was wholly repealed. There is in the act of 54 Geo. III. c. 96, a reservation in favour of the customs and bye-laws of the city of London, and of other corporate towns, but in general the necessity of apprenticeship, as a means of access to particular trades, is abolished, and a perfect liberty, in this respect, is established. Moreover by the act to provide for the regulation of municipal corporations (5 & 6 Will. IV. c. 76, s. 14), any persons may use any trade in boroughs, although not free of the city or borough, or of the trading company.

Apprenticeship, though no longer absolutely necessary, still continues to be the usual mode of learning a trade, and as such is recognised by law; it may therefore be useful to mention, in a summary manner, some of the leading provisions of the law upon the subject. By the common law, an infant, or person under the age of twenty-one years, being unable to contract any obligation except for his own benefit, cannot bind himself apprentice so as to entitle his master to an action of covenant for departing his service, or other breaches of the indenture. The statute of 5 Eliz. c. 4, ss. 42, 43, enacts that every person bound by indenture according to the statute, although within the age of twenty-one, shall be bound as amply, to every intent, as if he were of full age. But by these words of the statute, the infant is not so bound as that a remedy lies against him upon any covenant of the indenture; and it has therefore been a common practice for a relation or friend to be joined as a contracting party in the indenture, and engaging for the faithful discharge of the agreement. But by the custom of London, an infant, unmarried and above the age of fourteen, may bind himself apprentice to a freeman of London, and it is said that, by force of the custom, the master may have such remedy against him as if he were of full age, and consequently an action of covenant. Any person under the age of twenty-one years is, by 5 Eliz. c. 4, ss. 35, 36, compellable to be bound apprentice, if so required by any householder using half a plough of land in tillage. The same act also provides that the binding must be by indenture, so that binding by deed-poll, or by an agreement to execute an indenture, on a parol binding, have been held not to constitute an apprenticeship, though, by statute 31 Geo. II. c. 11, a binding by deed not indented enabled a person to gain a settlement, and now no deed is required to be indented.

By statute of 43 Eliz. c. 2, confirmed by 8 & 9 Will. III. c. 30, and by subsequent acts, the churchwardens and overseers of a parish, with the assent of two justices of the peace, might bind children of paupers apprentices till the age of twenty-one, and not only persons in husbandry and trade, but gentlemen of fortune and clergymen might be compelled to take them, subject to appeal to the sessions; but by the 7 & 8 Vict. c. 101, the powers for compelling persons to take parish apprentices were repealed; and under the same statute, all bindings of parish apprentices are now made by guardians of the poor (instead of churchwardens and overseers), and they need not be allowed by justices, but are subject to the rules of the poor-law commissioners. Parish apprentices may also be bound (7 & 8 Vict. c. 112; 14 & 15 Vict. c. 96) to the sea service. Various regulations have been made by several acts of parliament, and in particular by 56 Geo. III. c. 139, for ensuring that parish apprentices shall be bound to proper masters, and securing them from ill-treatment. The statute (14 & 15 Vict. c. 11) provides for the apprentices being periodically visited by the parish officers. Special provisions also exist, regulating apprenticeship in mills and factories, and in mines and collieries, and also in respect of chimney-sweepers. A settlement is gained by apprentices in the parish where they last resided forty days during the service (13 & 14 Car. II. c. 12). [POOR LAW; SETTLEMENT.]

An indenture cannot be assigned over, either by common law or equity, but by custom it may. Thus, by the custom of London and other places it may be done by a "turn-over." Parish apprentices may also (32 Geo. III. c. 57, s. 7), with the consent of two justices, be assigned over by indorsement on the indentures.

An indenture is determinable by the consent of all the parties to it; also by the death of the master, apprenticeship being a personal trust between master and servant. But it is said that the executor may bind the apprentice to another master for the remainder of his term. And if there is any covenant for maintenance, the executor is bound to discharge this as far as he has assets. In the case of a parish apprentice (32 Geo. III. c. 57, s. 1), this obligation only lasts for three months, where the apprentice-fee is not more than 5*l.*, and the indenture is then at an end, unless upon application by the widow or executor, &c., of the master to two justices, the apprentice is ordered to serve such applicant for the remainder of the term. By the custom of London, if the master of an apprentice die, the service must be continued with the widow, if she continue to carry on the trade. In other cases, it is incumbent on the executor to put the apprentice to another master of the same trade. By the Bankrupt Act, 12 & 13 Vict. c. 106, the bankruptcy of a master is a complete discharge of an indenture of apprenticeship; and where an apprentice-fee has been paid to the bankrupt, the court is authorised to order any sum to be paid out of the estate for the use of the apprentice which it may think reasonable.

A master may by law moderately chastise his apprentice for misbehaviour. He cannot, of his own accord, discharge him. But if he have any complaint against him, or the apprentice against his master, on application of either party to the sessions, by 5 Eliz. c. 4, or to two justices in the case of a parish apprentice, by 20 Geo. II. c. 19, and other acts, a power is given to punish or to discharge the apprentice, and in some cases to fine the master. If any apprentice, whose premium does not exceed 10*l.*, run away from his master, he may be compelled (6 Geo. III. c. 25) to serve beyond his term for the time he absented himself, or make suitable satisfaction, or be imprisoned for three months. If he enters another person's service, his master is entitled to his earnings, and he may bring an action against any one who has enticed him away. On the other hand, by the statute, 14 & 15 Vict. c. 11, masters or mistresses of apprentices or servants are legally liable to provide them necessary food, clothing, &c.; refusing or neglecting to do so, or assaulting them so as to endanger life, or permanently injure health, they are guilty of misdemeanour, punishable by imprisonment not exceeding three years.

In London, moreover, in case of misconduct by the master towards the apprentice, or by the apprentice towards the master, either party may summon the other before the chamberlain, who has power to adjudicate between them, and, upon the disobedience or refractory conduct of either party, may commit the offender to Bridewell.

The main objections to apprenticeship are, its interference with the property which every man has, or ought to have, in his own labour, and its encroachment not only on the liberty of the workman, but also of those who might be disposed to employ him, and who may safely be allowed to judge whether he is fit to be employed or not. To require in the more common mechanical trades the same length of apprenticeship as in the nicer and more difficult arts, is manifestly unnecessary and inexpedient; and it is obvious that long apprenticeships have a tendency rather to repress than encourage a love of industry, as an apprentice is excluded from the greatest incentive to voluntary labour, namely, a participation in the fruits of his exertions or skill. Most of these objections apply to apprenticeship as a necessary rather than a voluntary contract, and are of course removed by the present state of the law. At the age at which apprentices are usually bound some subjection to restraint is desirable; and, whether by being bound as an apprentice, or by working as a journeyman, a workman is most likely to gain a complete knowledge of his trade, and to acquire habits of industry, may be left to the determination of those who are practically interested in the question.

APPROACHES. This term is applied to the covered roads which are made by a besieging army to protect them from the fire of the place attacked. They consist generally of trenches excavated in the ground, the earth being thrown towards the fortress to screen them from the defenders. Occasionally, as on rocky or marshy ground, they are made by bringing masses of earth to the ground in bags, or by stuffed gabions, wool packs, or any other bulky material which can be easily obtained. For further particulars see SIEGE.

APPROVER. By our ancient law, where a person indicted for treason or felony confessed the crime charged in the indictment, he might be admitted by the court to reveal on oath the accomplices of his guilt, and he was then called an *approver*.

The court might either give judgment and award execution upon him, or admit him to be an approver. In the latter case a coroner was directed to receive and record the particulars of the approver's disclosure, which was called an *appeal*, and process was thereupon issued to apprehend and try the *appellees*, namely, the persons whom the approver had impeached as the partners of his crime.

As the approver, in revealing his accomplices, rendered himself liable to the punishment due to the crime which he had confessed, and was only respited at the discretion of the court, it was conceived that an accusation made under such circumstances was entitled to peculiar credit, and the accomplices were therefore put upon their trial without the intervention of a grand jury.

Here, however, as in other appeals [APPEAL], the accused were allowed to choose the mode of trial, so that the approver might be compelled to fight each of his accomplices in succession. But, unlike an appeal by an innocent person, the prosecution might be defeated by a pardon either to the approver or to the appellee.

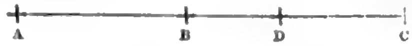
If the approver failed to make good his appeal, judgment of death was given against him. If he succeeded in convicting the appellee, then he was entitled to a small daily allowance from the time of being admitted approver, and to a pardon.

The appeal by approvers had become obsolete before the abolition of it by parliament; and the present practice is to prefer a bill of indictment against all parties implicated in the charge, and to permit the criminal, who confesses his guilt, to give evidence against his companions before the grand jury. If upon the trial the demeanour and testimony of the accomplice is satisfactory to the court, he is recommended to the mercy of the crown. (2 Hawk., *Pleas of the Crown*, ch. 24; 'Blackst. Comm.' Mr. Kerr's ed., vol. iv. p. 390.)

APPROXIMATION, from the Latin, signifies a *drawing near to*. In mathematics, results are said to be found by approximation, when the process employed gives nearly, but not exactly, the result required.

Strictly speaking, the observed phenomena in every branch of experimental philosophy are approximations, more or less near, to the truth. Thus the distance of the sun, or the diameter of a planet, are only known approximately: but general custom does not sanction the application of the term to any "drawing near" in which the imperfection arises from error of the senses, or of instruments. It is only when the defects of mathematical analysis oblige us to be content with a formula which gives results only nearly true, that the latter are said to be approximate. To this part of the subject, then, we confine ourselves.

It may be stated as a general fact, that there are very few mathematical processes, except those of pure geometry, which give absolutely correct determinations, in which the answer obtained is neither more nor less than is necessary to satisfy the conditions of the question. But the fault is not in the processes themselves, but in the problems which it is necessary to submit to them, and in the nature of arithmetical, as distinguished from geometrical, magnitude. It is worth while, briefly, to elucidate this point. In geometry, the mind conceives one line or angle to differ from another by some magnitude of the same kind which can be *assigned*, and a magnitude is rather imagined to be given, than actually given. If we attempt to *construct* the line or angle of geometry, we must have recourse to approximation, and that of the roughest character, since the errors are as great as those of the senses. It is only by laying down the postulate that any line or angle can be assigned independently of all mechanical methods, that geometry becomes a science of absolute exactness. In arithmetic, on the contrary, the very first notion of numbers throws a theoretical difficulty in the way. We can imagine a line to grow or increase *continuously*; that is, in such a way that it shall not increase from one to two feet, without previously assuming every possible length which lies between one and two feet. This idea is forced upon us whenever we see points moving to or from each other. But is it therefore true, that every possible length which is greater than one foot and less than two, can be expressed by one foot and some determinate numerical fraction of a foot? This question reduces itself to the following. Let A D be



greater than A B (one foot), and less than A C (two feet); if B C be successively divided into two equal parts, three equal parts, four equal parts, and so on, *ad infinitum*, does it follow that some one or other of the subdivisions must of necessity fall upon the point D, previously taken at hazard? If we appealed to the evidence of the senses, we should certainly answer in the affirmative, for, though the finest compasses were used, we should soon find some point of subdivision so near to D, as not to be distinguishable from it by the severest test our senses could apply. But our mechanical points are minute solids, while the mathematical point has neither length, breadth, nor thickness. Conceive the latter, and the affirmative answer does not appear self-evident; for though the continuation of the points of subdivision is unlimited, the number of points which can be taken in the line is also unlimited. But we can demonstrably answer the question in the negative (see the 'Treatise on the Study of Mathematics,' by the Society for the Diffusion of Useful Knowledge, p. 81): as an instance, let B D be equal to the side of that square of which B C is the diagonal, or let B C be the circumference of that circle of which B D is the diameter. In neither case can one of the subdivisions of B C ever fall on D.

Here then is a fruitful source of the necessity of having recourse to approximation, since we cannot be sure that any required relation between concrete magnitudes is absolutely expressible in numbers. In fact, we may state the following as a result of experience, though, not so far as we know, capable of demonstration: numbers being taken at hazard, and submitted to any process which requires the solution of an equation higher than the first degree, the odds are greater than can be assigned against obtaining an absolute result without approximation. In a common table of logarithms, fixing at hazard upon any number, the odds are nearly seventeen thousand to one against choosing a number of which the logarithm can be exactly given.

This would appear to throw an air of uncertainty over almost all the conclusions of pure mathematics, and justly so, if it were not for the following truth, which, except so far as the labour of approximation is concerned, renders it practically immaterial whether a result is obtained exactly, or by approximation. Any equation whatsoever, which expresses the conditions of a possible problem, if not capable of exact solution, may yet be so far satisfied that a number or fraction can be found, which, on being tried in the given equation, shall produce an error smaller than any we may think it necessary to name at the outset. For instance, the ratio which the circumference of a circle bears to its diameter does not admit of an exact and absolute determination. If any two numbers be named, their ratio is either too great or too small. But supposing it asked to determine the circumference of a circle from its diameter so nearly, that the error shall not be so much as a foot for every hundred miles of diameter, or in that proportion. It can be shown to be more than sufficient for this purpose to multiply the diameter by 355 and divide by 113; which, if the diameter were 100 miles, would give 314 miles, 280 yards, and 1 foot: this, though too small, is within the conditions of the question, not being too small by one foot. Again, though it is impossible exactly to solve the equation $x^2=7$ or $x^2-7=0$, that is, to find a fraction which, multiplied by itself, shall make 7, yet naming any fraction, however small, at pleasure, for example, one millionth or ·000001, it is possible so to determine x, that x^2-7, though not absolutely *nothing*, shall be less than the proposed fraction, one-millionth.

It is not our purpose here to enter upon methods of approximation: no space which we could devote to the subject would suffice to explain any of them with sufficient detail to render them of practical use. We shall therefore content ourselves with giving a general view of one of the great methods, we might say, *the* great method, usually employed, and shall thereby, in succeeding articles, show the young mathematician that various methods, upon which he must have come in the course of his reading, contain a common principle, though disguised under the various forms of calculation which it is necessary to employ in different cases. We must now suppose the reader acquainted with the elements of the differential calculus.

When a number is given, and certain processes are also known, so that they can be performed either exactly or approximately, we are in possession of the solution of the following question—given the number, and the process, to find the result of the process. Hence immediately there results reason for inquiry into the inverse question—knowing the process, and the result of it, what was the number on which the process was employed? The way of finding this number is called the inverse process, and, if of sufficiently frequent occurrence, a name is given to it, and the rule for finding it is put into words, and arranged in its most systematic form. Thus the process of *squaring* or multiplying a number by itself, is known when multiplication is known, and the question is easily answered, what is the square of $2\frac{1}{2}$ or any other number, or what *results* from the process of *squaring* employed upon the *number* $2\frac{1}{2}$? From this arise such questions as the following:— The *result* of *squaring* is found to be 50; what was the *number employed?* This can only be answered approximately; that is, no number squared can give *exactly* 50, though one can be found, the square of which is as near 50 as we please. This operation occurs sufficiently often to receive the name of the extraction of the square root, and the rule for approximating to it is well known. We can now carry the generalisation a step farther, for the result of the last is to put a new process into our hands which we may consider as direct, since the means of performing it in all cases, approximately at least, have been found. We may now ask, what is the result of the process denoted by

$$x^2+\sqrt{x^3-1},$$

any number being substituted instead of x: but the inverse question —namely, suppose the above process to have been performed, and the result to be 20; what number was employed?—presents itself and requires new investigations. Neither the direct nor inverse process in this case has received a name; and it is evident that, name as many as we may, each addition will give new processes, require new inverse processes, and so on *ad infinitum.*

Previous to entering upon the process of approximation, it is necessary to inquire into the effect which a small change in the number employed would produce upon the result. We say a *small* change, because the changes of any magnitude require formulæ of great intricacy, compared with small changes. The consideration of the effect of such changes is, among other things, the object of the DIFFERENTIAL CALCULUS; into which we can here enter no further than to state, that in connexion with every process it discovers others, which we shall here call by the names of the *first* derived process, the *second* derived process, &c.; the two first of which are indispensable, the first for obtaining the approximation, the second for ascertaining the degree of accuracy to which the approximation has been carried. These *derived* processes (as we here call them) are the first and second differential coefficients. [DIFFERENTIAL CALCULUS.]

Let $f x$ represent the required process or FUNCTION. Let $f' x$ and $f'' x$ represent its first and second derived functions. We suppose this notation known to the reader; but any one who has studied algebra may be prepared to follow us by reading the first thirteen pages of the treatise of the Society for the Diffusion of Useful Knowledge, entitled 'Elementary Illustrations of the Differential and Integral Calculus.' If the operations which $f x$ indicates to have been performed upon x, be successively performed on a and $a+h$, giving fa and $f(a+h)$, it may be proved that

$$f(a+h)=fa+h\ f'a+\frac{h^2}{2}f''(a+\theta h) \quad \text{(A)},$$

where θ is a fraction less than unity, or θh is less than h. This rule only admits of exception where fx is such that either $f''x$ becomes very large, or $f'x$ very small, for some value of x lying between a and $a+h$; and since in approximations h is a very small quantity, this will rarely happen, and when it does happen, the results of an attempt to approximate will soon point it out. Let us now suppose that we wish to find x in such a way that $fx=0$. Every case may be easily reduced to this: for example, to solve $x^2=7$ is to find or approximate to a value of x, which makes $x^2-7=0$. The first step is to find by trial some value of x which will very nearly satisfy the proposed condition, that is to find a, so that fa shall be small. No general rule can be given for this part of the process, which is, however, easily done in most cases. To carry an example with us, let us suppose it required to solve the equation:

$$x^3-2x=5$$

or to make

$$x^3-2x-5=0$$

Here fx is x^3-2x-5, and by the rules of the differential calculus, $f'x$ is $3x^2-2$, and $f''x$ is $6x$. We soon find that there is a root between 2 and 2·1, for if $x=2$, then x^3-2x is 4, and if $x=2·1$, it is 5·061; the first less than 5, the latter greater, but not much. We therefore take 2·1 as the approximate value of x found by trial.

Returning now to equation (A), let us suppose a the approximate value increased by h, in such a way that $a+h$ shall be the real value of x required, or $f(a+h)=0$. This gives

$$h=-\frac{f a}{f' a+\frac{1}{2}h f''(a+\theta h)} \quad \text{(B)},$$

in which h is not, strictly speaking, determined, because it occurs on the second as well as the first side. But h is small, because a is nearly the value required, and therefore we may approximate to the value of h from (B) by rejecting the small term

$$\tfrac{1}{2}h f''(a+\theta h)$$

from the denominator of the fraction, which gives

$$h=-\frac{fa}{f'a}$$

for an *approximate* value of h: so that the new value of x obtained from the step just made is

$$a-\frac{fa}{f'a}.$$

With this new valne of x we may recommence the process, and find a new correction; and so on.

Resuming the example, we find putting $a=2·1$,

$$fa=a^3-2a-5=·061,$$
$$f'a=3a^2-2=11·23,$$
$$h=-\frac{·061}{11·23}=-·0054 \text{ nearly},$$
$$x=a+h=2·0946 \text{ nearly}.$$

Trying this value in x^3-2x-5, we find it ·005, nearly; less than the tenth part of its preceding value. With 2·0946 for a, the process must be now repeated.

The degree of approximation thus obtained may be estimated as follows, though we can only very briefly explain it to those who have no more practice in the differential calculus than we have hitherto supposed. Resuming the correct equation (B), we see that, if we call fa, as obtained, a small quantity of the first order, $(fa)^2$ of the second, and so on, then h will be of the same order as fa, unless $f'a$ be also of that order, which is one of the excepted cases. Hence, in rejecting θh, we reject only quantities of the first order from the term $f''(a+\theta h)$, or of the second from $\frac{1}{2}h f''(a+\theta h)$, or of the *third* order from the whole fraction, since fa is itself of the first order. This will appear from the development of the second side of (B) by common division. Thus rejecting θh, and developing

$$-\frac{fa}{f'a+\frac{1}{2}h f''a}$$

as far as terms of the second order, we have

$$h=-\frac{fa}{f'a}\left(1-\frac{f''a}{f'a}\frac{h}{2}+\text{\&c.}\right),$$

in which, if on the second side we write $-\frac{fa}{f'a}$ for h, which rejects terms of the second order only, we still reject terms of the *third* order only in the value of h. Hence

$$h=-\frac{fa}{f'a}\left(1-\frac{1}{2}\frac{f''a\,fa}{(f'a)^2}\right) \text{ nearly},$$

and its ratio to its preceding value $-\frac{fa}{f'a}$, is

$$1-\frac{1}{2}\frac{f''a\,fa}{(f'a)^2},$$

whence $-\frac{1}{2}\frac{f''a\,fa}{(f'a)^2}$ represents roughly the greatest part of itself, by which the correction $\frac{fa}{f'a}$ may be erroneous, the sign indicating whether it is too small or too great. In the preceding example, where $a=2·1$, and where

$$fa=a^3-2a-5=·061,$$
$$f'a=3a^2-2=11·23,$$
$$f''a=6a=12·6,$$

the preceding fraction is roughly $-\frac{1}{32}$, so that the correction ·0055 may possibly be one thirty-second of itself too great, or about ·0002 too great.

This method does not appear to be of much use for the second approximation; but becomes more powerful at every succeeding step. Whatever number of correct decimal places is obtained at the end of any one of the successive approximations, it is, roughly speaking, doubled by the next; since the second term of the preceding development of h, being

$$\frac{1}{2}\frac{f''a}{(f'a)^3}\cdot(fa)^2,$$

is of the same order as the square of h, or of the same order as

$$\left(\frac{fa}{f'a}\right)^2.$$

In treating the various articles, DIVISION, SQUARE ROOT, &c., EQUATION, we shall show that principles analogous to the preceding have been adopted in the rules for approximating.

Various methods of approximation are found in the Hindoo Algebra; but, as far as we can find, Vieta is the first who generalised the main principle so far as to connect the approximate solution of equations with the particular cases of division and the square root, which were known before Hutton, in his 'History of Algebra' (see his Tracts), attributes this extension to Stevinus, but on searching the works of the latter, we cannot find anything which, in our opinion, justifies the assertion. The connexion of the arithmetical rules, in which successive figures are successively found, with the preceding, will not at once be obvious; but our limits oblige us to refer to INVOLUTION AND EVOLUTION on this point. Newton first applied the theory of derived functions directly to algebraical equations; and the method was further extended by Lagrange.

APRIL, the fourth month of the year, consists of thirty days, which was the number said to be assigned to it by Romulus. Numa Pompilius deprived it of one day, which Julius Cæsar restored, and which it has ever since retained. In the original Alban or Latin Calendar, April held the first station, and then consisted of thirty-six days. (Pitisci, 'Lexicon Antiq. Roman.' tom. i. p. 129; Brady's 'Clavis Calendaria,' p. 67.) Its name is usually considered to have been derived from *aperire*, to open; either from the opening of the buds, or of the bosom of the earth in producing vegetation. The Anglo-Saxons called it Ooster or Easter-Monath. In this month the sun travels through parts of the signs of Aries and Taurus, that is to say, of those parts of the ecliptic which astronomers designate by those names. The real motion of the sun among the constellations is through parts of Pisces and Aries. [PRECESSION; ZODIAC.]

APRIL CEREMONIES. The custom of making fools on the first of April is a practice well known in England, France, Sweden, and probably in other countries of Europe; and it is believed to be connected with an immemorial custom among the Hindoos, held near the same period in India, towards the end of March, called the Huli Festival, when mirth and festivity reign among the Hindoos of every class, and people are sent upon errands and expeditions which end in disappointment, and raise a laugh at the expense of the person sent. ('Asiat. Res.' vol. ii. p. 334.) In Europe the practice is similar: the fun consists in deceiving a person in any not injurious manner, such as "sending them on a sleeveless errand," as Addison terms it in the 'Spectator.'

The origin of this April custom seems unknown everywhere, though Bellingen, in his 'Etymology of French Proverbs,' considers that it may possibly have an allusion to the mockery of our Saviour, about this time, by the Jews: a conjecture which is in some degree paralleled, if not corroborated, by the custom of Lifting in the Easter holidays, undoubtedly intended to represent our Saviour's resurrection.

In England, the first of April is usually termed 'All Fools' Day,' and the person imposed upon, an April Fool. In France this person is called a 'Poisson d'Avril,' *i.e.*, a mackarel, or silly fish. In Scotland, 'an April Gowk.' In Portugal, according to Southey, the like practice prevails on the Sunday and Monday preceding Lent. Maurice, 'Indian Antiq.' vol. vi., p. 71, speaks of the Huli Festival as the celebration of the period of the vernal equinox.

A PRIO'RI and A POSTERIO'RI; two logical terms, signifying, literally, 'from a thing before,' and 'from a thing after.' They are applied to distinguish between two different methods of reasoning; the first, *a priori*, in which the conclusion is drawn from previous arguments, which render it unnecessary to examine the particulars of the case in point; the second, *a posteriori*, in which the thing to be proved is examined, and made the source out of which the reasoning is drawn. It must be noticed, however, that these are rather terms of common conversation and writing, than of logic, properly so called; so that they are seldom noticed by writers on that science. The use of them is in general very vague, and the consequence of any attempt to define them very strictly would be either to make out *a priori* reasoning to be altogether impossible, or to throw insuperable difficulties in the way of finding where it ends and the other begins. In common language, we reason *a priori* when we infer the existence of a God from the general difficulties in the supposition of the existence of what we then call the creation, on any other hypothesis; but we reason *a posteriori* when we infer the same from marks of intelligent contrivance in this particular creation with which we are acquainted.

The term *a priori* is, however, frequently used in a sense which implies "previous to any special examination." As when a sentence begins with "*a priori* we should think," &c &c., which in most cases will be found to mean nothing more than an expression of the leaning which the speaker found his mind inclined to, when he had only heard the proposition, and before he had investigated it.

All *a priori* reasoning is dubious, to say the least: in but very few cases, if any, are we able to say we know sufficient beforehand to render this sort of argument safe. Pure mathematics and logic are capable of establishment *a priori*, and no other sciences whatever. But though the method is of little effect towards the establishment of most kinds of truth, it is highly effective in its discovery; indeed, by the very nature of its definition, it must be the guide which points out the probable direction in which the thing sought may be found. Columbus went to look for the continent of America, in consequence of certain convictions of his own, derived from *a priori* reasoning. So far he was right: but had he contented himself with writing a quarto volume to prove the existence of the new continent, by reasons which were only strong enough to make it right to look for more, some less imaginative *a posteriori* reasoner would have been the real discoverer.

APSE, or APSIS, in Architecture, the semicircular termination to the choir of a cathedral or church. Formerly it was applied to the entire choir, or a portion railed off. The apse corresponds to the hemicycle, or curved recess in which was the tribunal in the ancient Roman Basilica; and hence in Roman Catholic countries the bishop's throne is always placed within the apse,—the church being regarded as the tribunal where the bishops sat to administer spiritual justice, penance to the guilty, and the eucharist to the absolved. [BASILICA.] The term apse is also applied to the semicircular terminations of aisles, and sometimes to similar terminations of transepts. In the cathedrals of Italy, Germany, and France, the apsidal termination is very general. In England, the cathedrals of Canterbury, Rochester, Norwich, and Peterborough, Ripon Minster, and Westminster Abbey, as well as several parish churches, have apsidal terminations; and in some instances, as at Gloucester and Worcester cathedrals, the crypts retain the apsidal form, though the apse itself has been removed at a period subsequent to the original foundation of the church. In some French cathedrals a great complexity of form is given to the apse by the substitution of a range of columns for the semicircular wall, beyond which is a series of chapels. For this form, Mr. Fergusson ('Handbook of Architecture,' p. 618) proposes the vernacular term *chevet*. He says, "The apse, properly speaking, is a solid semicylinder, surmounted by a semi-dome, but always solid below, though generally broken by windows above. The *chevet*, on the contrary, is an apse, always inclosed by an open screen of columns on the ground-floor, and opening into an aisle, which again always opens into three or more apsidal chapels. This arrangement is so peculiarly French, that it may properly be characterised by the above French word, a name once commonly applied to it, though latterly it has given way to the more classical but certainly less suitable term of apse." But the term apse (*abside*) is that generally applied to it by French architects and writers on architecture.

APSIDES, a Greek term, used to signify those points of a planet's orbit in which it is moving at right angles to the line drawn to the primary. These points are also those of greatest and least distance from the primary. [APOGEE and PERIGEE for the moon and sun; APHELION and PERIHELION for the earth or a planet.]

AP'TERAL, a term used in architecture with reference more particularly to a mode of arrangement peculiar to the temples of the ancient Greeks and Romans. It is formed from a Greek compound term, signifying 'without wings;' and in this sense it is applied to a temple having prostyles, or porticoes of columns projecting from its fronts or ends, but of which the columns do not extend laterally, and run along the flanks from one end to the other, so as to make it *peripteral*. [TEMPLE.] Modern churches which have porticoes, though some of them are professedly on the Greek model, are, nevertheless, generally, illustrations of the apteral arrangement, and of these that of St. Pancras in London may be best referred to as an example.

APUS (Constellation), from the Greek ἄπους, without feet, used to signify the bird of Paradise, the *Avis Indica* of Linnæus, which was formerly believed to have no feet. It is a constellation introduced by Bayer, and lies too near the south pole to be visible in our hemisphere. It is surrounded by Octans, Pavo, Triangulum Australe, and Cameleon. The following is a classified enumeration of its principal stars :—

Magnitude.	Number of Stars.
4	1
4·5	1
5·	1
5·5	2
6	6
	11

Hence the total number of stars visible to the naked eye in this constellation amounts to 11. The principal star is thus designated :—

Character.	No. in Catalogue of Lacaille.	No. in Catalogue of British Association.	Magnitude.
ζ	L 7162	5810.	4

AQUAFORTIS. [NITRIC ACID.]

AQUA REGIA. [NITROHYDROCHLORIC ACID.]

AQUA'RIUS (Constellation), the Water-Bearer, one of the twelve zodiacal constellations. Its Greek name is Ὑδροχοεὺς, the Water-Pourer. In the Indian zodiac it is simply a water-jug, the name of which, according to Legentil, is Coumbam, and the same in the Arabic. In the Egyptian, it is a male figure holding two urns, from which the water flows. The mythology of the Greeks refers the Water-Bearer in different places to the fables of Deucalion, Ganymede, Aristæus, and Cecrops. Its probable origin however, whether we place the origin of the zodiac in India or Egypt, is the watery season of the year in which the sun was in this sign. Dupuis, who supports the latter opinion, thinks that Aquarius, as well as Capricornus and Pisces, refer to the months of the year during which the inundation of the Nile took place. Legentil, who advocates the former, imagines that they represent the rainy season which is absolutely necessary for the growth of the rice-crops.

The constellation Aquarius may be found in the heavens by producing southward a line drawn through the bright stars in the head of Andromeda and the wing of Pegasus. This line passes through the two brighter stars in Aquarius, α and β, situated in the two shoulders. The middle point between these two shoulder stars is on the meridian at 12, 10, 8, and 6 P.M., in the months of August, September, October, and November respectively, at an altitude of about 35 degrees.

A distinction must be drawn between the constellation and the sign of the Zodiac. [PRECESSION.] The latter is the part of the ecliptic which begins at the horn of the constellation Capricornus and ends in the middle of the body of that of Aquarius, comprising the arc of longitude between 300° and 330°, and forming the sun's path between January 20th and February 20th.

The following is an enumeration of the principal stars in this constellation, classified according to the order of their apparent magnitudes:—

Magnitude.	Number of Stars.
3rd	3
4th	4
5th	18
6th	73
	98

Hence the number of stars in this constellation which are visible to the naked eye amounts to 98. The following are the various designations of the stars down to the 4th magnitude inclusive:—

Character.	No. in Catalogue of Flamsteed.	No. in Catalogue of British Association.	Magnitude.
—	3	7201	4
β	22	7478	3
γ	48	7795	3
ζ	55	7832	4
η	62	7868	4
λ	73	7970	4
δ	76	7980	3

AQUATINTA ENGRAVING. The word aquatinta is a compound of two Latin words, *aqua* (water) and *tinctus* (stained), by which is implied that this mode of engraving is an imitation of water-colour or India-ink drawings. The inventor, a German artist named Le Prince, was born at Metz in 1723. Although capable of very pleasing, and indeed of very beautiful effects, aquatinta engraving has fallen into comparative disuse: partly no doubt owing to the facility which it affords for the production of inferior plates, but more to the introduction of lithography. Yet, as the very facility with which it can be executed, renders it especially valuable in places where skilful engravers are not readily met with, and as it appears not unlikely from some of the experiments of M. Niépce de St. Victor and others, that at least some stages of the aquatinta process may be of value in heliographic (or photographic) engraving, a subject likely to engage a good deal of attention among amateurs, we think it may be convenient to give a description of the process in sufficient detail to enable any one tolerably acquainted with art to produce for himself an aquatinta engraving.

Le Prince's method was to sift the common black resin, when tied up very loosely in a muslin bag, over the plate, so as partly to cover the surface with the particles. It was then fixed by a moderate heat sufficient to make the dust adhere without fluxing or becoming an even varnish: he thus formed a granulated surface on the plate, usually called a *ground*, which suffered very little from the action of the diluted acid, yet allowed it to corrode very freely in the small spaces left between the grains of the resin. In recent methods the ground is prepared by dissolving the black resin in the highest rectified spirits of wine (alcohol), and then pouring the mixture over the plate, the quantity of resin determining the coarseness or fineness of the grain: the plate here referred to is the ordinary copper-plate used by engravers, but the directions apply equally to a steel plate.

When the ground is thoroughly dry, the surface will be of a bright copper colour, and in a few hours will be ready for use. A warm room is requisite for this operation in cold weather, but if not, the early morning must be taken. Dust should be most carefully avoided. A small plate may be held on the points of the fingers and thumb of the left hand whilst the ground is laid, and be gently moved about till the ground has granulated or formed; this aids the better formation or crystallisation of the grain. Before a ground is laid, the plates are to be well cleansed with dry whiting and a dry linen cloth, it being absolutely necessary that the plate should have a very perfect polish, for without this the granulation cannot be well effected. Any of the resinous gums will, with spirits of wine, make a ground, but the black resin is generally preferred. Modern aquatinters use a composition for painting the forms of leaves of trees, or other objects, where the trouble of surrounding the forms by a varnish would be too great. This composition is made of moist sugar or treacle added to the same bulk of whiting, and ground well on a slab with a little water; a very small proportion of gum Arabic or gamboge may be added. When this composition is used, it must be thoroughly dry before the varnish is passed over it; the varnish also must be allowed time to dry, after which, cold water poured on the plate will in a few minutes bring off all the composition and the varnish which had passed over it, leaving the forms perfect and the ground in those places free to receive the acid again—the remainder of the plate being permanently *stopped out* by the varnish. This varnish is either Canada balsam or turpentine varnish mixed with a little lamp-black and spirits of turpentine; with this also the margin of the plate is to be varnished, leaving a narrow strip of the ground for trials. These trials are made, after each time that the acid has been on the plate, by taking off a small portion of the strip with spirits of turpentine, cleaning the place well, and then rubbing in with the finger a little powdered white lead; this process will give a good idea of the actual and comparative strengths of tints. It is only by these trials that the aquatinter knows what he is doing, for the acid varies so greatly with the weather, that what might be considered very weak in a cool morning, becomes very strong towards the evening; for this, and other obvious reasons, if the room be kept at an equal temperature, the work will advance with much greater certainty than when it varies by the changes of weather.

When the ground is dry, the design intended to be engraved is made on it; this is done in the following manner:—The design is first copied on very thin transparent paper, called tracing-paper; between this tracing and the prepared ground on the plate a thin sheet of paper is placed, which has been rubbed over with lamp-black, or vermilion, and sweet oil; every line of the design is then gone over with an instrument called a blunt point, with a moderate pressure, and is thus transferred to the ground so securely that the acid cannot destroy it.

Before the acid is poured on the plate, a border or wall of wax, about an inch in depth, is placed round the margin of the plate. The bordering wax is made by melting together one pound of burgundy pitch, half a pound of bees'-wax, and a wine-glassful of sweet oil; when melted, to be poured into cold water and worked into small cakes. When wanted, these cakes are put into lukewarm water and made into small rolls like a sausage, then flattened, and one of the edges being a little melted at the fire, is to be pressed close to the plate with a wet finger, making a spout at one corner; this should be well performed, or the acid will get beneath it and occasion much mischief. In order to make the wax adhere, the plate should be made as warm as the hand of the operator.

The plate being so far made ready, the completion of the design is resumed by stopping out the highest lights on the edges of clouds, water, &c., with a mixture of Canada balsam or turpentine varnish, and the *perfectly* impalpable oxide of bismuth (bismuth is preferred on account of its weight); these are mixed with a spatula on a slab, and used with a small sable brush, diluting the varnish occasionally with spirits of turpentine. Next pour on the acid, which has been prepared by mixing one-sixth of a pint of the strongest nitric acid to five-sixths of a pint of water; let it remain, according to its strength, from half a minute to a minute, then pour it off, and wash the plate three or four times with clean water, and dry it with a clean linen cloth or a pair of bellows: the last is the best, if the stopping-out varnish should not be perfectly hard. If on trying the strip the tint is found not to be sufficient, repeat the acid for another half minute, and then proceed. The colour of the bismuth varnish must be changed for the second stopping-out, by adding a little chrome yellow, vermilion, or lamp-black, or any other colour that is not destroyed by the acid. The colour is to be changed after each application of the acid, that the engraver may remember in what places he has carried forward his work, what tints have been softened at their edges, &c.

It is impossible to give a scale of times for each employment of the acid, but the following may serve as a guide. If the first tint has half a minute, the second may take three-quarters, the third one minute, the fifth one minute and three-quarters, the sixth two minutes and a-half, the seventh five minutes, the eighth twelve minutes, &c. The acid should be strengthened a very little after each application; and it may be so equally done that the above proportions will serve very well as a general rule, depending on the strength of the tints required. When the ground changes to a gray colour it is beginning to fail, and must be taken off by heating the plate till the bordering wax will lift off; after this, sweet oil is applied to the whole surface, and a brisk heat beneath the plate will bring off all the different varnishes with a linen cloth; then an oil-rubber, made of fine woollen cloth, rolled up hard and the end cut off, applied with sweet oil, will take out the stains; tints which are too strong may be softened or even rubbed out. Perhaps it need not be added, that a single grain of sand or any other hard substance under the rubber will ruin the whole work. Gradations in skies, &c., are sometimes made in this manner, though more generally by pouring the acid on slowly, beginning at the darkest corner. It will frequently happen that some portions of the varnishes will become so hard, that the common method will not stir them; in this case a little of the oil of spike lavender applied with the finger is quite certain to produce the effect. The plate is now cleaned with spirits of turpentine and sent to the printer to prove, after which it is to be exceedingly well cleaned with turpentine, &c., and another ground laid; this should be done in such a manner as to make the grains fall exactly on the granulations of the former ground, which is called *re-biting*. It is done by making the ground much stronger than was used before. Fortunately, the liquid ground has a natural tendency to granulate upon the same places as before, and when the acid is again applied it will act in the same interstices as before, and only wants a little care to make it answer. The process for the second ground is the same as for the first; re-touching with the acid those tints which require more depth, and stopping out those parts that are sufficiently dark. Another proof must be taken, and the plate then finished with the burnisher, which some use with oil, but others prefer to use dry, previously filling the whole plate with powdered white lead, by which it can be seen how much has been burnished down, according to the quantity of colour left in the plate.

AQUA TOFA'NA, a poisonous fluid invented about the middle of the 17th century by an Italian woman of the name of Tofana. This woman, who resided first at Palermo, and afterwards at Naples, was one of the most celebrated of a class of persons known under the name of Secret Poisoners, who in ancient times were believed to possess the power of destroying life at any stated period, from a few hours to a year; and who, during the 16th and 17th centuries, were regarded in all the nations of Europe with extraordinary terror. In the year 1659, during the pontificate of Alexander VII., it was observed at Rome that many young married women became widows, and that many husbands, suspected to be not agreeable to their wives, died suddenly. The government used great vigilance to detect the poisoners. Suspicion at length fell on a society of young wives, whose president appeared to be an old woman, who pretended to foretel future events, and who had often predicted very exactly the death of many persons. By means of a crafty female, their practices were detected; the whole society were arrested and put to the torture, and the old woman, whose name was Spara, with four others, were publicly executed. It appears that Spara, who was a Sicilian, derived her art from Tofana at Palermo, the latter selling the poison, which hence acquired the name of *Aqua della Tofana*, in small glass phials with this inscription,—"Manna of St. Nicholas of Barri," and ornamented with the image of the saint. Though this infamous woman lived to an advanced age, she was at length dragged from a monastery, in which she had taken refuge, and put to the torture. She confessed that she had been instrumental to the death of no less than 600 persons.

The dose of her poison was from four to six drops; yet though in this state of concentration its nature could not be detected, it was subsequently discovered to consist of a solution of arsenic; but so little was that age acquainted with the art of chemical analysis, that they had no means of detecting a solution of arsenic so highly concentrated that from four to six drops was a mortal dose; whereas, at present, even when arsenic has been dissolved in the stomach and mixed with vegetable and animal fluids, it may be reduced to its metallic form, and made to exhibit all the physical properties of the metal to the *naked* eye with as great distinctness as in any quantity, however large, *when only the twentieth part of a grain has been procured.* Modern chemistry therefore has deprived the poisoner by arsenic of all chance of escape by concealing or disguising the poison he administers.

AQUÆDUCT, or AQUEDUCT (*aquæ ductus*), the channel or passage for conducting water; of late years, however, the word *conduit* has been more commonly used to express the generic idea of a conducting passage, whilst the word aqueduct has been applied specifically to the class of structures which perhaps it would be more correct to call AQUEDUCT BRIDGES. As, however, this specific signification of the word has some advantages, it will be hereafter adopted in this Cyclopædia, and the following notice of Aqueducts will be devoted exclusively to an investigation of the practice of ancient and modern engineers, in the construction of bridges for the purpose of conveying streams of water above the surface of the ground from one comparatively high point to another. The laws of the flow of water in *conduits* (whether of masonry, open or covered, or of earthwork, wherein the water flows simply by the effect of gravitation; or of closed pipes, wherein the flow is effected by the pressure at the entry), will be discussed under the articles CONDUIT and WATER PIPES; whilst the investigation of the contrivances for the conveyance of water for the supply of town populations will be reserved to the article WATER SUPPLY.

It does not appear that either the Assyrians, or the Egyptians, executed any important works of the kind under consideration; for although unquestionably the systems of irrigation they adopted, and some pictorial representations in the sepulchral monuments of the Egyptians would lead us to believe that they were acquainted with the leading principles with respect to the flow of water, and were even aware of the effects of hydrostatic pressure, no remains of the aqueducts executed during the periods of the independent existence of the national governments of those countries have survived to our days. In Greece, and in Asia Minor, there are some remains of aqueducts; but the style of their construction would rather lead to the belief that they were erected subsequently to the Roman conquest; and, indeed, their outlines more closely approximate to the principles of Latin, than they do to those of Hellenic, art. The most authentic example of a Greek aqueduct is supposed to be the one described and figured by Mr. G. Rennie, in the Proceedings of the Institution of Civil Engineers, Jan. 16th, 1855; and it is the more interesting from the fact of its illustrating the practical application of the principle of the reversed syphon at a very early period in the history of art. The valley near Patara on the coast of Lycia, where this aqueduct was erected, is about 250 feet deep, and 200 feet across; and in it a wall of loose rubble masonry, at the bottom of which is left a small rough arch for the passage of the stream flowing in the ravine, has been formed terminating with a series of wrought stone blocks, well cramped together, closely jointed, and bedded in cement. These blocks are laid in a curved line, with its chord on the upper side; and they were perforated with a circular hole 13 inches in diameter. It is said that at Syracuse there are also remains of aqueducts of Greek construction, and that near Antioch an important work of this description was erected during the reigns of the Seleucidæ. But the mode of arching introduced in the latter work is so decidedly in the style of the Roman engineers, that it is hardly possible to attribute this monument to any one else than to the masters of the ancient world; just as it is necessary for the same reason to attribute to them the construction of the aqueduct of Mytelene.

The Roman government appears, at a very early period of its existence, to have felt the necessity for supplying large quantities of pure water to the inhabitants of the great centres of population submitted to its sway; and naturally it executed a series of important works for the supply of the Eternal City itself. Rome, in fact, was built on the banks of the Tibur, a stream so turbid as to merit and receive the name of the 'Flavum Tibrim;' and the quantity of water obtainable from wells sunk in the alluvial formations of the valley was soon found to be insufficient for the continually increasing population. About the year 312 B.C., then, Appius Claudius erected the first conduit through which the waters, afterwards known as the Aquæ Appianæ, were led into Rome. From that period to the close of the republican era, several other great works of this description were erected; such as the Anio Vetus about 273 B.C.; the Aqua Marcia about 146 B.C.; the Aqua Tepula about 127 B.C.; this last conduit was subsequently increased in importance by the addition of the Aqua Julia, in the year 35 B.C.; and in the very earliest days of the empire, Agrippa increased the supply of water in the eternal city by leading into it the Aquæ Virgo, Alsietina, and Augusta. At later periods the Aquæ Claudia, Anio Vetus, and Alexandrina were conducted to Rome, and thus added to the already copious supply of water it possessed. From the local conditions of the city, and of its neighbourhood, the streams thus diverted were forcedly brought from a great distance; and they arrived in the alluvial plain of the Tibur at a considerable elevation. It seems that the total lengths of the various conduits formed previously to the end of the first century of our era, was about 456,987 yards, of which 4930 yards were supported on a solid substructure, and not less than 53,421 yards were carried by aqueducts, in the limited sense of the word now adopted, which were frequently from 80 to 100 feet in height. In the provinces also the Roman engineers erected numerous important works of the same description, amongst which may be cited the aqueducts near Nîmes, Metz, Luynes, Fréjus, Trèves, Arceuil, Segovia, Tarragona, Evora, Merida, Carthage, Constantina, Tunis, Cairo, &c.; whilst at a later period of their rule they erected some ruder, but still colossal, aqueducts for the supply of Constantinople.

The practice of the Roman engineers in the construction of aqueducts, appears to have been to avoid large openings when the length between the sides of the valley was considerable. They appear to have been induced to adopt this principle, on account partly of their desire to avoid expense in foundation works, and partly on account of the difficulty they must have encountered in framing large centres such as should be able to carry the weight of an arch of considerable span, from the high price and the rarity of wrought iron. Whatever were their determining motives, the ruling dimensions they adopted were, for the openings, when dressed stone or ashlar was used, between 24 and 50 feet; though in the case of the Pont du Gard, the span of the largest arch is 80 feet; and in some of their road bridges even greater openings were admitted, as in the bridge of Alcantara, which has a span of 101 feet, and in that of Narni, which has a span of 139 feet. When the material employed was a small rubble stone, with ashlar bond courses, the spans usually varied from 18 to 36 feet; and when rubble or brick-work alone were used, the spans were limited to 24 feet, as a maximum, and were usually made from 15 to 18 feet. The width of the aqueduct varies from $\frac{1}{2}$ to $\frac{1}{4}$ of the openings, and the thickness of the piers from $\frac{1}{3}$ to $\frac{1}{5}$ of the span, though there are many examples in which they are made equal to the latter. When the height was considerable the aqueducts were built in tiers; but until the clear height under the key-stone attained 80 feet, the Roman engineers do not appear to have hesitated in executing such works with only one range of arches; when that height became from 90 to 160 feet, it was customary to construct two ranges of arches; and when it became from 180 to 250 feet three ranges were introduced. Their engineers seem also to have studied carefully the laws of perspective in designing these structures; for the proportions of the respective ranges of arches are almost always such as to produce the most agreeable effect upon the eye. The height from the ground to the underside of the first tier was usually made equal to $2\frac{1}{4}$ times the opening of the arches; the distance from the underside of the key to the top of the first horizontal line was made about $\frac{1}{3}$ the opening; the second row of arches was made about $\frac{1}{4}$ less in height than the first, and the third row $\frac{1}{4}$ less than the second. In the erection of the great modern aqueduct of Caserta, Vanvitelli neglected to observe these laws of perspective, and he made the upper tier of arches loftier than either of those beneath it; thus entirely marring the effect of what would otherwise have been a very fine monument.

But though the Roman engineers thus habitually resorted to the construction of aqueducts when they were compelled to cross deep valleys, they unquestionably did so from motives of economy, or from dread of deposition in the pipes, rather than from ignorance of the laws of hydrostatics. Gauthey gives a description of a lead pipe dredged from the bed of the Rhone, which had evidently formed part of a reversed syphon in the course of the conduit of Arles; but the most remarkable instance of the use of such reversed syphons by the Romans, in connection, it is to be observed, with ordinary aqueducts, is the one described in Delorme's 'Recherches sur les Antiquités de Lyon.' In this case the water brought from the Mount Pila is carried across several valleys, by means of thirteen aqueducts and three syphons; the first of which syphons, between the hills of Soncieu and Chaponest, is laid in a valley about 2600 feet across, and 217 feet deep; the second between Baunan and St. Foy, in a valley 3458 feet wide, and 325 feet deep; and the third between St. Tranée and the gate of Trion. A description of the Soncieu syphon is added; but it may be important here to observe, that a great deal of the interest attaching to this work arises from the singular illustration it affords of the state of the metallurgic arts amongst the Romans.

The water is admitted, on the upper side, into a reservoir of masonry, in the walls of which are inserted, at about 10 inches from the floor, nine lead pipes, 8¾ inches diameter and 1$\frac{1}{16}$ inches thick. These pipes are carried down the side of the valley on a species of substructure, arched in some places, so as to preserve a regular inclination; they are of the same diameter, as at the commencement, for a distance of 81 feet, and they then bifurcate into pipes of 6 inches diameter each. The eighteen smaller pipes are continued to the bottom of the syphon; but instead of descending quite to the lowest part of the valley, they are carried across an irregular depression of the latter on an aqueduct of about 80 feet maximum height; so that in fact the descending limb of the syphon is only about 164 feet in vertical height, and the descending limb is about 142 feet 2 inches. Midway in the ascending limb, the two 6-inch pipes are re-united into 9-inch ones, and the latter pour the waters they convey into a small reservoir corresponding with the one on the descending side. The Baunan syphon was deeper than the Chaponest one,—in fact, the dip of the descending limb was 282 feet; and therefore the diameter of the pipes at starting was smaller. The St. Tranée syphon was of considerably less importance than either of those above mentioned. Count Caylus, who examined the remains of these pipes very carefully, states that they contained so enormous a quantity of lead, that, even in his day, it would have been worth at least 500,000*l.*: what it must have cost in the time of Claudius Cæsar it would be impossible to say. The engineers of the Ponte dell' Arcate, on the conduit which supplies Genoa with water, adopted, in 1782, precisely the same system of syphon aqueduct thus described as having been used by the Roman engineers at Lyon, substituting cast iron however for lead; and a modification of the same system was even applied by the engineers of the Croton Waterworks, New York.

Amongst the most important aqueducts erected since the fall of the Roman empire may be cited the aqueduct of Spoleto, said, though, without reason, to have been built by Theodoric the Goth. It is however unquestionably of great antiquity; and perhaps it merits more attention than it hitherto has received, if it were only for the sake of correcting the errors printed in all works upon architecture with respect to it. Thus, in all those works, the height of the Spoleto aqueduct is said to be not less than 420 feet; but from recent measurements it would appear that the real height does not exceed, even if it attain, 240 feet. There is a remarkable aqueduct of the Renaissance period near Pavia; and at Caserta is a very lofty one, before mentioned as having been constructed by Vanvitelli: the latter aqueduct is about 2000 feet long and 200 feet high in the deepest part of the valley. At Lisbon there is an aqueduct, erected by Manoel da Maya, a Portuguese engineer, about 1738, of about 2600 feet in length and 231 feet in height; and about the year 1680 Vauban and Lahire had commenced the gigantic ruin which was intended to have carried the Eure to Versailles. This work was designed to have been of a total length of 3¼ miles nearly, and of a height of 234 feet. The aqueduct of Montpellier is about 2300 feet long and 92 feet high, in round numbers; whilst [the Roquefavour aqueduct, lately erected near Marseille, is 1312 feet long by not less than 282 feet in height. In England there are some large canal aqueducts, such as the Chirk and Pont y Cyssylte bridges, of cast iron, erected by Telford, and the Lune aqueduct, erected by Rennie; and of late years some remarkable works of the same description have been erected in France and in Italy, either for the canal or the irrigation works of those countries; but all these works sink into insignificance when compared with the aqueducts recently erected by the engineers connected with the Irrigation departments of our Indian empire. The great Solani aqueduct, upon the Ganges canal, is, for instance, of about 1050 feet in length, with an average height of 51 feet; but as the area of the water-way in the Solani aqueduct is as nearly as may be 80 times as much as that of the aqueduct of the Pont du Gard, it would be impossible to draw anything like a comparison between the two.

It may be necessary to add, that English engineers have almost entirely abandoned the use of aqueducts for town supplies, and that they have substituted for those costly monuments the simpler system of laying reversed syphons in the valleys through which they have to carry a water supply. In the cases of the Liverpool, Manchester, and Glasgow water-works, some remarkable illustrations of this practice may be observed, which will be noticed hereafter under the head SYPHON, REVERSED.

A'QUILA (the Eagle), a constellation situated above, so as to rest on, Capricornus and Aquarius. It may be readily found by means of the head of Draco and the bright star α Lyræ, since a line passes between β and γ Draconis, and through α Lyræ, passes through a bright star of the first magnitude, α Aquilæ, cutting also two stars of the third magnitude, β and γ, situated directly above and below α. This constellation is on the meridian at 8 o'clock P.M. in the middle of September, at about 40° of elevation. The following is an analysis of the number of stars visible to the naked eye in this constellation, arranged in the order of their respective magnitudes:—

Magnitude.	Number of Stars.
1·5	1
3	3
3·5	4
4·	2
4·5	1
5	10
5·5	12
6·	28
Total number	61

The stars down to the 4th magnitude inclusive are thus designated:—

Character.	No. in Catalogue of Flamsteed.	No. in Catalogue of British Association.	Magnitude.
ϵ	13	6487	3·5
λ	16	6526	3
ζ	17	6528	3
δ	30	6646	3·5
κ	39	6713	4
γ	50	6772	3
α	53	6802	1·5
η	55	6811	4
β	60	6833	3·5
θ	65	6934	3·5

In the Greek mythology, this constellation represents the eagle of Jupiter. According to some, it is the bird which was the tormentor of Prometheus. M. Dupuis conjectures, but with very little probability, that the name was given when Aquila was near the summer solstice, and that the bird of highest flight was chosen to express the greatest elevation of the sun.

The constellation Antinous is usually considered as a part of Aquila, and is treated as such in catalogues. It is represented as a boy in the grasp of the eagle, and its principal stars are η, θ, ι, κ, and λ, in the above catalogue. It is said to have been placed in the heavens by the order of the Emperor Hadrian, in memory of a favourite of that name, who is generally supposed to have perished in the Nile, A.D. 131. Others have supposed it to refer to the fabulous history of Ganymede, who was carried to heaven by the eagle of Jupiter; but this is rendered unlikely by the silence of Ptolemy, who, though he speaks of the group of stars in question, does not call them the constellation Antinous, but simply "unformed stars, among which is Antinous." Had the two figures originally contained any reference to the mythology above alluded to, it is most probable that the constellation would have been regularly distinguished long before the time of Ptolemy.

ARA (the Altar), a southern constellation, not visible in our latitude. It is situated near Lupus, above Pavo and Triangulum Australe, in such manner that the Centaur appears to be placing the wolf upon the altar. One mythological account explains it as the altar upon which Chiron sacrificed a wolf; another, as an altar constructed by Vulcan, upon which the gods swore fidelity to each other during the war against the Titans.

The following is a classified enumeration of the stars visible to the naked eye in this constellation:—

Magnitude.	Number of Stars.
3	3
3·5	1
4	3
5·5	4
6	48
Total number of stars	59

Subjoined are the designations of the principal stars:—

Character.	No. in Catalogue of Lacaille.	No. in Catalogue of British Association.	Magnitude.
θ	7535	5683	4
α	7301	5697	3
δ	7271	5850	4
β	7237	5852	3
γ	7233	5877	3
ϵ'	7050	5899	4
ζ	7034	6105	3½

ARABESQUE. This term is applied to a species of ornament, or mode of enrichment on flat surfaces, employed in works of architecture principally; though more commonly applied to painted ornament, the term is also applied to mosaics and to sculpture in low relief. The name is intended to mean simply "in the Arabian manner," and is a French form of that expression. The mode of enrichment which it refers to, was practised in the decoration of their structures by the Moors, Saracens, or Arabians of Spain, and from them particularly the species of ornament to which it belongs was so designated: the Alhambra affords almost endless examples of this description of Arabian ornament. As far as the Mohammedan conquerors of Spain were concerned, they appear to have borrowed the idea from the hieroglyphical enrichments of the monuments of Egypt. The dogmas of their religious code, however, forbidding the representation of animals, in order to avoid the very semblance of idolatry, they employed plants and trees in a similar manner, and with stalks, stems, tendrils, foliage, flowers, and fruit, produced an endless variety of forms and combinations, with which they painted and sculptured the surfaces of their buildings. Hence fanciful combinations of natural objects to form the continuous ornament of a flat surface came to be called Arabesque, though they differed so widely from the Arabian or Mohammedan compositions as to be filled with representations of animals of every variety, and with combinations of plants and animals, as well as combinations of animal forms almost equally discordant with nature. The name, indeed, has become so general as to be applied to the fanciful enrichments found on the walls in the ruins of Herculaneum and Pompeii, as well as to others of the same and earlier date, which were formed and forgotten long before the sons of Ishmael learned to draw.

Among the ancients, this style of ornament was most practised by the Etruscans, who largely introduced it in wall-paintings, vases, mirrors, &c.; indeed, it seems to have been singularly congenial to their turn of mind. (Muller, 'Etrusker,' ii.; Inghirami, 'Monumenti Etruschi;' Agincourt, &c.) It was from the frequent recurrence of these extravaganza decorations in the Etruscan grottoes, that what are now more generally called Arabesques used to be commonly styled Grotesques. Among the bizarre decorations of the Etruscans oriental forms often occur, which were no doubt obtained in the course of their commercial intercourse with the East. Among the Romans a taste for fantastic combinations was very prevalent in the days of Vitruvius and Pliny, both of whom strongly condemn it. In all, the object seems to have been to produce a cheerful fanciful effect. Sometimes the arabesques on the walls of Roman houses were made to serve as frames of larger pictures.

The most celebrated arabesques of modern times are those with which Raffaelle ornamented the piers and pilasters of the arcaded gallery of the palace of the Vatican, which bears his name. As Hittorff has pointed out, Raffaelle most probably received his first impression of the value of arabesques for the decoration of palatial apartments from those on the walls of the newly excavated Baths of Titus. The later discoveries in Pompeii and Herculaneum were of course unknown to Raffaelle and his scholars. Although the gallery of the Vatican, or rather the three galleries, for it is in three lengths, are always distinguished as Raffaelle's Galleries ("le Loggie di Raffaelle"), because of the arabesques and of the illustrations of the Bible history in the ceilings, only one of the three sides exhibits the designs of the great artist himself. As mere decoration the effect is by no means satisfactory. Their variety and irregularity, and their entire want of harmony with the subjects of the scriptural paintings, have been justly objected to, and they certainly detract from the simplicity and grandeur of the architecture. In the Villa Madama, the arabesques of which were designed by Raffaelle subsequently to those of the Vatican, and executed by his scholars, Giulio Romano and Giovanni da Udine, the subjects are entirely mythological, and they are treated in the manner of the ancient wall-paintings. (Grüner, 'Fresco Decorations of Churches and Palaces in Italy, during the 15th and 16th Centuries.')

From the time of Raffaelle arabesque painting rapidly declined. It was revived in France under Louis XV., but in a very meretricious style. During the present century it has been a good deal practised among the Germans, and some of the most eminent painters, as Kaulbach and others, have attempted it with more or less success. The best examples are at Munich and Berlin. Kept within proper bounds, it may be made a very effective means of ornamenting buildings and public rooms, especially those to which it is desirable to impart a gay, lightsome, and festive character.

M. Hittorff, in his 'Essay on the Arabesques of the Ancients, as compared with those of Raffaelle and his School' (p. xvi.), prefixed to the work of Mr. Grüner, cited above, lays down the following as the principles which should guide the artist in producing works like these:—

"That immoderate multiplicity fatigues the eye; that excessive copiousness causes many objects to be condemned as useless; that unity of conception, proportion of parts, and symmetry in the principal decorations, are indispensable laws never to be neglected."

ARA'BII were, according to St. Augustin ('Hæres.' c. 83), a sect of Christians in Arabia, who believed the human soul to be mortal, and that it is dissolved by death together with the body, but will be restored to life at the resurrection. Mosheim (in 'Commentariis de Rebus Christianorum ante Constantinum Magnum,' ed. 1753, p. 718, et seq.) thinks that the materialism of Epicurus had some influence on the origin of this sect: but it is more likely that the prevailing opinion in those days of the materiality of the human soul occasioned their heretical inferences. The Arabii were confuted and converted by Origen in a synod held in Arabia, A.D. 246 (Mansi 'Collectio Conciliorum,' t. i. p. 789.

ARABIN. [GUM.]

ARABLE LAND, so called from the Latin word *arare* 'to plough, is that part of the land which is cultivated chiefly by means of the plough.

Land in general is divided into arable, grass land, wood land, common pasture, and waste. The first of these is by far the most important in agriculture. In this article we shall briefly explain the principles on which are founded the most improved methods of cultivating arable land, by which the natural produce of the soil is greatly increased, and many productions are obtained in perfection which are foreign to the soil and climate.

1. We shall, first, consider the nature and properties of various soils.
2. The best modes of preparing and improving the natural soil, so as to increase its produce.
3. The most advantageous succession of crops, so as to obtain the greatest returns, with the least diminution of fertility.

Of soils.—When the surface of the earth is penetrated, we generally find that the appearance, texture, and colour vary at different depths. There is a layer of earth nearest the surface, of greater or less thickness, which covers the more solid and uniform materials which lie below it. This may be particularly observed wherever there are natural or artificial excavations or pits. A distinct line, nearly parallel to the surface, generally marks the depth of the upper soil, and separates it from the sub-soil. The soil is more or less composed of minute parts of various kinds of earth, mixed with animal and vegetable substances, in different states of decomposition; and to these, in a great measure, it owes its colour, which is generally darker than that of the subsoil. Except where iron, peat, coal, or slate abounds in the soil, a dark colour is an indication of corresponding fertility. The rich soil of gardens, long cultivated and highly manured, is nearly black. As the soil is the bed in which all vegetable productions are to be reared, and in which they are to find their proper nourishment, its texture and composition become objects of great importance to the cultivator; and, without a competent knowledge of these, no practical rules can be laid down or depended upon.

All soils are composed of earths,* metallic oxides, saline substances, vegetable and animal matter, and water. The earths are chiefly clay, or alumina, sand or silica, and lime.

Magnesia, barytes, and other earths, are occasionally met with, but in so few instances that they may be omitted in the list.

Of the metals, the most abundant is iron in the state of peroxide. The other metals are rarely found near the surface.

Saline substances form a small part of the soil, but an important one.

Potash exists in almost every vegetable, soda in a few, and ammonia is produced by the decomposition of almost all kinds of vegetable and animal matters, but it is very liable to waste, owing to its volatile nature and the extreme solubility of almost all its compounds.

Vegetable acids are more or less fully developed in all such decaying vegetable matters as exist in the soil. And in combination with some base, as lime or potash, they form part of the food which the roots of plants absorb.

The mineral acids are found united with earths and alkalies, in the state of neutral compounds.

These saline substances have a powerful effect on vegetation, and a knowledge of their proportions in the soil and of their various qualities, is indispensable if we would attempt to modify or correct their action by the addition of other substances for which they have an affinity.

Water, in a state of combination, or of mere mechanical diffusion, is essential to the growth of all plants: without it and atmospheric air, there is no life either animal or vegetable.

Of the Earths.—Clay or alumina, so called because it is obtained in its purest state from alum, in which it is combined with sulphuric acid,† is the basis of all strong and heavy soils. When it is minutely divided, it is easily suspended in water; when dried slowly and stirred while drying, it becomes a fine powder soft to the feel, and when kneaded with water, a tough ductile mass easily moulded into vessels which retain liquids. This property, of being comparatively impervious to water, gives the specific character to clay as an ingredient of the soil. In a pure and unmixed state it is barren. When clay is heated to a great degree, it parts with the water combined with it; it is then said to be baked, as we see in bricks. It is no longer diffusible in water, and differs little from silica or sand in its effects on the soil.

Silica, or the earth of flint, suffers no change in water. It consists of crystals, or fragments, of very hard stone, forming *gravel* or *sand*

* We retain the old division, although the earths have been ascertained to be oxides of peculiar metals; but as they are never found in the soil in their metallic state, the results and reasonings are not affected by this circumstance.

† Sulphuric acid, commonly called oil of vitriol, is composed of sulphur and *oxygen* which is about one-fifth part of the atmosphere.

according to their size; and the finest siliceous sand, when examined with a magnifying glass, has the appearance of irregular fragments of stone without any cohesion between them.

Siliceous sand holds water in its interstices by simple cohesive attraction in proportion to its fineness. It heats and cools rapidly, letting the water pass through it readily, either by filtration or evaporation. Its use in the soil is to keep it open, to let the air and water, as well as those other substances on which the growth of plants depends, circulate through it. Unmixed, it dries so rapidly that no vegetation can continue in it, unless a constant supply of moisture be given by irrigation. A small portion of clay will much improve light sands; it takes a large quantity of sand to correct the tenacity of clay.

Lime in its pure state is familiar to every one as the basis of the mortar used in building. It is produced by burning marble, chalk, limestone, or shells, in a great heat. In the stones which are formed principally of lime, it is combined generally with carbonic acid, which separates from it by the operation of burning, in the form of an air or gas, hence called *fixed air*, from its being thus *fixed* in a stone. These stones, of various degrees of hardness, are now all classed under the name of carbonates of lime.

Lime unites readily with water, which it also absorbs from the atmosphere. It then becomes *slaked*. By uniting with carbonic acid, it returns to its former state of carbonate; with this difference, that, unless much water be present, it remains a fine impalpable powder. Pure lime is soluble in water, though sparingly; a pint of water cannot dissolve more than about twenty grains: the carbonate is not soluble in simple water; though in water containing carbonic acid, it readily dissolves. Carbonate of lime has a powerful effect on the fertility of a soil, and no soil is very productive without it. It is consequently used extensively as an improver of the soil, otherwise called a *manure;* but its use in this respect, and the mode in which it acts, will be given in the articles MANURE and LIME.

Carbonate of lime, as an earth, is neither so tenacious as clay, nor so loose as sand. In proportion to the fineness of its particles it approaches to the one or the other, and when the parts are large and hard it takes the name of limestone gravel. Its distinguishing feature is its solubility in acids, which it neutralises, depriving them of their noxious qualities in the soil.

A proper mixture of these three earths, in a due state of mechanical division, forms a soil well fitted to the growth of every species of plants, especially those which are cultivated for food; and nothing more is required than a proper climate as to heat, a proper degree of moisture, and sufficient nourishment, to make all the plants generally cultivated thrive most luxuriantly in such a mixture, which is usually called a loam.

But there are some soils, which, besides a proper mechanical texture and mixture of earths, contain a large proportion of a natural manure which renders them extremely fertile. This is a substance produced by the slow decay of animal and vegetable matter. It can be separated from the other parts of the soil, and has been accurately analysed and described by many of the most experienced chemists, particularly by Fourcroy, Davy, Chaptal, and Theodore de Saussure. (See 'Recherches Chimiques sur la Vegetation,' Paris, 8vo, 1804.) This substance has been called *vegetable mould;* but, as this is not a very distinct term, we shall, after Thaer and other eminent writers on agriculture, adopt the name of *humus* when speaking of it. Humus is a dark, unctuous, friable substance, nearly uniform in its appearance. It is a compound of oxygen, hydrogen, carbon, and nitrogen, which along with certain mineral ingredients. are the elements of all animal and vegetable substances. It is the result of the slow decomposition of organic matter in the earth, and is found in the greatest abundance in rich garden mould, or old neglected dunghills. It varies somewhat in its qualities and composition, according to the substances from which it has been formed and the circumstances attending their decay. By bringing fresh portions of soil to the surface and permitting the access of air to it, this half-decayed vegetable matter is made to undergo still further changes resulting in carbonic acid and other substances in a form adapted to the nourishment of the growing plant. Hence we see the great importance of frequently stirring the surface of the earth between cabbages and other vegetables.

We can now readily understand the great importance of humus, and of those rich manures which are readily converted into it when not immediately absorbed by plants. But this vegetable ingredient of the soil has still another property, highly important to fertility: it renders stiff clays porous, and consolidates loose sands. It does so more than lime, or any other earth. Hence a soil with a considerable proportion of humus is much more fertile than the quantity of other substances in its composition would lead one to expect, as we shall see when we come to the analysis of soils of known fertility; and we see the great advantage of animal and vegetable manures, not only as nourishment to vegetables, but as mechanical improvers of the texture of soils.

The greatest enemy of humus is stagnant water; it renders it acid and astringent, as we see in peat; and soils abounding with vegetable matters, from which water is not properly drained, become *sour*, as is very justly said, and produce only rushes and other useless and unpalatable plants. The remedy is simple and obvious; drain well, and neutralise the acids with lime; by these means abundant fertility will be restored.

In very light soils humus is seldom found in any quantity, being too much exposed to the air and rapidly decomposed; the extract is washed through them by the waters, and as they waste manure rapidly, they are called *hungry*. Such soils are very unprofitable until they are improved and consolidated by clay or marl, which makes them retain the moisture.

With calcareous earths humus acts well, provided they are pulverised and of sufficient depth. Some chalky soils are rendered very fertile by judicious culture and manuring.

In order to ascertain the probable fertility of a soil, it is very useful to analyse it and find out the proportion of its component parts. To do this with great accuracy requires the knowledge of an experienced chemist; but certain steps in the process of analysis may be easily taken by any person possessed of an accurate balance and weights, and a little muriatic acid. For this purpose, some of the soil, taken at different depths, not too near the surface (from four to eight inches, if the soil is uniform in appearance), is dried in the sun till it pulverises in the hand, and feels quite dry: the small stones and roots are taken out, but not minute fibres. A convenient portion of this is accurately weighed: it is then heated in a porcelain-cup, over a lamp or clear fire, and stirred till a chip or straw put in it turns brown. It is then set to cool, and weighed; the loss of weight is the water, which it is of importance to notice. Some soils, to appearance quite dry, contain a large proportion of water; others, scarcely any. It is then pulverised and sifted, which separates the fibres and coarser parts. The remainder, again weighed, is stirred in four or five times its weight of pure water; after standing a few minutes to settle, the water is poured off, and it contains most of the humus and soluble substances. The humus is obtained by filtration, well-dried over the lamp, and weighed. The soluble substances are obtained by evaporating the water; but, unless there is a decidedly saline taste, this may be neglected. The humus may be further examined by heating it red hot in a crucible and stirring it with a piece of the stem of a tobacco-pipe, when the vegetable part will be consumed, and the earths remain behind; thus the exact quantity of pure vegetable humus is found. Some muriatic acid, diluted with five times its weight of water, is added to the deposit left after pouring off the water containing the humus and soluble matter: the whole is agitated, and more acid added gradually, as long as effervescence takes place, and until the mixture remains decidedly acid, which indicates that all the calcareous earth is dissolved. Should there be a great proportion of this, the whole may be boiled, adding muriatic acid gradually, till all effervescence ceases; what remains, after washing it well, is siliceous and argillaceous earth. These are separated by agitation, allowing the siliceous part to settle, which it does in a few seconds. The alumina is poured off with the water, filtrated, heated over the lamp, and weighed,—the same with the siliceous sand. The loss of weight is calcareous earth. In this manner, but with greater care and more accurate tests, various soils of known fertility have been analysed, of which we will give a few examples.

A very rich soil near Drayton, Middlesex, examined by Davy, consisted of $\frac{3}{5}$ of siliceous sand and $\frac{2}{5}$ of impalpable powder, which analysed, was found to be composed of

	Parts.
Carbonate of lime	28
Siliceous earth	32
Alumina	29
Animal and vegetable matter	11
	100

This is a rich sandy loam, probably long and highly manured, fit for any kind of produce, and, if deep, admirably fitted for fruit trees.

Another good turnip soil, also examined by Davy, consisted of eight parts of coarse siliceous sand, and one of fine earth, which, being analysed, consisted of—

	Parts.
Carbonate of lime	63
Silica	15
Alumina	11
Oxide of iron	3
Vegetable and saline matter	5
Water	3
	100

This is a very light sandy soil, and owes its fertility to the fine division of the carbonate of lime and the vegetable and saline matter. It may probably have been limed or marled at some time or other.

The best loam in France, according to Mr. Tillet, consists of

	Parts.
Fine siliceous sand	21
Coarse ditto	25
Carbonate of lime	37·5
Alumina	16·5
	100

A loam at Chamart, highly prized by gardeners about Paris, as the basis of their artificial soils, consists of

	Parts.
Argillaceous sand	57
Finely divided clay	33
Siliceous sand	7·4
Carbonate of lime, coarse	1
Ditto, fine	0·6
Woody fibre	0·5
Humus and soluble matter	0·5
	100

The argillaceous sand is composed of fragments of soft stone, which retain moisture, and do not bind hard; the small proportion of humus is of no consequence where manure is to be had in any quantity.

A very rich heath or bog-earth found at Meudon, and in great request for flowers and in composts, consists of

	Parts.
Gritty siliceous sand	62
Vegetable fibres partly decomposed	20
Humus	16
Carbonate of lime	0·8
Soluble matter	1·2
	100

This soil, like our bog earth, would be very unfit for the growth of corn, but, from the quantity of vegetable matter, is highly useful in composts and artificial soils. Mixed with lime, it would make an excellent top-dressing for moist clay soils.

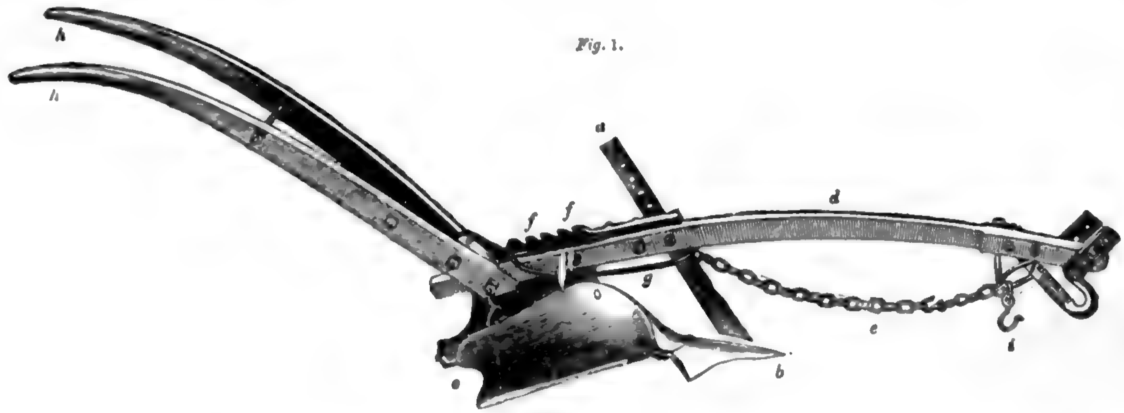
The above analyses give but a rough idea of the composition of a soil; in fact they for the most part indicate those causes of fertility or barrenness in soils, which reside in their varying texture or in their relations to water, rather than those which act by the abundance or deficiency of those substances which are the food of plants. An analysis which shall fully explain the fertility of a soil, must tell us not only the quantity and condition of the sand, and clay, and lime, and humus of a soil, but also the quantities of potash, soda, magnesia, phosphoric acid, sulphuric acid, chlorine, soluble silicates, and ammonia present in it. It is the presence, whether of humus or any other ingredient which shall, by the operation of atmospheric solvents, gradually yield to the growing plants such substances as these, which determines the fertility or infertility of a soil. And since the publication of Liebig's writings on Agricultural Chemistry, the importance once attributed to the presence of mere humus in the soil as the true index of its fertility, has disappeared. It is now known that the decaying vegetable matter of a soil is of service, not only as itself yielding, by its gradual destruction, food for plants, but also, and even chiefly, by its action as a ferment on the stores of food laid up in the clays and purely mineral portions of the soil, as well as by the facilities of access given, by its mixture with these mineral matters, to the air and water of the atmosphere, which by their disintegrating and decomposing operations, let loose from these stores much that is naturally locked up and useless.

Of course, the depth of the soil and the nature of the subsoil greatly affect the value of land. However rich it may be, if there is only a thin layer of good soil over a sharp gravel or a wet clay, it can never be very productive: in the first case, it will be parched in dry weather; and in the latter, converted into mud by every continued rain. If the subsoil be loam or chalk, six inches of good soil will be sufficient. With a foot of good soil, the subsoil is of little consequence, provided it be dry, and the water can find a ready outlet. The best alluvial soils are generally deep; the chalky, shallow. It is of importance to observe, that not only does fertility depend on the presence in the soil of abundant food for the growth of plants, but also on there being sufficient freedom of passage through it for the rain-water, which, as it traverses the soil, dissolves out this food, and takes it by the roots of plants, thus giving them an opportunity of absorbing it. A soil in which water is stagnant, or through which it cannot pass, is necessarily barren; the plants which would grow upon it starve, because there can be no circulation through it of dissolved food, no opportunity therefore of supplying the roots with fresh supplies of nourishment. It is to its thus providing for the circulation through the soil of food for plants, that the fertilising influence of land drainage is chiefly due; but the reader must be referred to the article DRAINAGE for a fuller explanation of its operation.

The exposure, with respect to the sun, and the declivity of the ground, are very important circumstances in the value of land; they are indeed equivalent to an actual difference in the climate. A gentle declivity towards the south, and a shelter against cold winds, may make as great a difference as several degrees of latitude; and in comparing the value of similar lands in different climates, the average heat and moisture in each must be accurately known. A soil very fertile in the south of Europe may be very unproductive in England; and a light soil of some value in the west of Scotland, might be absolutely barren in Italy or Spain.

Of the Cultivation of the Soil.—The better the soil, the less cultivation it requires to produce tolerable crops; hence, where the land is very rich, we find in general a slovenly culture; where the ground is less productive, more labour and skill are applied to compensate for the want of natural fertility. The simplest cultivation is that of the spade, the hoe, and the rake,—and on a small scale it is the best; but spade husbandry cannot be carried to a great extent without employing more hands than can be spared from other occupations. The plough, drawn by oxen or horses, is the chief instrument of tillage, and has been so in all ages and nations of which we have any records. Its general form is familiar to every one, and requires no minute description. The various kinds of ploughs in use at different times, and the improvements which have been made, and are attempted, daily, will be noticed in a separate article. [PLOUGH.] Suffice it to say at present, that a plough should as much as possible imitate the work done with a spade. It should cut a slice from the land by its coulter (*a*) vertically, and by the share (*b*) horizontally lift it up, and turn it quite over by means of the mould-board (*c*); and the art of the plough-

Fig. 1.



[Plenty's Swing Plough.]

a, The coulter.
b, The point of the share.
c, The mould-board.
d, The beam.
e, The chain by which it is drawn; *g*, a long iron link to which the chain is fixed, which can be hooked in any of the notches, *f f*, altering the line of draught.
h h, The handles, or stilts.
i, The hook to draw by.

man consists in doing this perfectly, and with such a depth and width as suit the soil and the intended purpose. In rich mellow soils a ploughed field should differ little from a garden dug with the spade. In tenacious soils, the slice will be continued without breaking, especially if bound by the fibres and roots of plants; the whole surface will be turned over, and the roots exposed to the air: it is of great consequence that each slice be of the same width and thickness, and the sides of it perfectly straight and parallel. The plane of the coulter must be perfectly vertical, and that of the share horizontal, in order that the bottom of the furrow may be level, without hollows or *baulks*, which are irregularities produced by the rising or sinking of the plough, or inclining it to either side. The ancients were very particular in this respect, and recommended sounding the earth with a sharp stake, to ascertain whether the ploughman had done his duty. There are various modes of ploughing land, either quite flat, or in *lands* or stitches, as they are called in England, and, in Scotland *riggs*, that is in portions of greater or less width, with a double furrow between them—somewhat like beds in a garden. Sometimes two furrow slices are set up against each other, which is called ridging or *bouting;* the land then is entirely laid in high ridges and deep furrows, by which it is more exposed to the influence of the atmosphere and kept drier; this is generally done before winter, especially in stiff wet soils. Sometimes two or more ridges are made on each side, forming narrow stitches. When the ground is to be ploughed without being laid in lands or stitches, and all the ridges inclined one way, the mould-board of the plough is shifted at each turn from one side to the other. The plough which admits of this is called a *turn wrest plough,* and is in general use in Kent, and in many parts of the Continent, where the subsoil is dry and the land not too moist. In most other situations the ground is laid in *lands,* and the mould-board of the plough is fixed on the right side. When grass land or stubble is ploughed, care must be taken to bury the grass and weeds completely, and the slice cut off by the plough must be turned over entirely, which is best done by making the width of the furrow greater than the depth. When the grass and weeds are rotten, and the ground is ploughed to pulverise it, a narrow deep furrow is best; the earth ploughed up is laid against the side of the preceding ridge, which forms a small furrow between the tops of the ridges, well adapted for the seed to lodge in and to be readily covered with the harrows.

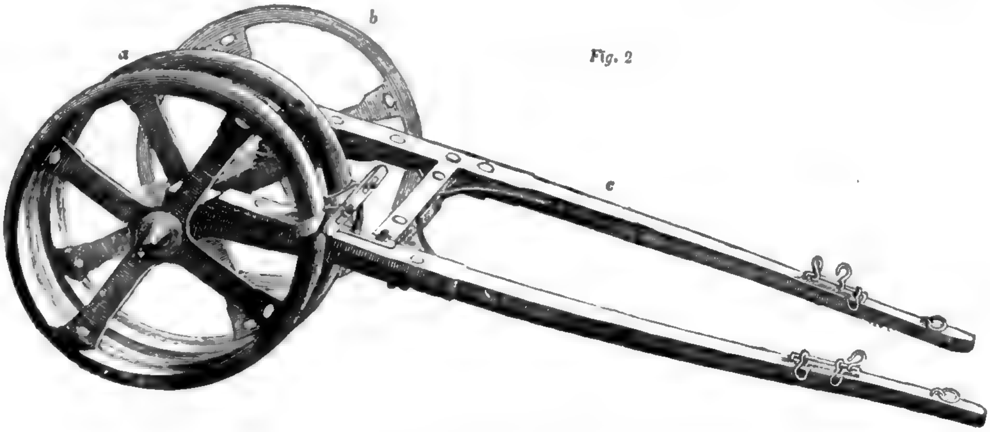
Nothing has divided both practical and theoretical agriculturists more than the question whether the land should be ploughed deep or shallow; but a very slight attention to the purposes for which land is ploughed, and to the nature of the soil, will reconcile these apparently contradictory opinions. A deep, rich, and stiff soil can never be moved too much nor too deep: deep ploughing brings up rich earth, admits the air and water readily, and gives room for the roots to shoot, whilst the rich compact soil affords moisture and nourishment. Wherever trees are to be planted, the ground should be stirred as deep as possible, even in a poor soil: for grass and corn, however, this is not always prudent; for though their roots traverse a considerable depth of soil, yet the principal portion of them terminates in the surface soil; and in addition to this there is, in reference to some plants, an advantage in preserving a firm texture of subsoil.

Whenever the soil below a certain depth is of an inferior quality, there can be no use in bringing it up, until by tillage and land draining it has been improved; and where the soil is light and porous, the bottom had, as we have said, for many plants better not be broken. In such soils, indeed, it is usual rather to attempt the artificial consolidation of the land than to loosen it; and to this end the *land-presser* or *press-drill* is used. This instrument consists of two very heavy cast-iron wheels, *a a, fig.* 2, with angular edges, set on a common axle, at a distance from each other equal to the width of the furrows, and a lighter wheel, *b*, to keep the instrument vertical.

It is drawn by a horse immediately after the plough; pressing two furrows at once, and going twice over each furrow, or if it follows two ploughs, once only. It leaves the land in regular drills, and the seed sown by hand falls into the bottom of the drills, and is covered by the harrows. When the plants come up they appear in regular parallel rows.

The great object in ploughing land is to divide it, expose every part

Fig. 2



Press Drill or Land Presser.

of it to the influence of the elements, and destroy every plant or weed but those which are sown in it. To do this perfectly requires several ploughings, with certain intervals, and during that time no crop can be upon the land. This is the real use of fallows, and not, as was once supposed, to allow the land to rest; on the contrary, it ought then to have the least repose.

Where the soil is good, with a porous subsoil, the greatest care should be taken not to go too deep; but where the subsoil is compact and impervious to water, but not wet for want of outlet or draining, it is useful to stir the soil to a great depth, but without bringing it to the surface, which may be done by a plough without a mould-board, following a common plough in the same furrow. This is an excellent auxiliary to draining, at the same time keeping a reservoir of moisture, which in dry weather ascends in vapours through the soil and refreshes the roots.

The mode in which the soil is prepared most perfectly for the reception of the seed, is best shown by following the usual operations on fallows. After the harvest, the plough is set to work, and the stubble ploughed in. The winter's frost and snow mellow it, while the stubble and weeds rot below. In spring, as soon as the weather permits, it is ploughed again, the first ridges being turned over as they were before: this completes the decomposition of the roots and weeds. It is then stirred with harrows or other instruments, which tear up the roots which remained, and some of these not being easily destroyed, are carefully gathered and burnt, or put in a heap to ferment and rot, a portion of quicklime being added. Another ploughing and stirring follows, at some interval, till the whole ground is mellow, pulverised, and free from weeds; manure is put on, if required, and immediately spread and ploughed in; the land is then prepared for the seed.

This has been the method universally followed by all industrious husbandmen from the oldest times. The Romans had names for each of the ploughings: the first was *frangere,* the next *vertere,* the third *refringere,* and the fourth *revertere;* more ploughings were often given, and in modern agriculture the direction of the third ploughing is sometimes changed across the old furrows, at a right, or acute angle, as Virgil recommends ('Georgica,' i. 98), by which the earth is still better divided and mixed. The best modern practice does, however, now so far depart from the ancient model, that a greater portion of cultivation is generally effected before winter. The practice of autumn cultivation of stubbles has greatly increased of late years. A thorough cleansing of stubble land, and even the manuring of it previous to the last ploughing before winter, is now often accomplished. The soil is then left in such a state, that it only needs a stirring and harrowing in the spring, to be ready for most of the spring-sown crops.

Various instruments have been invented to stir the earth and mix it, without so often using the plough, and also to loosen and separate roots and weeds; of these the principal are, the cultivator or scarifier, which enters but a few inches into the ground, and moves a great surface by means of tines, or iron teeth of various constructions. The whole instrument is made of iron: *a a,* the frame; *b,* the beam; *c c,* rods by which it is drawn, the horses being attached by a hook at the point *d; e e,* the handles; *f f f,* different-shaped shares and tines to be used according to the state of the soil; *g g g,* contrivances by which the teeth are fixed to the frame at any required distance from each other, and lengthened or shortened; *h h h,* three wheels to regulate the depth of the ground moved. By raising the beam and fixing it higher or lower on the piece (*i*), by means of an iron pin passed through the different holes, the whole instrument is raised or depressed in the ground. *Fig.* 3 represents a simple form of this tool. Coleman, Bentall, Ransome, and many other manufacturers, have better and more efficient implements of the kind.

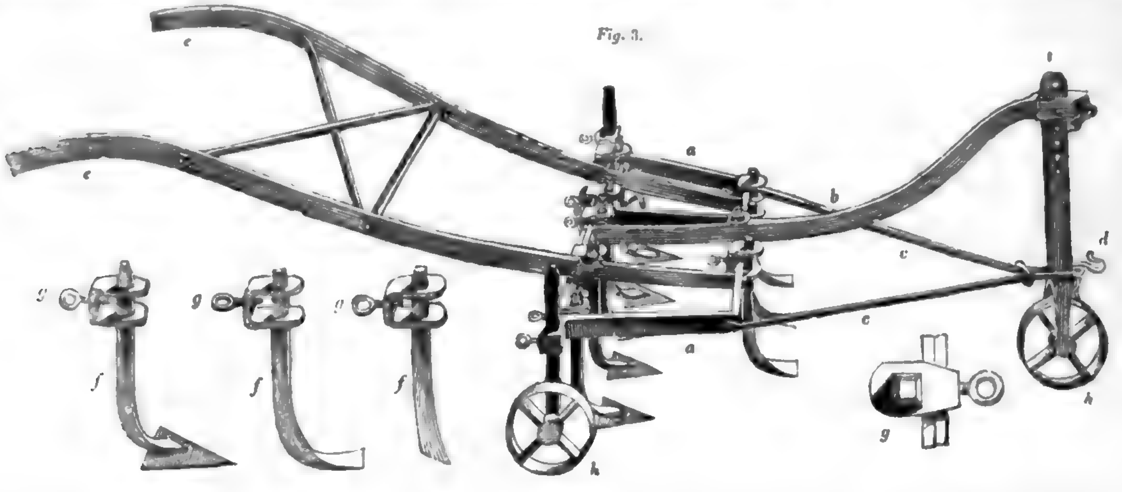
This instrument divides the soil, but does not turn it over; it is well calculated to destroy roots and weeds, and let in the air; but, evidently, is only adapted to tolerably loose and mellow soils, where there are no large stones.

An ingenious harrow or cultivator has been invented by Finlayson, which rakes the weeds out of the ground, and throws them on the surface without clogging the instrument; it is excellent in light soils (*fig.* 4).

When the soil turned up by the plough is in large hard lumps, a roller, smooth, ribbed, or toothed, is drawn over the land to break the clods. The need of this is greatly increased where very stiff soils have been ploughed when too wet, and the ridges have dried, and been ploughed again in dry weather. Deep wet clay soils should be carefully watched, to know when is the proper time to plough them; nothing pulverises them like frost, and if they are kept from wet by careful draining and numerous water furrows in autumn, they will be loose and friable in spring; they had better not be touched than worked when too wet. On light soils the plain roller is used to advantage to produce firmness, without which the plough cannot so well turn the ground over completely, but merely pushes it to the right and left.

The great expense of teams for the plough has led to expedients and inventions to lessen the labour; but, in general, a more imperfect cultivation has resulted from it. Columella mentions one Celsus, whom he blames because, to 'save the expense of a stronger team, he only

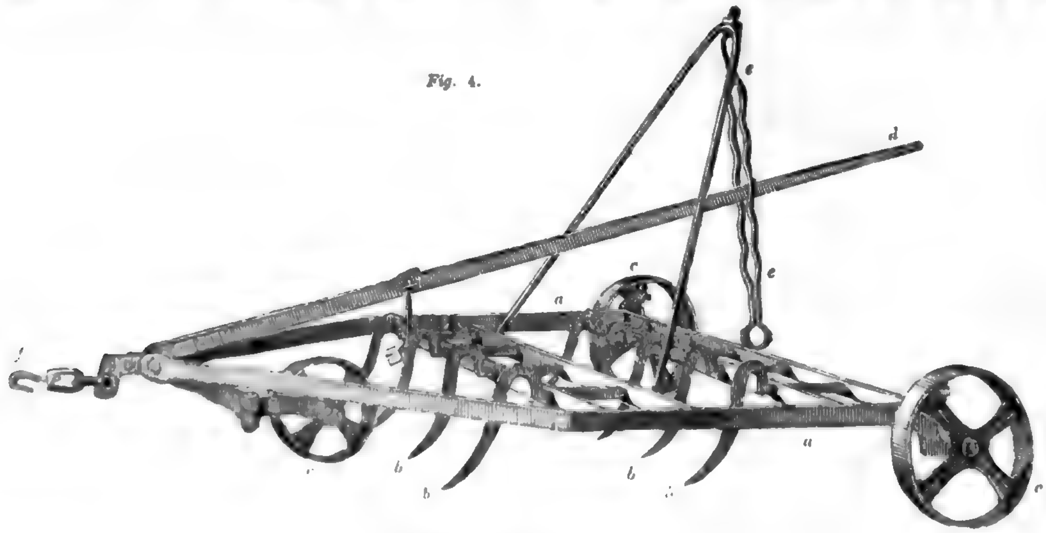
Fig. 3.



Scarifier.

scratched the ground with small shares and toothed instruments (*exiguis vomeribus et dentalibus*);' and a modern agriculturist of some note has revived the practice of Celsus. General Beatson, who had been in India and had seen the simple instruments used there by the natives, substituted for the plough and cultivators in common use, various light instruments, of which he published an account. He recommended stirring the soil only a few inches deep, except occasionally; and, by means of burnt clay, which he used in great abundance, he produced a succession of good crops: but he had too high an opinion of the fertilising qualities of burnt clay, which made him undervalue animal and vegetable manure; and although he may have improved the texture of his heavy soil by the burnt clay, which is

Fig. 4.



[Finlayson's Patent Harrow.]

a, a, The iron frame. *b, b,* The teeth, shaped so, as to turn the weeds over.
c, c, c, Three small wheels, of which the foremost is brought forward by depressing the lever *d*, and raising the teeth out of the ground.
e, Is a contrivance to keep the lever, *d*, in any required position, so as to regulate the depth to which the teeth, *b, b,* enter the ground.
f, is the hook by which the instrument is drawn.

insoluble and absorbent, he will find out, like the followers of Tull, that manures which contain the whole food of plants can alone maintain fertility.

The influence of the atmosphere on the soil, and the increased fertility produced by pulverising and stirring heavy lands, has led to the notion adopted by Jethro Tull, that labour might entirely supersede the necessity of manure: hence the origin of the horse-hoeing husbandry, which at one time was so highly thought of as to be called, by way of distinction, the *new* husbandry. Fallows and manuring were both discarded as unnecessary, the seed was sown in rows with wide intervals, which were continually kept worked and stirred. At first the result was highly satisfactory; all the available food of plants, by exposure to the air, was brought into use, and taken up by the plants, which throve well as long as the supply lasted; but in the end it was exhausted; and the warmest admirers and supporters of Tull's system, Du Hamel and De Châteauvieux, besides many others, found to their cost, in practice, that pulverising alone will not restore fertility. The system of drilling and horse-hoeing, when united with judicious manuring, has, however, been found a great improvement in agriculture. The most distinguished follower of the school of Tull is the the Rev. S. Smith, of Lois Weedon, Northamptonshire, whose experience, now extending over eleven or twelve years, proves that on certain soils a properly timed and industrious tillage, gradually deepening the cultivated land, does maintain its fertility in an extraordinary manner, independently of any addition of fertilising matter in the form of manure. But for a further description of this subject, we must refer to the article TILLAGE.

In describing the various processes in general use in the cultivation of the soil, we have taken the year when the land is fallowed; because it is then that it receives the most perfect culture, which enables it to produce several crops afterwards with a much smaller quantity of labour. By such fallowing and proper manuring, the soil is fully restored to its highest degree of fertility. In light soils, which are generally poorer, turnips or other green crops are sown, on which sheep are penned, which by their manure still more enrich the soil; and it is only when this manure is ploughed in, that the land may be considered as possessing the full degree of fertility.

There are some soils which are so mixed with pebbles and stones, that instruments for their cultivation must be adapted to their texture. Some of these soils, abounding with chalk, are tolerably fertile, and the stones, when they are not so large as to impede the operations, are rather beneficial than otherwise. Theophrastus mentions a field which had been deprived of its fertility by the removal of the stones, and others have learned the same from experience. Pebbles prevent too great evaporation, shelter the young plants in exposed situations, and reflect the light and heat of the sun. The only inconvenience found from them in good soils is that they occupy the room of better earth, and wear out the instruments used, which in consequence are made stronger and blunter. When there is a crop to be mown with the scythe, the stones must be removed from the surface, but not otherwise, at least in light soils.

When the land has been duly prepared, the seed is sown. This is done sometimes before the last ploughing, but then the manure should have been ploughed in before; for, except in planting potatoes, which are not seed, but budded portions of an underground stem, the manure should always be deeper, and not in contact with the seed; indeed, the proper plan is to mix the manure thoroughly with the soil. When the seed is ploughed in, the furrow-slice should not be above two or three inches deep, and eight or nine wide; and it is only in particular soils that this mode is to be recommended. The most common method is, to sow the seed on the land after the last ploughing, and draw the harrows over to cover it. When the land has been well ploughed, and especially if the press-drill has followed the plough, the seed will mostly fall in the small furrows made by two adjoining ridges, and rise in regular rows. But by far the most perfect way is, to sow it at a regular depth, by means of a machine, and in rows at regular distances [DRILL], or to *dibble* it, which is an operation performed only in a few parts of England, especially in Suffolk, Essex, and Norfolk. A man makes small holes at the distance of four or six inches, and in rows nine to twelve inches asunder, with two rods about thirty inches long, one in each hand, having an oval ring for a handle at one end, and at the other an inverted cone three inches in the axis and an inch and a half diameter at the base, which he pushes and turns with his hands in the ground to prevent the earth adhering, and makes the holes rapidly going backwards along the furrows. Two or more children follow and drop three or four grains in each hole. A harrow is drawn over the ground, and fills the holes with loose earth. When the corn comes up it looks like a regular plantation.

The proper season for sowing each kind of grain, the choice of seed, and other particulars will be given under the names of the different seeds usually sown. As a general rule it may be observed, that the smaller the seed, the less it must be covered, and clover or grass seed are either very lightly harrowed in, or only pressed in with the roller.

Of the succession of crops or rotations.—It has been found by experience, that besides the general exhaustion produced by vegetation, especially by those plants which are allowed to ripen their seeds, each kind of crop has a specific effect on the soil, so that no care or manure can, as a general rule, make the same ground produce equal crops of the same kind of grain, for any length of time without the intervention of other crops. Whether this be owing to any peculiar nourishment necessary to each particular kind of plants, or because plants not indigenous degenerate in a foreign soil; the fact is certain with respect to most crops usually raised; the turnip and clover crops may be cited as instances. This points out the advantage of varying the crops, according as they are found to succeed best after each other. In general, all kinds of grain succeed best after a crop which has been cut before the seed has ripened, or the stem is dried up. Those plants which have a naked stem with few leaves thrive best after leguminous plants, which have more succulent stems and more leaves, and which bear their seeds in pods, as peas, beans, tares, or vetches; or after esculent roots, which strike deep into the ground, as carrots, parsnips, beet-roots, and turnips. From this circumstance, confirmed by universal experience, the different systems of rotation have had their origin, taking the nature of the soil into consideration.

The simplest rotation, and one which can only be adapted to the richest strong alluvial soils, is that of wheat and beans, alternately, and without any intermission. It is in use in some parts of Kent and Essex, and in a few places in Germany. The land is well prepared and manured for the beans, which are set or drilled in rows, so as to admit of horse-hoeing between, as in Tull's method, till the beans get to a considerable height; besides this, careful hand-hoeing and weeding are practised, by which the land is cleaned and stirred as in a regular fallow. The beans being cut, the ground is ploughed once, and the wheat sown. It is the practice in some places to scarify the land immediately after harvest, to cut up the stubble. It is done in Kent with a plough without a mould-board, and with a very broad share, hence called *broad-sharing*, but most usually by the scarifier mentioned before: the stubble and weeds, if any, are raked up and burned: this is an excellent practice. Another equally simple rotation, on very poor light land, is that of turnips and barley alternately, which is mentioned by Arthur Young as being in use in the county of Durham, with the simple variation of clover occasionally. The turnips are always fed off by sheep folded on them. Where winter food for the sheep is scarce, this rotation may answer, but otherwise cannot be very profitable.

The oldest rotation known, and which was almost universal in Europe, from the time of the Romans, wherever any regular system of agriculture prevailed, is the triennial rotation of fallow, winter corn, and summer or lent corn; that is, wheat or rye sown in autumn, and barley or oats sown in spring. This was called the three-field system; and on every farm, the arable land was divided into three parts, one of which was in fallow, one in winter corn, and one in summer corn. When properties were much intermixed and subdivided, the whole of a considerable tract was divided into three fields, and it was almost impossible for any individual to deviate from the established course; especially as a right frequently existed of pasturing all the sheep of the parish or district on the fallow field in summer, and on all the others after harvest. In England, this impediment was removed by the legislature passing Acts of enclosure; but it is still felt in many parts of the Continent. This rotation had its advantages, or it could never have been so long in use. Where a sufficient quantity of manure could be collected by means of cattle fed on pastures and commons in summer, and in the strawyard in winter, to give a regular dressing to the fallows every third year, good crops were produced, and the fertility kept up. The labour was very equally divided throughout the year; and such was the regularity of every operation, that a large quantity of land might be cultivated by a proprietor at a considerable distance, with only occasional inspection, without an overseer or bailiff, provided he had honest servants. But, when pastures came to be broken up, and converted into arable land, and cattle consequently diminished, the land could not be manured on every fallow; the crops suffered; less straw being grown, the quantity of manure was diminished, and the land became gradually less and less productive, till, from necessity, a portion was left uncultivated, and returned to natural and inferior pasture; this gave the idea of laying the land down regularly to grass by sowing seeds, and gradually introduced the alternate and convertible system of which we will take notice hereafter.

The apparent loss of a third part of the land by the fallows introduced various crops, which were supposed not to exhaust the soil, but rather to enrich it: of this kind, one of the first was clover, introduced by the Flemish; and afterwards turnips, which have been found of such importance in light soils and moist climates. By substituting turnips for an entire fallow, or, more properly, sowing them early on the regular fallow, and interposing the clover between the summer and winter corn, the highly improved Norfolk rotation has been obtained, namely, 1. Turnips, well manured; 2. Barley; 3. Clover; 4. Wheat. By this a sufficiency of food for sheep and cattle is obtained, without natural pastures, and the land, manured every fourth year at least, is kept in a regular state of progressive improvement. The advantages of this rotation have made it a condition in many leases of light land, under heavy penalties in case of deviation. The first and principal inconvenience found in it was the failure of the clover in most soils, if sown every fourth year; this obliged the farmer to have recourse to other less profitable crops, such as ray-grass, peas, or tares, which, in light lands, are not equal to broad clover as a preparation for wheat. Where the soil is firm and rich, and at the same time mellow, a rotation may be introduced, compounded of the first and last mentioned; that is, beans, wheat, turnips, barley, clover, wheat, making a rotation of six years. This can only be introduced with advantage where there are considerable pastures, and much cattle is kept to supply manure for the land *twice* in the rotation, namely, for the turnips and for the beans, and where the drill husbandry admits of hoeing and weeding thoroughly; but with these advantages, no course can be more profitable, as is found in those parts of Kent and Essex where marsh pastures are attached to the farms. If the soil is too heavy and wet for turnips, and they cannot well be drawn off nor fed on the land without injuring it, a clean fallow is substituted for the turnips, the other crops remaining the same; or cabbages, or mangold wurzel, are planted for the cattle, but seldom to a great extent. A long fallow from after harvest until the second spring, including two winters, prepares the land admirably for barley, so that it can be sown without any manure, which is reserved as a top-dressing for the young clover after the barley. This is a very excellent method. The clover or ray-grass will be more abundant, and the wheat after it will not be in danger of running to straw, or lodging, that is, falling down for want of a sufficient hold of the ground by the roots.

We may add here the following enumeration of existing rotations. The four years' course of crops which originated in Norfolk, is, as has been said, 1. Wheat; 2. Turnips; 3. Barley; 4. Clover.

When the too frequent repetition of clover or turnips induces disease, one half of the barley stubble is broken up for beans, and that half is put to mangold wurzel after the succeeding crop of wheat, so that this becomes an eight years' rotation, namely, 1. Wheat; 2. Turnips; 3. Barley; 4. Beans; 5. Wheat; 6. Mangold Wurzel; 7. Barley; 8. Clover.

Sometimes when turnips are all fed off on the land where they grow, the barley crop is too luxuriant and becomes laid, and the malting qualities of it cannot be good. In that case the four years' or Norfolk rotation, is modified by the introduction of a wheat crop between the turnips and barley, so that it becomes a five years' rotation, namely, 1. Wheat; 2. Turnips; 3. Wheat; 4. Barley; 5. Clover.

Where the land and climate are unfavourable to the adoption of so severe a rotation, the Norfolk course is modified by the extension of the clover over two years, thus, 1. Wheat; 2. Turnips; 3. Barley; 4. Clover and Grass; 5. Clover and Grass.

The East Lothian rotation, adapted to the rich soils of the lowlands in that county, lasts six years, thus, 1. Wheat; 2. Turnips; 3. Barley; 4. Clover and Grass; 5. Oats; 6. Potatoes and Beans.

And in the same county, where potatoes are more largely cultivated a seven years' rotation obtains, that crop being taken after the turnip crop, thus, 1. Wheat; 2. Turnips; 3. Potatoes; 4. Wheat; 5. Grass; 6. Oats; 7. Beans.

On the clay alluvial lands of Scotland, a bare fallow is taken in the first year, followed by, 2. Wheat; 3. Barley; 4. Clover and Grass; 5. Oats; 6. Beans; 7. Wheat.

We may add to these a fourth modification of the Norfolk course, recommended by Mr. Caird, for cases of light potato soils where the cultivation of potatoes is advisable, namely, 1. Wheat; 2. Clover; 3. Oats; 4. Turnips; 5. Potatoes.

These rotations are sufficient to give some idea of the principles on which they have been adopted. In Scotland they adhere less strictly to particular rotations, nor are the tenants in general so much tied down as in England; seasons and circumstances cause deviations, which are sometimes judicious and often unavoidable. It is best, however, to follow some regular course, and in the end it will be found most profitable. A very common rotation in Scotland is fallow, wheat, clover, or grass fed one, two, or three years, then oats, peas, or beans, and wheat again, if the land is clean and in good heart; for there is no rule better established, than that of never allowing the soil to be exhausted beyond a certain point where manure and tillage can readily recruit it. The greedy cultivator is sure to pay dearly in the end for every crop forced from the land unreasonably; but the means of remedying exhaustion of the land, both those which depend on the use of efficient implements of tillage, and those which depend on the application of manure, are so multiplied and extended since the days in which most of these systems of rotation originated, that there is not that need of them which once there was, and an energetic and liberal cultivator need not be deterred by the circumstance that it is out of its place in the rotation, from taking any crop from soil in fitting condition which it may be his interest to grow.

Without preventing the tenant from using his discretion as to the mode in which his farm is best cultivated, a proprietor may be sufficiently protected against wanton deterioration of the land, by insisting on a green crop or fallow intervening between every two crops of grain, and consuming all the fodder and roots on the farm. For this subject we must refer to the article Farm. A proprietor with skill and experience cultivating his own land, need only consider the state and quality of his fields, and what will most likely grow well in them: what is most in request, both for his own use and in the market; what will keep his men and cattle in most regular work, without confusion or hurry. If he allows his land to be impoverished for want of manure, or to run wild with weeds, for want of hoeing or fallowing, he has not the experience and judgment which are necessary for his pursuits.

The Flemish husbandry proceeds much on this principle: The greatest attention is paid to manuring and weeding. Much more manual labour is bestowed than with us, and the crops seem more certain, varied, and abundant. That it is not unprofitable we may conclude from the wealth of the peasants, the comfort of the labourers, and the sleek appearance of the cattle. From the very interesting account of Flemish agriculture in the work of Mr. van Aelbroek of Ghent, written in Flemish, translated into French, and published at Paris in 1830, we learn with what great care the soil is cultivated in Flanders. After ploughing into lands as we do, every intervening furrow is deepened and cleared with the spade, the earth being thrown over the bed sown. Liquid manure (which is sadly thrown away in this country), chiefly the urine of animals and drainings of dunghills, is carefully collected, and is carried on and distributed over the poor light soils, by means of water-carts, before sowing, and again when the crop is come up. By this means such lands are made to yield crops of rape seed, clover, lucern, flax, and corn equal in luxuriance to those on the richest soils. Fallows are rendered unnecessary by the careful destruction of weeds. In short, it is a garden culture on an extended scale. All the land is in tillage, except where rivers occasionally overflow, and render the meadows rich and profitable. The cattle are mostly kept in stables, and fed with green food cut and brought to them; by which means one acre of clover, lucern, or other artificial grass, will maintain five times as many beasts, or more, as an acre of the best pasture; but the great object is to increase manure, especially in a liquid state, which is carefully preserved in reservoirs, without loss or waste, till wanted for the land. This system is also followed in Switzerland, which, considering its soil and climate, is one of the best-cultivated countries in Europe.

We observed before, that the want of a sufficient supply of manure on the old three-field system led to the laying-down arable land to pasture for a time and then breaking it up again. This was first practised in a regular rotation in Holstein and Mecklenburg, and raised these countries rapidly amongst agricultural nations.

In Holstein, on moderately good soil, they adopt the following course: 1. Oats, on newly broken-up grass land. 2. A fallow to destroy grasses and weeds, and accelerate the decomposition of their roots. 3. Wheat with or without manure, according to the state of the land. 4. Beans, barley, or oats. 5. Wheat, manured, unless it has been done for the beans the year before. 6. Grass seeds pastured for three years or more, when the rotation begins again.

A Mecklenburg rotation, not unlike the Scotch, consists of, 1. Beans well manured, or potatoes. 2. Wheat or oats. 3. Barley or oats, unless sown the year before. 5. Peas or tares, *manured*. 6. Wheat. 7. White clover and grass seeds, which were sown among the wheat the year before, and are kept in pasture during the 8th and 9th years. There is no fallow, and in a moist climate it will be difficult to keep the land clean. It might, however, easily be introduced, as in the Holstein rotation.

Another rotation is, 1. Oats. 2. Beans well manured. 3. Wheat. 4. Tares manured. 5. Barley. 6. Clover and grass seeds mown for hay and green fodder. 7 and 8. ditto, fed. All these are excellent for a moderately good soil well managed. If the soil is very rich, the following is the most profitable of any: 1. Rape seed well manured. 2. Wheat. 3. Beans or potatoes manured and hoed. 4. Barley. 5. Clover. 6. Wheat. 7. Oats with white clover and grass seeds pastured two or three years. The principal object in this convertible system is to lay the land down in good heart, and as clear of weeds as possible: the grass will then be abundant, and continue good for several years. Liquid manure, carried upon it in spring, will so enrich it as to admit of making the crop into hay, or cutting it green for the cattle in the stables. In light soils, the tread of sheep and cattle is of great use; in heavy, wet soils, they would do harm. No wet land will bear this rotation.

We have now given a brief outline of the manner in which arable land may be cultivated and improved. If we should be asked, whether so much attention and labour upon land of a proper quality will be repaid by the value of the produce, after deducting the portion due to the landlord, or to the state? we shall answer, without any hesitation, in the affirmative, provided the cultivator is possessed of knowledge, judgment, and experience, and devotes all his time to the superintendence of his farm. The calculations on which this opinion is founded cannot be introduced here; some idea of them will be given in the article Farm. Agriculture is so healthy and so agreeable an occupation, that it can never be extremely profitable: the competition for land will always prevent this. The butcher and cattle-dealer will always, if successful, make far greater profits than the farmer; and a decent livelihood, with a moderate interest on the capital laid out, is the most that a farmer can expect, even with the greatest assiduity. If he neglects his business, and leaves it to others less interested in the result, he must be a loser. Gentlemen who cultivate for pleasure, and employ bailiffs, are fortunate if they get a moderate rent after paying expenses. For careless farmers, the simplest system alone can prevent great loss; and grass land may be profitable in the hands of a proprietor, who would probably be ruined if his land were all arable and in his own hands.

Our limits will not permit us to enter into the important subject of improvements,—nor into the question of great or small farms, as most beneficial to the community:—these and various other branches of the subject will be found under proper heads; such as Barren Land, Farm, Draining, Irrigation, Manure, Labour, Grass-land, Cattle, &c.; and for the peculiar cultivation of the various products of agriculture, see Wheat, Beans, Barley, Clover, Oats, Peas, &c. &c.

We shall only add the names of a few authors whose works may be studied and consulted with advantage, by all those who desire to have a competent knowledge of agriculture, either as a branch of general knowledge, or for the purpose of its practical application.

Of the Greek writers on husbandry we have hardly anything left, except in the collection of Cassianus Bassus, entitled 'Geoponika' (earth-labouring). This collection, in twenty books, was made at the command of the Emperor Constantinus Porphyrogennetus, and was chiefly compiled from Greek writers, whose names are given. We are not aware that there is any foreign translation of the 'Geoponika,' except the old German version of 'Herren,' first printed at Strasburg in 1545, 4to. The Latin writers, Cato, Varro, Virgil in his 'Georgics,' Columella, and Palladius, are well known: their works, especially the last two, will be found to contain many valuable remarks; and abridged translations of them, or extracts, would be very useful even to modern agriculturists. Of the above, the following have been translated by the Rev. T. Owen, rector of Upton Scudamore, Wilts: 1. 'The Three Books of M. Terentius Varro, concerning Agriculture.' London, 1800. 8vo. 2. 'The Fourteen Books of Palladius on Agriculture.' London, 1807. 8vo. The same author has also published 'Agricultural Pursuits, translated from the Greek.' London, 1805. 2 vols. 8vo. Of the earlier English writers, we shall only mention Fitzherbert, Blythe, Hartlib, and Weston. Afterwards came Evelyn, Tull, Hale, and the great oracle of modern husbandry, Arthur Young; with

Sir John Sinclair, to whom, as President of the Board of Agriculture, much useful information was communicated, which he industriously compiled. (Sinclair's 'Account of Systems of Husbandry,' &c., 2 vols. 8vo.) The Surveys and Reports on the agriculture of the different counties, prepared for the Board of Agriculture, are replete with useful information as to what is the actual practice; and among a multitude of agricultural publications, journals, and proceedings of societies, we may notice Loudon's 'Encyclopædia of Agriculture.' That of Wilson, published by Fullarton; and that of Morton, published by Blackie, are also useful as books of reference. The works of Professor Low, and Henry Stephens, of Edinburgh, may also be consulted. The Journals of the Agricultural Societies of England and Scotland, and the weekly agricultural papers, 'Bell's Messenger,' 'Gardeners' Chronicle,' 'Mark Lane Express,' and 'North British Agriculturist,' are full of valuable agricultural information.

The French are rich in elementary works, among which the 'Théâtre d'Agriculture,' par Olivier de Serres, is a standard work. It was written at the express desire of Henry IV. and his minister Sully, and published in 1600; the last edition, in four volumes quarto, Paris, 1804, with numerous additions, and the 'Cours Complet d'Agriculture,' by various members of the Institute of France, published in 1820, contain everything that was then known of the science of agriculture. A little work of much merit may be mentioned, called 'Le Manuel Pratique du Laboureur,' by Chambouillé Dupetitmont, Paris, 1826, two volumes, duodecimo; and also 'Le Calendrier du bon Cultivateur,' by C. I. A. Mathieu de Dombasle (on the plan of Arthur Young's 'Farmer's Calendar'), Paris, 1833, duodecimo, is a very useful work. The 'Journal d'Agriculture Pratique' is another more recent valuable agricultural periodical. Numerous works on particular branches, and the annals and memoirs of various agricultural societies, are constantly being published. Among the German authors we shall only mention Thaer, whose works we have quoted above, and which form a most complete body of theoretical and practical agriculture: his experiments made on a large scale at the national farm of Mögelin near Frankfort on the Oder, and repeated for many years, can be fully depended upon. We have also quoted the work of Mr. van Aelbroek, 'De l'Agriculture Pratique de la Flandre,' Paris, 1830, octavo, as a useful and interesting work.

ARACHIDIC ACID ($C_{40}H_{40}O_4$). A crystalline acid found in the oil expressed from the seeds of the *Arachis hypogæa*, a plant growing in Guinea and Brazil. It crystallises in small brilliant plates, which fuse at 167° Fahr., is very slightly soluble in cold alcohol, but easily soluble in boiling absolute alcohol and in ether. Arachidic acid forms an ether and an extensive series of salts which have recently been investigated by Gœssman and Scheven ('Ann. der Chimie u. Pharm.,' xcvii. 257). It also forms a compound with glycerin termed *Arachine.*

ARACHINE. [ARACHIDIC ACID.]

ARACK, or ARRAC. This word is derived from the Arabic word *arak*, which properly signifies perspiration. Under various modes of spelling it is employed as a general name for distilled spirits along the northern coast of Africa, including Egypt, over all Asia, and even in the north and eastern parts of Europe. This spirit is prepared from different substances, from the juice of the areka palm and rice, from palm-sugar and rice, but more especially from the sweet juice (toddy) extracted from the unexpanded flowers of different species of the palm tribe. The best sorts are produced at Goa, Batavia, and Ceylon. In Ceylon, where a large quantity of arack is manufactured, it is entirely distilled from coco-nut tree toddy. The 'toddy topes,' or coco-nut tree orchards, are very extensive in Ceylon, and their produce is collected for the distillation of arack, and the manufacture of sugar, vinegar, and oil: the latter chiefly, for the production of which steam-machinery is employed.

In Ceylon, when it is intended to draw toddy from a tope, the toddy-drawer selects a tree of easy ascent near to the centre of the tope, the stem of which he surrounds with a number of bands made of creepers, about a foot distant from one another. Upon these bands he ascends the tree, and by means of the stems of creeping plants or *coir* ropes, he connects the heads of a number of trees, so as to enable him to pass from tree to tree in the subsequent operation of collecting the produce.

The ordinary implements of a toddy-drawer are a large broad knife, which he carries in a coffer or basket suspended by a cord tied round his body; a mallet, consisting of a piece of hard wood about a foot in length; and the shell of a large gourd, which is suspended round his waist. When a tree is in a state fit for yielding sweet juice, the toddy-drawer ties the flowering spath in different places, by means of the white leaves of young branches. This process has the effect of preventing a bud from blowing. The spath is then bruised along its whole length by means of slight blows with the mallet or bat of hard wood. This operation occupies a few minutes, and requires to be regularly repeated every morning and evening for six or seven days. In a few days after the spath has been tied, a few inches of it is cut off by means of the broad knife. Two or three days after it is thus truncated, sweet juice exudes from the cut surface, which is received in an earthen vessel attached to the spath. The liquor issues, drop by drop, and a good healthy blossom will yield from two to four English pints in twenty-four hours, and continue to afford that quantity for a period extending from three to five weeks. As the coco-nut tree blossoms every four or five weeks, two spaths on one tree sometimes yield sweet juice at the same time. The toddy-drawer generally ascends the trees, for the purpose of collecting the sweet juice that has exuded into the toddy pots, both morning and evening, and to cut off a fresh portion of the flowering spath. The toddy is poured from the earthen vessels into the gourd, which is conveyed to the ground by means of a line. The gourd is emptied into a large vessel by a person at the foot of the tree, and drawn up by the toddy-drawer for the purpose of being refilled.

Arack may be distilled from toddy the same day it is drawn from the tree, but sometimes this operation is delayed until it becomes sour. The process of distillation is carried on in the maritime provinces in copper stills, but in the interior of the island earthen vessels are chiefly employed. Toddy yields by distillation about one-eighth part of proof-spirit.

On the peninsula of India, arack is distilled from the flowers of the *Bassia longifolia*, Tell mee (*Cingalese*), the *Máhwah*-tree, and the *Bassia latifolia*. Mahwah-arack may be procured at the rate of an English pint for less than one penny.

Arack is prepared in the island of Java, where it is known by the name of *kneip*, from a mixture of molasses, palm-wine, and rice. The rice is first boiled, and after being cooled, a quantity of yeast is added to it and pressed into baskets. Each basket is placed over a tub for about eight days, during which time a quantity of fluid passes through the basket into the tub; this fluid is added to the molasses and toddy in large fermenting vats, where the mixture is allowed to remain until it is fit for distillation.

In most parts of Turkey, arack (*raki*) is made from the skins of grapes. It is flavoured with aniseed, and sometimes contains a solution of gum-mastic. The mountain Tartars distil it from sloes, elder berries, wild grapes, plums, &c., and the Calmuck Tartars distil it from milk. The chief markets for arack are the East India Presidencies, to which a large quantity is supplied by Ceylon. In Europe Amsterdam is the chief place of importation, principally if not entirely from Batavia.

ARÆO'METER. [HYDROMETER.]

ARÆOSTYLE (from ἀραιὸς, *rare* or *few*, and στύλος, *a column*), a term used by writers on architecture, who follow the system of Vitruvius, for one of his "five species of temples." As the term itself imports, it refers rather to the arrangement of columns than to the composition or structure of a temple. The kind of temple called aræostyle is, according to Vitruvius, that in which "the columns are placed more distant from each other than in fact they ought to be." This, the commentators upon that writer say, is when the space between columns, or the intercolumniation, is from four to five diameters. The aræostyle intercolumniation is generally assigned by the same authorities to what in the Vitruvian system is called the Tuscan order; for as the remains of the more classical architectural works of the Greeks and Romans, on which the system *professes* to be based, exhibit no examples of either the aræostyle intercolumniation, or of the Tuscan order of columns, each could with safety be assigned to the other. [TEMPLE.]

ARÆOSYSTYLE. This term is compounded of *aræo* and *systyle*, and was formed to designate an arrangement of columns not mentioned by Vitruvius. The French architect, Perrault, is understood to have introduced the term aræosystyle to designate an alternately very wide and very narrow intercolumniation, or what is familiarly called coupled columns. This arrangement is alternately *aræostyle*—columns too far apart; and *systyle*—columns too close together. Perrault's front of the palace of the Louvre in Paris, the western portico of St. Paul's cathedral, the porticoes, pavilions, and colonnades of Buckingham palace, and many other edifices in London, exemplify the mode of arranging columns which the term aræosystyle designates.

ARAMÆAN or ARAMAIC LANGUAGE (לָשׁוֹן אֲרָם, or אֲרָמִית, from the unusual root אָרַם, which is related to the cognate forms רוּם, רָמַם, חָרַם, עָרַם, רָאַם, *to be high*, or *he was elevated*), literally means the Highland dialect, in contradistinction to לָשׁוֹן כְּנַעַן, the language of Canaan, or the Lowland dialect. The Aramæan was thus denominated because those parts of Aram which bordered upon Palestine were higher than the territory of the Jews, and especially higher than the coast of the Mediterranean Sea inhabited by the Canaanites. Thus a designation became current which was improperly applied to the whole of Aram, many parts of which had a lower level than Canaan, but passed under the general appellation of Highlands, because Aram bordered by Mount Lebanon upon Palestine, and had a higher level in all points of immediate contact. Aramaic is spoken near Mardin and Mosul (see Niebuhr's 'Reisebeschreibung nach Arabien,' t. ii. p. 352; and its French translation of 1780, t. ii. p. 275), where it is asserted that the Syriac is also spoken in several villages of the government of Damascus. Niebuhr calls the Christian idiom Chaldee. The Christians of Mardin and Mosul write even the Arabic in Chaldee characters, and the Maronites in Syriac letters. W. G. Brown mentions in his travels that the Syriac is spoken at Malala and Wara. Compare the 'Journal of a Residence at Bagdad,' by Anthony Groves, 8vo, London, 1832. It is also said to be spoken in some of the dales of the mountains of Kurdistan. The Aramæan is, on the whole, the poorest and the least refined of all the Semitic languages; yet Julius Fürst, in his 'Lehrgebäude der Æramäischen Idiome mit Berzug auf die Indo-Germanische Sprachen,' &c., published at Leipzig in 1835, has shown the great probability of the Aramæan having been the mother tongue of all the Semitic languages, and of its having had much influence on those of Indo-Germanic origin.

The Aramæan language comprises two principal dialects, the Babylonian or East-Aramaic (which is usually, but improperly, called Chaldee), and the Syriac or West-Aramaic dialects; both dialects, though nearly extinct, are yet spoken by a few tribes dwelling in the ancient Aram. This fact, mentioned by various travellers, we find also recorded in the 'Journal' of Mr. Groves. The Samaritan and Palmyrene were minor dialects of this language.

The sections in Daniel and Ezra called Chaldee, and a few words in Jeremiah and Genesis, are the most ancient remains of the East-Aramaic dialect, which is called by the Jews לְשׁוֹן תַּלְמוּד, that is, the language of the Talmud, or the language of learning, because parts of the Talmud and many rabbinical writings are composed in this idiom, which is now usually written and printed in the Hebrew square characters, or לְשׁוֹן תַּרְגּוּם, that is, the language of translation, because the Targums of Onkelos and Jonathan are paraphrastic translations of the Old Testament into the East-Aramaic language.

The oldest specimens of the West-Aramaic are much later; they consist of some Palmyrene inscriptions, one of which has been referred to A.D. 49. The characters of the West-Aramaic or Syriac differ greatly from the Hebrew. [SYRIAC LANGUAGE.]

The Aramaic is one of the Semitic dialects spoken by the descendants of Shem. Many forms of nouns and verbs, which in Hebrew and Arabic are polysyllabic, are shortened in Aramaic into monosyllables. The forms of nouns in Aramaic are less numerous than in Hebrew and Arabic. The dual is rare in the East-Aramaic. The personal pronoun of the second person singular combines both genders in one form אַנְתְּ.

Thus we see that the Aramaic has fewer grammatical forms than the cognate dialects, but we observe the reverse in the following instances.

The Aramaic has four active and four passive modifications, under every active modification, two participles, one of which has a passive signification, although the passive modifications have their own participles. The third person plural of the preterites distinguishes the genders by means of a double formation. A present tense is formed by the combination of participles with the personal pronoun.

While the Jewish community maintained its political independence in Palestine, the Hebrew continued to be the common language of the country, and, so far as we are able to judge, although not entirely pure, was, during that time, free from any important changes in those elements and forms by which it was distinguished from other languages. A few foreign words only had crept in along with the products of foreign commerce, arts, and inventions; and these, in consequence of the want of appropriate terms in the language of the country, received the right of citizenship. Even in the time of Hezekiah, the Hebrew dialect differed so much from the Babylonish-Aramæan, chiefly, it is probable, in respect of pronunciation, that the latter sounded in the ears of the common people of Jerusalem like an entirely foreign language, and was intelligible only to the principal officers of the court (comp. 2 Kings xviii. 26). But when the Assyrian and Chaldæan rulers of Babylon subdued Palestine, everything assumed another aspect. The Jews of Palestine lost, with their political independence, the independence also of their language. The Babylonish-Aramæan dialect supplanted the Hebrew, and by degrees became the prevailing dialect of the people.

The Babylonish-Aramæan language was very closely allied to the Hebrew; it stood to it in nearly the same kind of relationship as the Lower Saxon does to the High German. Both were the offspring of the original Semitic language, which was used from the Halys in Cappadocia to the regions beyond the Tigris, and from the source of the Tigris to Arabia. Both of these, as well as the other Semitic dialects, had the same stock of ancient radical words, and essentially the same grammar. The principal features of their difference were, that many words of the old primitive language remained current in one dialect, which were entirely or partially lost in the other, for example, the verb שְׁמַשׁ (to expose to the sun, or to dry) in Aramean, of which only the noun שֶׁמֶשׁ (sun) remained in the Hebrew. The same word was sometimes in use in both dialects, but in different significations. The Babylonish dialect borrowed expressions from the northern Chaldæans, who made an irruption into the country. Traces of such additions are to be found in the names of the officers of state, and other terms having reference to the government. The Babylonish pronunciation was easier of utterance, and more sonorous than the Hebrew.

The numerous Aramæan colonies (2 Kings xvii. 24), which were substituted for the subjects of the kingdom of Israel, carried to Assyria by Shalmaneser, retained their former language, and caused it to spread in the neighbourhood of their places of residence, even before the destruction of the kingdom of Judah. At a later period, the Babylonish-Chaldæan governors who ruled over Palestine; the standing forces which they had brought with them for the preservation of tranquillity, and which were composed of Aramæans and Chaldæans (2 Kings xxiv. 2); the host of foreign officers in their train, and the transactions of all public business in the Babylonish-Aramæan dialect, must have greatly tended to restrain the use of the national Hebrew dialect, since the Jews, who held public offices, or stood in any other near connection with the new rulers, were compelled to become familiar with the ordinary dialect of these rulers. There is also reason to suppose that the Babylonish had still earlier been the court language at Jerusalem (see 2 Kings xviii. 26).

The Aramæan language derives peculiar interest from having been spoken generally by the inhabitants of Palestine, from the Babylonian captivity to the final and general dispersion of the Jews. We find that Jesus Christ, when repeating on the cross the beginning of the twenty-second Psalm, does not quote the Hebrew original, but the Aramaic version. Many other occasional quotations and expressions used in the New Testament and in the writings of Josephus indicate the prevalence of the Aramaic language in Palestine in the age of Christ. The oldest Syriac version of the New Testament, the Peshito, is stated to be contemporary with the Apostles, or, at least, not later than the 1st century; and a valuable addition to Syriac literature has been made by the Rev. Wm. Cureton, by his publications, in 1845, of the 'Ignatian Epistles;' in 1858, of 'Remains of a very Ancient Recension of the Four Gospels in Syriac;' 'Fragments of the Iliad of Homer,' in 1851; and 'Spicilegium Syriaca;' together with other works in the same language, chiefly from MSS. obtained by Archdeacon Tatham from the monasteries of Syria, and M. A. Pacho, in Egypt. These interesting MSS. are now in the Library of the British Museum. The Greek, however, had been long firmly established in Palestine, where it was first introduced by the Macedonian conquests, and extended under the dynasty of the Seleucidæ. We know, both from positive testimony and the indirect evidence of inscriptions, &c., that Greek must have been as common in Palestine at this period as the French now is in Alsace, though it was no more the native tongue than French now is in the province just mentioned. Greek was also the language of science and learning, as it contained nearly all the knowledge which at that time existed. Concerning the language of Palestine in the age of Christ, compare the dissertations of De Rossi and Pfannkuche, and a chapter in Hug's introduction to the New Testament; which have been translated, partly in America, by Robinson, in the 'Biblical Repository,' for 1831, and partly in Edinburgh, in the 'Biblical Cabinet,' vol. i. 1833. The standard work on the Aramaic language is 'Andreæ Theophili Hofmanni Grammaticæ Syriacæ libri tres, cum tabulis varia Scripturæ Aramaicæ genera exhibentibus,' Halæ, 4to, 1827. Gesenius has since published a 'Thesaurus Philologico-critico' of the Hebrew and Chaldee Old Testament, in 3 vols., 1828-42; and Julius Fürst, a small Hebrew and Chaldæan Dictionary, in 1835.

English readers may compare Yates's 'Syriac Grammar; Harris's 'Chaldee Grammar,' 8vo, 1824; and ספר השרשים, a Hebrew and English Lexicon, containing all the words of the Old Testament, with the Chaldee words in Daniel, Ezra, and the Targums, and also the Talmudical and Rabbinical words derived from them, by Selig Newman, 8vo, London, 1834.

Strabo calls the Aramæans ('Geogr.' i. p. 112, ed. Siebenk.) Ἀρμενίους καὶ Ἀραμαίους, and Ἀρίμους. Comp. Stephanus Byz. under Ἄριμα; and Gesenius, 'Commentar zum Jesaiah,' t. i. 688, to chap. xxii. 6.

AR'BITER was a term in the Roman law signifying a judge invested with a discretionary power, and was applied to different kinds of judicial functionaries. The *arbiter compromissarius* answered to the arbitrator of modern jurisprudence, whose office will be treated of under the article ARBITRATION.

Another species of arbiter, peculiar to the law of Rome, partook more nearly of the character of an ordinary judge. In order to understand the nature of his office, it must be borne in mind, that all actions were commenced, and the preliminary proceedings carried on, before the prætor, technically termed (*in jure*); and when the altercations of the parties formally expressed had raised a question of fact disputed between them, a person was nominated in the formula to whom the adjudication of this fact was referred, whose title and powers depended on the contents of the formula. The different kinds of actions known to the Roman law were divided into three classes; actions of strict law, actions of good faith, and arbitrary actions: under the first class were comprehended all actions upon contracts called unilateral, that is, where only one of the parties is bound, as in the case of money borrowed, where the borrower is bound to repay, but no further obligation lies upon the lender. In these actions the person appointed to adjudicate was styled a judge (*judex*), and the only question for him to decide was, simply whether the plaintiff had completely established his case as originally stated.

In the two other classes of actions the person appointed to adjudicate was allowed a greater latitude of judgment, and was styled an arbiter. Actions of good faith were such as were founded on bilateral contracts, that is, on contracts by which an obligation is imposed on both parties, such as the contract of sale, where the seller is bound to deliver the goods, and the purchaser to pay the price. In all these actions the arbiter was not compelled, as in actions of strict law, either to grant or to reject altogether the claim of the plaintiff, but might enter into the merits of the case, and decide according to what seemed to him to be just and equitable between the parties. For the object of these actions was to obtain the fulfilment of such agreements as every honest man ought to be willing to execute, an object expressed in the formula, "Quidquid dari filii oportet ex fide bonâ."

To the third class, namely, that of arbitrary actions, belonged those chiefly in which the restitution of property, or some specific performance, was required of the defendant. In these cases the arbiter had authority to estimate the just claims of the plaintiff, and to condemn the defendant to some greater penalty, as, for instance, to pay fourfold in case of his not performing the judgment. Properly speaking they were actions not tied down by the *strictum jus*, but capable of receiving such modifications as the arbiter pleased, therefore they did not include the conditiones, or the actiones civiles ex delicto, whilst they did include those bonæ fidei, in rem, and prætoriæ; at the same time it is as well to bear in mind that these arbitrary actions did not embrace all unrestricted actions whatever, in spite of the modifications of which they were susceptible by means of the arbitraria formula; for though every arbitraria actio was an arbitrium, every arbitrium was not an arbitraria actio.

(Just. *Institut.* lib. iv. tit. 6; Heineccii, *Elem. Jur. Civ.* §§ 1181, 1196; Idem, *Antiq. Rom.* iv. 6, 36; Abdy, *On the Roman Law of Civil Procedure*, chaps. iii. iv.)

ARBITRATION is the adjudication upon a matter in controversy by private individuals selected and appointed by the parties. This mode of settling differences is very frequently resorted to as a species of amicable litigation, and a means of avoiding the delay and expense of a lawsuit, and the publicity of a trial. It has the further advantage of providing an efficient tribunal for the decision of many causes—such, for instance, as involve the examination of long and complicated accounts,—which our ordinary courts of law are, from their mode of proceeding and the want of proper machinery, incompetent to investigate.

The person appointed to adjudicate is called an arbitrator, or referee. The matter on which he is appointed to adjudicate is said to be referred or submitted to arbitration. His judgment or decision is called an arbitrament, or, more usually, an award.

Any matter actually in controversy between private persons may be referred to arbitration. By the 11th section of the Common Law Procedure Act, 1854, provision has been made in the case of prospective agreements to refer any differences which may hereafter arise. By that section, whenever, in spite of such agreement to refer, an action or a suit in equity has been commenced, power is given to the court, on the application of the defendant or defendants after appearance and before plea or answer, if satisfied that there is no reason why such reference to arbitration as agreed on should not be made, and that the defendant is ready and willing to concur in all acts necessary for causing such matters to be decided by arbitration, to make a rule or order staying all proceedings in such action or suit, on such terms as the court may think fit. No injury can be the subject of an arbitration, unless it is such as may be a matter of civil controversy *between the parties*: a felony, for instance, which is a wrong, not to the party injured merely but to society in general, is incapable of being referred.

There are no particular qualifications required for an arbitrator. In matters of complicated accounts, mercantile men are usually preferred. In other cases, it is generally considered advisable to appoint barristers, who, being accustomed to judicial investigations, are able to estimate the evidence properly, to confine the examination strictly to the points in question, and, in the making of the award, to avoid those informalities for which it might afterwards be set aside. Both time and expense are thus saved by fixing on a professional arbitrator. Any number of persons may be named as arbitrators: if the number is even, it is usually provided that, if they are divided in opinion, a third person shall be appointed, called an umpire, to whose sole decision the matter is then referred. [UMPIRE.]

A dispute may be referred to arbitration, either—1. When there is an action already pending between the parties relating thereto, or—2. When there is no such action.

1. In the former case, the parties to the action, if *sui juris*, are in general competent to submit to arbitration. The reference may be made at any stage of the proceedings; if an action is pending, it is effected by a rule of the court in which the action is brought, or by a judge's order, in which case it may be made a rule of court even after the submission has been revoked by one of the parties; if at the trial, by an order of Nisi Prius, with the consent of both parties by their counsel and attorneys. The usual mode of proceeding then is for the parties to have the jury sworn, and to consent that a verdict shall be given for the plaintiff for the damages laid in the declaration, subject to the award of the arbitrator. This is essentially necessary in bailable actions, otherwise the bail would be discharged by the reference. By the 17 & 18 Vict. c. 125, among other important alterations on the subject of arbitration, the third and sixth clauses have given extended powers to the judge engaged upon the trial of any issue of fact; by the third section the court or judge, upon the application of either party at any time after the issuing of the writ, may, if satisfied that the matter in dispute consists wholly or in part of accounts, order it to be referred to arbitration; and by the sixth clause, if it shall appear to him that the questions arising thereon involve matter of account which cannot conveniently be tried before him, he may, at his discretion, order it to be referred to arbitration either as to all or part of the matters in dispute.

The person named as arbitrator is not bound to accept the office, nor, having accepted, can he be compelled to proceed with it. In either case, if the arbitrator refuses or ceases to act, the reference is at an end, unless the contingency has been provided for in the submission, or unless both parties consent to appoint some other person as arbitrator in his stead.

Previously to the statute 3 & 4 Will. IV. c. 42, the authority of the arbitrator was revocable by either party at any time before the award was made; but by that statute it is declared that the authority of an arbitrator cannot be revoked by any of the parties without the leave of the court or a judge: but it is still determined by the death of any of the parties, unless a clause to obviate this is inserted in the submission; and if one of the parties is a single woman, her marriage, being in law a civil death of all her rights, will have the same effect. The order of reference usually provides that the award shall be made within a certain period; and if the arbitrator lets the day slip without making his award, his authority ceases, but a clause has usually been inserted to enable the arbitrator to enlarge the term: and now also by 17 & 18 Vict. c. 125 § 15, where an arbitrator is acting under any document or compulsory order of reference, he is directed to make his award within three months after the period of his appointment, unless the parties themselves have by consent enlarged the term for making the award, or the court or any judge thereof have from time to time enlarged the term. The authority of an arbitrator likewise ceases as soon as he has made or declared his award; but by statute 17 & 18 Vict. c. 125 § 8, power is given to the court or judge at any time, and from time to time, to remit the matters referred to the reconsideration and redetermination of the arbitrator.

When the arbitrator has accepted his office, he fixes the time and place for the parties to appear before him. Each of them furnishes him with a statement of his case, which is usually done by giving him a copy of the briefs on each side; and on the day appointed he proceeds to hear them (either in person, or by their counsel or attorneys), and to receive the evidence on each side, nearly in the same manner as a judge does at an ordinary trial: he is also invested by the order of reference with a power of examining the parties themselves if he think fit; but as by recent legislation the parties to suits, actions, or other proceedings in courts of law, are not merely competent, but are compellable, to give evidence for or against each other, it would appear to be the arbitrator's duty to examine the parties if required, even, it would seem, in cases where no action is pending.

No means existed of compelling the attendance of witnesses, or the production of documents, before an arbitrator, until the statute 3 & 4 Will. IV. c. 42, authorised the court or a judge to make an order to that effect; disobedience to which order, if served with proper notice of the time and place of attendance, becomes a contempt of court. The witnesses, thus compelled to attend, are entitled to their expenses in the same manner as at a trial. And where the order requires the witnesses to be examined upon oath, the arbitrator is by the same statute authorised to administer an oath or affirmation, as the case may require; and any person giving false evidence may be indicted for perjury.

The extent of an arbitrator's authority depends on the terms of the reference: it may either be confined to the action pending between the parties, or it may include any other specified grounds of dispute, or all disputes and controversies whatever existing between them at the time of the reference. Where the matters referred to him are specified, it is his duty to decide upon them all: where they are not specified, it is his duty to decide upon as many as are laid before him. In no case is an arbitrator authorised to adjudicate upon anything not in fact comprehended in the reference; such, for instance, as any claims or disputes which may have arisen after the reference was made, or, where the reference is specific, anything not expressly included in it. As nothing can be referred by the parties but the differences existing between themselves, an arbitrator can have no authority to bind any one who is not a party to the reference.

An arbitrator being a judge appointed by the parties themselves for the final settlement of their differences, his decision on the merits of the case submitted to him is conclusive; the question is set at rest, and never can be agitated between them again. But if his award be partially or illegally made, the superior courts have the power of setting it aside, upon application being made within the first seven days of the term next following the publication of the award to the parties. This happens either, 1. Where the award is not co-extensive with the arbitrator's authority; or 2. Where it appears on the face of it to proceed on mistaken views of law, or to fail in some of the qualities required for its validity [AWARD]; or, 3. Where any misconduct has been committed. This may happen in two cases: 1st, Where the arbitrators have been guilty of corruption or other misbehaviour, as, if they have proceeded to arbitrate without giving notice of the meeting, have improperly refused to receive evidence, or committed any other gross irregularity in practice; 2dly, Where it is proved that the arbitrator has been misled by fraud used by either of the parties. Where an award is absolutely void, as where it is made after the authority of the arbitrator has ceased, it is not in general necessary to set it aside, as it is incapable of being enforced.

When the award has been made and delivered, if one of the parties refuses to comply with it, the other may bring an action against him on the award. But the most prompt and efficient remedy is to apply to the court for an attachment, grounded on the contempt of court which he has been guilty of by disobeying the order of reference. But then the award must contain an order for the arbitrator to pay the money or do the act awarded, for otherwise the not doing of it will be no breach of the rule, and the court cannot grant the attachment. [ATTACHMENT, CONTEMPT.] In opposing this application, the other party may insist on any objection apparent on the award itself; but if there were any other objections affecting its validity, and he has neglected to apply to the court to set it aside within the time fixed by them for that purpose, it is too late for him to avail himself of them. It would appear, from some recent cases, that where there is a doubt as to the validity of an award, the court will neither enforce it by attachment nor set it aside, but leave the party to his remedy by action.

When, in the original action, a verdict has been taken, subject to an award or certificate, the party in whose favour the award is afterwards made, or certificate granted, may have the postea indorsed on the Nisi Prius record; and may, without any personal service of the award, sign judgment and sue out execution, without any previous application to the court, unless the reference is of the cause and all matters in difference, in which case the defendant is allowed the whole of the term after the making of the award to move to set it aside, until which time the award cannot be enforced.

2. Where no action has been commenced, the parties may refer their differences to arbitration by mutual agreement, either by mutual bonds of submission, or by deed, or by agreement not under seal, or by parol (but a parol or verbal submission cannot be made a rule of court, even with the consent of the parties). In these instruments it is of importance that the consent clause under 9 & 10 Will. III. c. 15, § 1 (referred to below) be introduced in order that the submission may be made a rule of court. Every person capable of making a disposition of his property may be party to such an agreement: no peculiar form is necessary for its validity.

Whether the submission be verbal or in writing, it is in the power of either of the parties to revoke it, and thus put an end to the authority of the arbitrator at any time before the award is made. In order to prevent this, it is usual for the parties to make it a part of their agreement, that they will abide by and perform the award; and if after this either of them should, without sufficient reason, revoke his submission, or otherwise prevent the arbitrator from proceeding with the arbitration, he will be liable to an action for the breach of his agreement.

The time for making the award may be enlarged, if there be a clause to that effect in the agreement of submission, or if all the parties consent to it, but not otherwise. But now, by 17 & 18 Vict. c. 125, § 15, the parties may, by consent in writing, enlarge the term for making the award; and if no period for the enlargement be mentioned, it shall be deemed to be an enlargement for one month. There are no means of compelling the attendance of witnesses, nor has the arbitrator the power of administering an oath; but the witnesses and—if they have agreed to be examined—the parties are sworn either before a judge, or, in the country, before a commissioner. They may, however, be examined without having been sworn, if no objection is made to it at the time.

The courts cannot enforce performance of the award by attachment; the only remedy is an action on the award itself, or rather on the agreement of submission; unless where the submission being in writing either contains the consent clause above mentioned, or does not contain words purporting that the parties intended it should not be made a rule of court: in which case the party in whose favour the award is made may have his remedy upon it by attachment. The defendant may insist on any objection apparent on the award itself, but where there is any other ground for setting it aside, his only remedy is by a bill in equity.

Thus it will be seen that where the reference is by agreement, many inconveniences occur, particularly from the deficiency of the remedies; but the legislature has enabled parties to put such references on the same footing as those which are made where a cause is depending, by enacting, by 9 & 10 Will. III. c. 15, § 1, that they may agree that their submission (which it is held in this case must be in writing) shall be made a rule of any of her majesty's courts of record (and in practice courts of equity have long enjoyed concurrent jurisdiction), and insert such agreement in their submission; and this submission may at any time afterwards be made a rule of court, by producing the affidavit of its execution made by a witness thereto. Moreover, by the stat. 17 & 18 Vict. c. 125, § 17, there is a further provision on this subject, by which any agreement or submission in writing may be made a rule of court, unless a contrary intention appear in such agreement or submission. The provisions of the statutes 3 & 4 Wm. IV. c. 41, and 17 & 18 Vict. c. 125, apply as well to arbitrations made in pursuance of such agreements of submission, as to those made by order of court; and the law is the same in both cases, except in some few points of practice.

The settlement of disputes by arbitration seems to have enjoyed in all ages a high degree of public favour. Aristotle, to give an instance of a metaphor that is appropriate without being obvious, quotes a passage from Archytas, in which he compares an arbitrator to an altar, as being a refuge for the injured. (Arist. 'Rhetor.' lib. iii. ch. xi.) There were at Athens two modes of proceeding which passed by the name of arbitration—the Greek word for which is diæta (δίαιτα). In the first of these the proceedings were of two kinds, first, when two parties agreed by a regular contract to refer a matter in dispute to a judge or judges selected by them; secondly, when a cause was brought before a public arbitrator in regular course of law. Except in one point, that of non appeal, which seems to have been the rule applicable to the former of these two kinds, there was no difference between them; the arbitrator in each case being subject to the same liabilities, and standing in the same relation to the parties, and the form of proceeding being the same (Dem. 'c. Meid.'). The arbitrators appear to have constituted what in modern jurisprudence would be called a Court of Reconcilement. A certain number of persons, of a specified age, were annually chosen from each tribe, as official referees; and from among these the arbitrators to decide upon each particular case were afterwards also chosen (Petit. 'Leges Atticæ,' p. 345; Dem. 'c. Meid.;' 'Heraldi de Rerum judicatarum auctoritate,' lib. ii. c. iv. s. iv.,) and were then bound to act under pain of infamy. They sat in a public court, and their judgments were subscribed by the archons. (Petit. p. 346.) An appeal lay from their decision to the ordinary courts; and sometimes the arbitrator referred the cause to their judgment at once, without pronouncing any sentence of his own. ('Heraldi de Rer. judic. auctor.' lib. ii. c. iv. s. iv.) In either case, all the writings connected with the trial were sealed up and delivered to the court before which the cause was brought. And it is said that originally no action could be introduced into the ordinary courts without having been first carried before the Court of Arbitrators. (Petit. p. 345; Pollux, viii. 10.) Their jurisdiction, however, was confined to Athenian citizens, and they took no cognizance of suits in which the sum in dispute was less than ten drachmæ, such smaller actions being disposed of in a summary manner by a special tribunal. (*Ibid.*) The litigant parties paid the expenses of the arbitration. (Boeckh, 'Public Œcon. of Athens,' i. 316, English Trans.) When their year of office expired, the arbitrators were liable to be called on for an account of their conduct, and if found guilty of corruption or misconduct, were punished with infamy.

In the other mode of proceeding, which was strictly in accordance with the definition which we have given of arbitration, the parties were at liberty to refer their differences to whomsoever they chose, and such referees were therefore distinguished by the title *αἱρετοί*, who were not, however, selected from the diætetæ of the tribes. The submission was generally made by a written agreement signed by the parties, which frequently contained an engagement by third persons to become sureties for its performance. (Demosthenes's 'Speech against Apaturius,' chap. 4.) The arbitrator was not required to adhere to a rigid interpretation of the law, but might decide according to the individual merits of the case before him. (Arist. 'Rhet.' i. 14.) There lay no appeal from his award to any other tribunal whatever. Though an instance is to be found in Demosth. ('c. Apat.') of a party having persuaded his opponent to leave a matter to the arbitration of three persons, and afterwards finding that they were likely to decide against himself, going before one of the public arbitrators. (See the law quoted by Demosthenes against Meidias, chap. 26.) On the subject of the Diætetæ, see 'Dictionary of Greek and Roman Antiquities,' art. Diætetæ, and Hudtwalcher 'Ueber die öffentlichen und privat Schiedsrichter Diäteten in Athen, und den Process vor denselben.'

The Roman law upon this subject is much better understood, and is of infinitely greater importance. Its influence has extended over the whole of Europe, and even in our own country it is evident that references made by virtue of a mutual agreement—apparently the first species of arbitration known in our law—are mainly founded upon the doctrines contained in the 'Digests' of Justinian, lib. iv. tit. 8. The only mode of referring a matter to arbitration in the Roman law, was by an agreement called *compromissum*, which contained the names of the arbitrators (hence called *arbitri compromissarii*), the matters intended to be referred, and an undertaking by both parties to abide by the award, or in default thereof to pay to the other a certain sum of money as a penalty. The rule which forbids matters of public interest to be submitted to the judgment of a private referee, was not confined in its operation to criminal prosecutions and penal actions only, but extended to these arbitrations, by allowing the arbitrator the power of refusing to entertain (*rector non compellatur sententiam dicere*), any question affecting the civil condition (*status*) of any individual,—his freedom, for instance,—as well as by withdrawing from his decision all questions arising out of the *actiones populares*, and out of actions in which an adverse verdict would result in *infamia*.

The persons named as arbitrators were not bound to undertake the office, but having once done so, they might, by an application to the prætor, be compelled to go through with it. Their authority was, however, terminated by the death of either of the parties, unless his heirs were included in the submission; by the expiration of the time limited for the decision; by either party having broken the agreement, and so incurred the penalty; or by his becoming insolvent, and his property in consequence of a *cessio bonorum* being vested in his creditors.

Their authority also ceased by what we should call an implied revocation, if the subject matter of the reference perished, or if the parties settled the dispute in some other way, referred it to other arbitrators, or proceeded with an action respecting it. The death of the arbitrator, too, put an end to the reference, for the principle on which the appointment of arbitrators rested, was that the arbitration was a personal matter, and did not pass to a successor. Besides the cases in which his authority was thus at an end, an arbitrator could not be compelled to proceed with the reference if he could allege any sufficient excuse, as, for instance, that the submission was void, that there had arisen a deadly enmity between him and one of the parties, or that he had been prevented by ill-health, or by an appointment to some public office in the state; but all these excuses were referred to the prætor for his consideration, to whose jurisdiction belonged all questions connected with the reference.

The extent of the arbitrator's authority depended upon the terms of the submission, which might be either special or general. The submission usually appointed a certain day for the making of the award, but power was generally given to the arbitrators to enlarge the time if necessary, but they could not give their award on an earlier day without the consent of the parties. On the day originally appointed, or on that subsequently fixed by the arbitrators, they formally pronounced their award, and (unless it had been agreed otherwise) the parties were required to be present, and if one of them failed to appear, the award was not binding, but the party who had thus prevented the arbitration being completed incurred the penalty specified in the submission. If there were several arbitrators, all were bound to attend: they were not, however, required to be unanimous, but the opinion of the majority prevailed; and if they were equally divided, it is said that they might of their own authority appoint an umpire, and, in case of their refusing, the prætor had the power of compelling them to do so. When their award was pronounced, their authority expired, and they could neither retract nor alter their decision.

The award when made had not the authority of the sentence of a court of justice, nor was there any direct method of enforcing the performance of it; but as the parties had bound themselves to abide by the arbitrator's decision, if either of them refused to perform it, or in any other way committed a breach of his engagement, he was liable to an action; and however unsatisfactory the award might appear, there was no appeal to any other court. If, indeed, the arbitrators had been guilty of corruption, fraud or misconduct, or if they had not adhered to their authority, their award was not binding: there was, however, no direct method of setting it aside; but if an action was brought to enforce the award, such misconduct might be insisted on as an answer to it. (Heineccii 'Elem. Jur. Civ.' part i. § 531-543; Voetii 'Commentarius ad Pandect.' vol. i. pp. 290-300.

The Roman law was, with some slight modifications, adopted in France (Domat's 'Civil Law,' part i. book i. tit. 14; and 'Public Law,' book ii. tit. 7; Pothier, 'Traité de Procédure Civile,' part ii. chap. iv. art. 2), and notwithstanding the changes which have been introduced from time to time, it still forms the groundwork of the system. There are at present three kinds of arbitration; the first is voluntary arbitration, which is founded, as in the Roman law, upon an agreement of the parties. The mode of proceeding in this case is treated of at considerable length, and with minute attention to details, in the 'Code de Procédure Civile,' art. 1003-1028.

The ordinary courts exercise a much greater control over the proceedings in references than they do in England, but they have never had the power which the magistrates had at Rome—of compelling a person who had once undertaken the office of arbitrator to proceed with it; nevertheless, if he fail to do so, without a sufficient excuse, he is liable to an action for the damages occasioned by his neglect of duty. In order to understand clearly the peculiarities of the French system, it will be necessary to bear in mind that the proceedings before the arbitrators are much more nearly on the same footing with the regular administration of justice than is the case with us, and that many of the details are merely adopted from the practice of the ordinary courts: for instance, there is a system of local judicature established in France, and as the judge is resident in the neighbourhood of the suitors, it has been found necessary—in order to guard against partiality or the suspicion of partiality—to allow either party to refuse or challenge a judge, as in England they would challenge a juryman; and in the same manner an arbitrator may be challenged, but this can only be in respect of some objection which has arisen since his appointment, for the very act of appointing him is an implied waiver of any objections which might have existed up to that time; but if there is no ground for challenge, the arbitrator's authority cannot be revoked without the consent of both parties.

An arbitrator's decision or award is considered as a judgment, and all the formalities required for the validity of a judgment must therefore be observed; but execution of it cannot be enforced until it has received the sanction of the public authority; this sanction is conferred by a warrant of execution granted by the president of the tribunal within the jurisdiction of which the cause of the action arose: the granting of this warrant is called the homologation of the award. If the arbitrator has not strictly pursued his authority, the warrant of execution may be superseded, and the award declared null by an application to the tribunal from which the warrant issued. Besides this, the same modes of obtaining relief may be resorted to in the case of an award, as in that of any other judgment. If any misconduct or irregularity has occurred, the award may be set aside by what is called a *requête civile;* and even where nothing can be alleged against the formal correctness of the proceedings, if one of the parties be dissatisfied with the judgment, he is at liberty (unless the right has been expressly renounced) to appeal to a superior court: when this happens, the whole case is re-opened before the tribunal of appeal, and the merits investigated anew; and when an award is brought under the consideration of a court in any of these ways, any final judgment which the court may have pronounced may be brought before the Court of Cassation, and there quashed if erroneous in point of law.

The second kind, which is called 'compulsory arbitration,' and treated of in the 'Code de Commerce,' div. i. tit. iv. art. 53–64, is where the parties are by law required to submit to a reference, and are precluded from having recourse to any other mode of litigation. The ancient laws of France introduced this species of arbitration very extensively for the settlement of disputes respecting either mercantile transactions or family arrangements; but by the codes now in force, it is admitted in one case only, that of differences between partners. Over such differences the ordinary courts have no jurisdiction whatever in the first instance, even by the consent of the parties; but the commercial courts exercise a superintending and controlling authority over the proceedings. Thus the arbitrators may either be appointed by the deed of partnership, or afterwards nominated by the partners; but if, when a dispute has arisen, one of the partners refuses to nominate an arbitrator, or nominates an improper person, the commercial court, upon application made by the other partner, will appoint one for him; but the authority of the person so appointed will be superseded, if at any time before he enters upon his functions an arbitrator is duly nominated by the partner in delay: and when the firm consists of several partners, upon an application being made by any one of them, the court, after taking into consideration how far their respective interests are identical and how far they are conflicting, will regulate accordingly the number of arbitrators to be appointed by each. The sentence of the arbitrators, howsoever appointed, is decided by the majority of votes.

The authority of the arbitrators in this case partakes more of the judicial character than it does in voluntary arbitration; they are considered as being substituted for the ordinary commercial tribunal; their sentence is accordingly registered among the records of the court; and for the same reason also they stand upon the same footing with the court, both in the power of sentencing the parties to imprisonment, and, unless the right has been renounced by the parties, in the liability of appeal from their decision. ('Code de Commerce,' art. 51–64.)

Besides the compulsory arbitration in matters of partnership, the parties who enter into any engagement are at liberty to stipulate that all differences arising between them shall be submitted to arbitration. This stipulation is compulsory, and the court will, if requisite, appoint an arbitrator ex officio for the party who should refuse to do so; but it is not exclusive, so as to take away the jurisdiction of the ordinary tribunals; it may be rescinded by the consent of the parties, or waived by their acts.

The third kind of arbitration is distinguished by the appellation of the persons to whom the reference is made; they are not called, as in the other cases, *arbitres*, but *aimables compositeurs*, or, in the older law, *arbitrateurs*. The peculiar characteristics of this amicable composition are, that the referees are not, as in other cases, bound to adhere rigorously to the rules of law, but are authorised to decide according to what they conceive to be the real merits of the case; and that in the exercise of this discretion their decision is final, and without appeal to any other tribunal. In case of irregularity or misconduct, the award may be set aside by the judgment of a court, but this judgment cannot be further questioned in the Court of Cassation. This modification of the general law may be introduced into all arbitrations, whether voluntary or compulsory. (See Pardessus, 'Cours de Droit Commercial,' § 1386–1419.)

In Denmark and its dependencies, *Courts* of Arbitration or Conciliation were established about the year 1795, and are said to have been attended with extremely beneficial effects. In Copenhagen the court is composed of one of the judges of the higher courts of judicature, one of the magistrates of the city, and one of the representatives of the commonalty. In other towns, the chief magistrate proposes five or six of the more respectable citizens for arbitrators, of whom the commonalty of the town elect two, advocates being excluded from the list of candidates. In the country, the bailiffs or sheriffs are the arbitrators, and generally act as such personally; but in extensive districts they have authority to appoint deputies. All matters of civil litigation may be referred to these official arbitrators, who in the country sit once in every week, and in the capital as often as occasion requires. It appears that, after investigating a disputed case, the arbitrators in these tribunals have no power to compel the parties to settle their differences in the manner proposed by the court. If they agree, the terms of the arrangement are registered, and it has then the force of a judicial decree; if, after stating their differences and hearing the suggestions of the arbitrators, the parties still disagree, no record is made of the proceeding, and they are at liberty to discuss their respective rights in the ordinary courts of justice. It is necessary, however, that before a suitor commences an action in the superior courts, he should prove that he has already applied to one of the courts of conciliation. These courts, which are attended with very small expense to the suitors, were, soon after their establishment, multiplied rapidly in Denmark and Norway, and are said to have produced an astonishing decrease in the amount of contentious litigation. (See 'Tableau des Etats Danois,' par Catteau, tome i., p. 296.)

ARBLAST, or **ARBALEST**, was the name more particularly given to the cross-bow. Robert of Gloucester, in his 'Chronicle,' published by Hearne, p. 378, makes an especial difference between the bowmen and the arblastes, or arblasters, the cross-bowmen. In the Latin of the middle ages it is called 'arcubalista,' from *arcus*, a bow, and the Greek word βάλλω, to cast or shoot.

The precise date and origin of the arbalest is unknown; but it seems easily derivable from the larger species of ballistæ. Vegetius is inclined to consider the *scorpio* to be the same as the cross-bow: he speaks of scorpions, which he says they now name *manuballistæ;* and in later writers the modern weapon is sometimes termed *scorpio manualis.*

Pitiscus, in his 'Lexicon,' has assigned the introduction of the arbalest into the Roman armies to the time of Constantine, or a little earlier.

Strutt thought that the cross-bow was introduced into England about the 13th century; but Daines Barrington comes probably nearer to the truth ('Archæologia,' vol. vii. p. 46), when he inclines to the opinion that it was the arbalest, and not the long bow, which was used with such destructive effect at the battle of Hastings by the Normans. There can be little doubt but that the arbalest was introduced by the Normans at their first arrival. We have no mention whatever of it in any writer or document of the Saxon times; but in the 'Domesday Survey,' compiled in 1086, we have several *arcubalistarii*, captains of cross-bow men, among the tenants in chief. No such appellation is given in that record to any person who held lands in the time of King Edward the Confessor.

Brompton, in Twysden's 'Scriptores,' col. 1278, says, that the use of the arbalest having been laid aside, was revived by King Richard I., who was afterwards killed by an arrow shot from one at the siege of Chalus.

The arrows for the cross-bow were called quarrels, from the French *carreaux*. [ARCHERY.]

ARBORETUM. This name has been lately extended beyond its strict botanical meaning, and made to apply to public parks opened near large manufacturing towns. In 1837 a resolution was passed by the House of Commons to the effect that, in all new Enclosure Acts, some portions of the waste land about to be appropriated should be set apart for the healthful recreation of the neighbouring towns and villages. This resolution has led to the establishment of many places for open-air recreation.

Mr. Joseph Strutt, of Derby, made a munificent gift to the inhabitants of that town, in 1840, of an Arboretum or public park. He expended twelve thousand pounds in the purchase of eleven acres of ground at the south end of the town, and in laying out this ground with walks, lawns, plantations, and other accessaries. The late Mr. Loudon was employed to conduct the operations; and, in a pamphlet on the subject, he has given the reasons which induced him to determine on an Arboretum, instead of a botanic garden or a mere pleasure-ground. Near each tree and shrub is a small tablet, on which is written the catalogue number of the specimen, the Latin or scientific name, the English name, the habitat, the full-grown height, the date of the introduction, &c. By a deed of settlement the Arboretum is placed in the hands of the corporation of Derby, for the benefit of the inhabitants.

When the modern town of Birkenhead was laid out on so magnificent a scale, a public park was planned on a basis of unusual liberality. An open spot of 190 acres was so arranged, that 120 acres were laid out in shrubberies, lakes, walks, and drives for the free use of the inhabitants; while the remaining 70 acres were appropriated for handsome residences intended to border the park. Mr. (now Sir Joseph) Paxton was employed to form the park. The cost of the land and the laying out of the park was about 130,000*l*; and it was computed that the 70 acres would resell for building-ground at about the same sum; so that this excellent public-spirited arrangement would in effect cost nothing to the townsmen collectively.

In 1846-7 no fewer than three public parks were established in the neighbourhood of Manchester; namely, Peel Park, opposite Salford-crescent; Queen's Park, in the Rochdale-road; and Phillip's Park, in Ancoats. The purchasing of the estates and the formation of the parks were effected by a committee, to whose hands munificent donations were entrusted.

In 1852 an Arboretum was opened at Nottingham. It comprised an area of 18 acres, at the northern limits of the town; and it comprised, greenswards, paths, and drives, plantations of trees and shrubs, and a lake containing aquatic birds. This was not the gift of a private individual; it resulted from the provisions of an Enclosure Act passed in 1846.

About the same period an Arboretum was formed at Ipswich. Bradford and Liverpool soon afterwards recognised the importance of places of open-air recreation, whether called by the name of Arboretum or by any other name.

The metropolis has, within a comparatively small number of years obtained an addition of two to its former number of public parks. These are Victoria Park and Battersea Park, situated respectively at the north-east and south-west extremities of the Metropolis. Each contains the beginning of what may one day be an Arboretum. The unsightly Kennington-common has been converted into a park of humble pretensions. A park and arboretum for Finsbury have long been under consideration, but though an Act has been obtained for its construction, no steps have been taken for carrying it into effect. Hampstead-heath, so far as it contains the elements for an Arboretum, has been with difficulty preserved from the builders, who have covered so many other open spots near London with bricks and mortar.

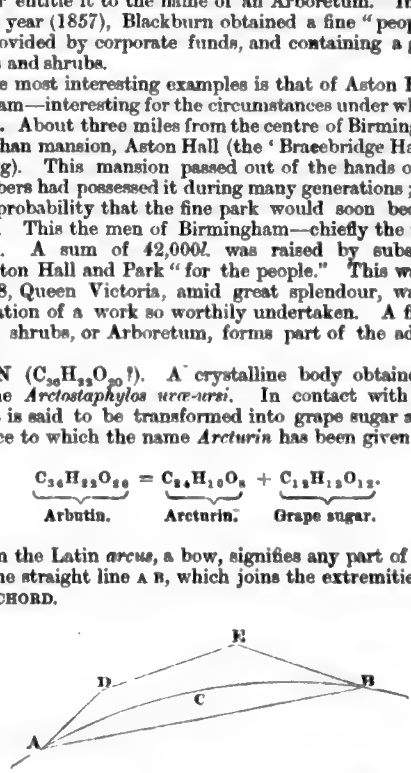
Without attempting to notice all the parks for the people, constructed and thrown open within the last few years, we must at any rate devote a few words of description to that at Halifax, munificently presented to the inhabitants by Mr. Crossley, a carpet manufacturer, and member for the borough. This park, which was opened in 1857, covers an area of about 13 acres; and cost, with the laying out of the grounds by Sir J. Paxton, no less a sum than 30,000*l.* Besides terraces, statues, vases, basins, fountains, a small piece of water, with a bridge, &c., the park contains a collection of trees, shrubs, and flowers, which so far entitle it to the name of an Arboretum. In the autumn of the same year (1857), Blackburn obtained a fine "people's park" of 50 acres, provided by corporate funds, and containing a goodly collection of trees and shrubs.

One of the most interesting examples is that of Aston Hall and park at Birmingham—interesting for the circumstances under which the work was effected. About three miles from the centre of Birmingham is a fine old Elizabethan mansion, Aston Hall (the 'Braeebridge Hall' of Washington Irving). This mansion passed out of the hands of the family whose members had possessed it during many generations; and in 1856, there was a probability that the fine park would soon become covered with houses. This the men of Birmingham—chiefly the working men—prevented. A sum of 42,000*l.* was raised by subscriptions, to purchase Aston Hall and Park "for the people." This was done; and in June 1858, Queen Victoria, amid great splendour, was present at the inauguration of a work so worthily undertaken. A fine collection of trees and shrubs, or Arboretum, forms part of the adornments of the park.

ARBUTIN ($C_{36}H_{22}O_{20}$?). A crystalline body obtained from the leaves of the *Arctostaphylos uvæ-ursi*. In contact with the ferment *Synaptase*, it is said to be transformed into grape sugar and a crystalline substance to which the name *Arcturin* has been given:

$$\underbrace{C_{36}H_{22}O_{20}}_{\text{Arbutin.}} = \underbrace{C_{24}H_{10}O_{8}}_{\text{Arcturin.}} + \underbrace{C_{12}H_{12}O_{12}}_{\text{Grape sugar.}}$$

ARC, from the Latin *arcus*, a bow, signifies any part of a curve line, as A C B. The straight line A B, which joins the extremities of the arc, is called its CHORD.



For the arc of a *circle*, see ANGLE, where the method of finding the arc from its angle, and the converse, is given. For the properties of the arcs of various curves, see their several names.

It is found necessary to assume the following axiom previously to any general investigation of the properties of an arc. Every arc is greater than its chord, but, when concave to the chord throughout, is less than the sum of the sides of any rectilinear figure which contains it. Thus A C B is greater than A B, but less than the sum of A D, D E, and E B. If x and y be the co-ordinates of any point in the curve, the general method of finding the arc is by the integration of the formula

$$\sqrt{dx^2 + dy^2},$$

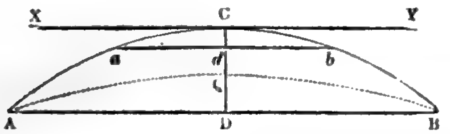
or, in the language of the fluxional calculus,

$$\text{fluent of } \sqrt{\dot{x}^2 + \dot{y}^2}.$$

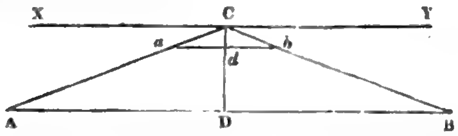
The practical method of finding the length of an arc, which is an approximation to the preceding process, is as follows:—Divide the arc into a number of smaller arcs, making the number large in proportion to the degree of accuracy required, and add together the chords of the smaller arcs. The sum of the chords will differ very little from the arc, even when the number of subdivisions is not very large. For instance, the arc of the quadrant of a circle, whose diameter is ten millions of inches, is 7,853,982 inches, within half an inch. Divide this quadrant into ten equal parts, and the sum of the chords is 7,845,910 inches: divide the quadrant into fifty parts, and the same sum is 7,853,659 inches, which is not wrong by more than one part out of 24,316. For only twenty subdivisions the sum of the chords is

7,851,963 inches, wrong only by one part out of 3890. Therefore, for every practical purpose, an arc of a circle (and the same may be said of every other curve) is the polygon made by the chords of a moderate number of subdivisions of the arc.

The preceding property is (but in what manner our limits will not permit us to show) a consequence of the following proposition. Let there be a number of arcs, such as ACB, cut off the same curve, having their chords parallel to the tangent XCY; then, as AB moves parallel



to its first position towards XY, CD not only decreases without limit but its proportion to AB decreases without limit; that is, let any number, however great, be named, then shall AB, before it reaches XY, reach a position in which it contains CD more than that number of times. This proposition is startling to the beginner in mathematics, and should be considered by him with great attention. It may be illustrated in the following manner:—Suppose that while AB moves from its first position towards XY, and has reached *a b*, a miscroscope moves with and over it, which increases in magnifying power as *a b* moves, in such a manner that *a b* always appears in the glass as large as AB to the naked eye. Then *a* c *b* will not be magnified into the form ACB, but into AQB, where QD grows less and less without limit, as *a b* approaches towards XY. But if two straight lines had been taken, as in the following figure, *a b* could not have been magnified to AB without changing *a* C *b* into ACB.



Formerly, the term arc was frequently confounded with angle, which arose from the practice of measuring angles by arcs of the circle. For such terms as ARC OF ELEVATION, &c., we refer to ANGLE OF ELEVATION, &c.

ARCADE signifies a series of arches on insulated piers, forming a screen, and also the space inclosed by such. This is, perhaps, a limitation of the term within that usually given to it; but arcade is properly a correlative of *colonnade*, and should not therefore have a more extensive signification. What, by a strange perversion of the term, are in this country called *piazzas*, and most particularly the part so termed of the buildings in Covent Garden, London, are strictly *arcades;* and the market within the inclosed area of that same place or square, to which the term *piazza* properly applies, exemplifies, in a great part of its exterior, the correlative term *colonnade*.

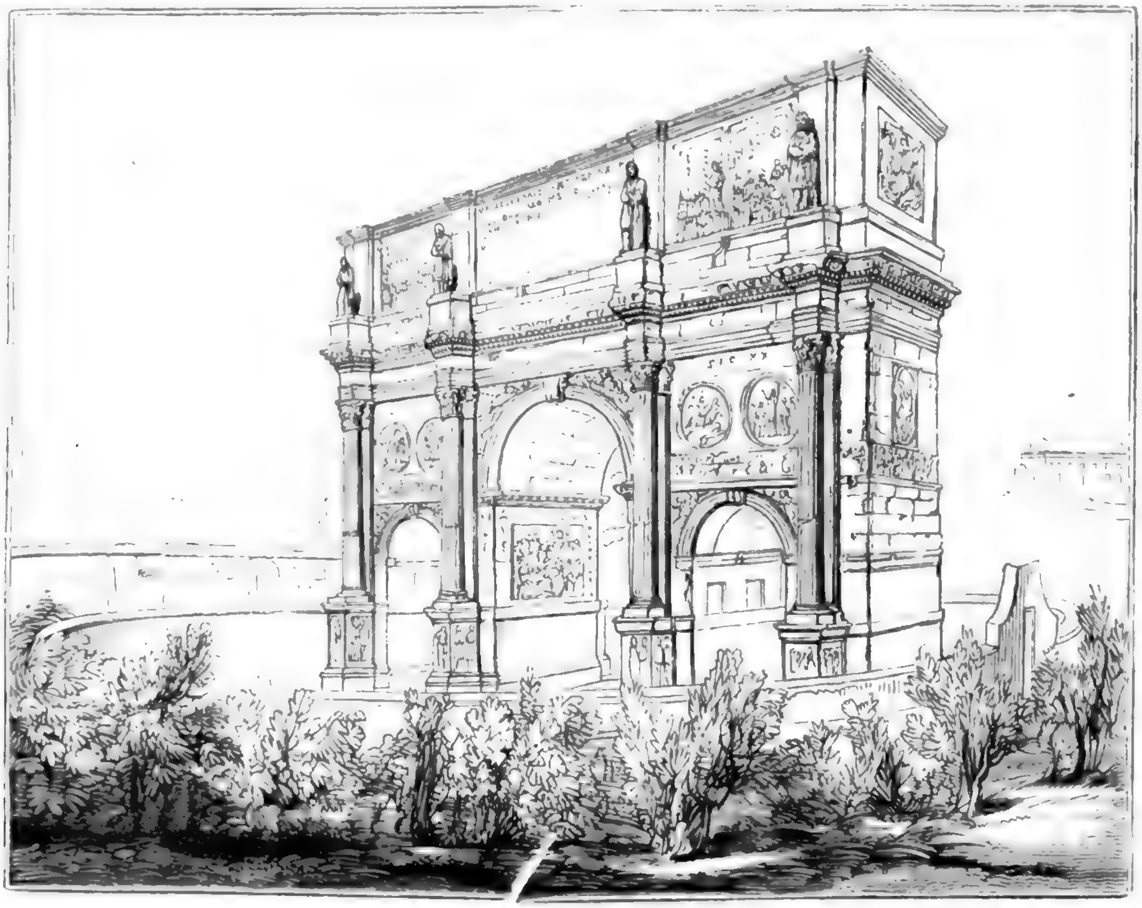
In Gothic architecture the term arcade is applied to a series of arches supported on piers, and used as decorations for the walls of churches, and occasionally of other buildings. The arches are sometimes open, but more commonly closed by the masonry of the wall. Good examples of arcades of the Norman and Early English styles (in which arcades are most employed) occur in Canterbury cathedral; of the decorated style in Lichfield cathedral: but most of our cathedrals possess some examples.

In addition to its proper technical meaning, this term has acquired a different signification among us as the popular name for what the Parisians more properly designate a 'passage' or 'galerie,' namely, an alley lined on each side with shops, and roofed over so as to be in fact a sort of 'in-door' street, entirely protected from the weather, and of uniform design throughout in its architecture. So far, an arcade answers to the idea of a bazaar, the chief distinction between the two being that the latter has not so much of street character about it, but consists either of a single spacious hall or separate rooms, fitted up with counters and stands, and may therefore be likened to a single large shop occupied by a number of different dealers, whereas in an arcade the shops are quite distinct from each other, and enclosed in front with windows after the usual manner; and they have besides dwelling accommodation, kitchen, &c., beneath, and a chamber over them, with the addition sometimes of an entresol. Another distinction is that an arcade serves as a public thoroughfare for foot-passengers. The Burlington Arcade, which was the first place of the kind in London, has indeed little more than its convenience as a thoroughfare and promenade for foot-passengers to recommend it, inasmuch as it makes no pretensions to elegance of design, nor has it anything in accordance with the title bestowed on it, it being neither arcaded in any way nor arched over. The Lowther Arcade in the Strand (erected 1831) manifests a great improvement upon that first specimen, for it is really a handsome piece of architecture; the side elevations are divided by pilasters into compartments, each of which contains a shop-front, with an ornamented triple window over it, and above that a semicircular one in the arched head of the compartment. On the plan, each of these divisions is covered by a pendentive dome with a circular skylight; and these numerous domes and their arches produce a pleasing perspective effect. Three other arcades have been opened in London since the erection of the Lowther Arcade. The first of them, Exeter Arcade, running from Wellington Street to Catherine Street in the Strand, erected in 1844 from the designs of Mr. Sidney Smirke, is very short; is more enclosed than either Burlington Arcade or Lowther Arcade; has a vestibule at each end; is glazed, so that the lights form a continuous skylight, and has polychromic embellishment applied both on the upper part of the walls (in ornaments and panels between the windows over the shops) and on the cove of the ceiling. The whole place has indeed more the appearance of a hall or gallery than of a place of thoroughfare and business. The arcade in New Oxford Street, opened in 1851, is short but of rather pretentious character. Both of these have proved commercially unsuccessful, and neither is, in fact, now employed for the purpose for which it was constructed. The South-Eastern Arcade, at the entrance of the South-Eastern Railway Station, London Bridge, is only remarkable for its unmitigated architectural baldness and poverty. In Paris arcades have obtained much greater popularity than in London. Among the Parisian arcades, the Passage Colbert is one of the most striking, both for its extent and architectural display, towards which last its Rotunda contributes in no small degree.

ARCH. The origin of that species of construction called an arch is unascertained; it cannot be stated with certainty either in what country or at what epoch it was first used. There is good reason to think that, though the arch form was certainly known to the Pelasgic inhabitants of Greece, it was unknown to the Greeks at the time when they produced their most beautiful temples, in the fifth, fourth, and third centuries before the Christian era. No structure answering to the true character of an arch has been found in any part of those works, though many occasions occur in which the application of the arch would have been of great service, and would seem unlikely to have been passed over by an intelligent and ingenious people like the Greeks if they had been acquainted with the principle. The want of the arch would necessarily lead them to contract the intercolumniation, or spaces between the columns, and to the general and frequent adoption of columns as the only mode of supporting a superstructure. But though not appropriated—at least for their sacred buildings—by the Greeks, it is now certain that the arch was known both to the Egyptians and the Assyrians. There are brick arches at Thebes in Egypt, which belong to a very remote epoch, and one long prior to the Greek occupation of that country. Minutoli ('Reise zum Tempel des Jupiter Ammon') has given two specimens of Egyptian arches, one of which is a false and the other a true arch. The first specimen is from the remains at Abydos in Egypt (p. 245), where the roof has the appearance of an arch, but is formed by three horizontal stones, of which that which occupies the centre and lies over the other two is the largest; the three stones are cut under in such a way as to form a semicircle. The true specimens are at Thebes (at least as early as B.C. 1490), on the west side of the river (p. 260), near and behind the building which contains the fragments of the enormous statue. They are circular arches, and formed of four courses of bricks (see pl. 29), and on the walls there are Egyptain paintings and hieroglyphics. (See also Belzoni's 'Plates,' No. 44, and his remarks on the brick arches of Thebes; and also Sir Gardner Wilkinson's 'Egypt and Thebes,' pp. 81 and 126; 'Manners and Customs of the Egyptians,' vol. iii.; and Colour, p. 297.) The stone arches in the Nubian pyramids can hardly perhaps be adduced in proof of the early use of the arch, as these edifices are probably not of very high antiquity (see Cailliaud's 'Plates,' No. 43), though Mr. Hoskins ('Travels in Ethiopia') attributes to the latest of them a date not more recent than that of Cambyses. A stone arch of a date not later than that of Psammeticus has been discovered at Saccara, and another in a tomb near Gizeh. Mr. Layard and M. Place found both round and pointed arches at Nimroud and at Khorsabad, the construction of which shows that the ancient Assyrians were at a very early period sufficiently acquainted with the constructive value of the arch to apply it to a variety of important purposes. In the roofs of the tombs of Lycia, of about the 5th century B.C., the pointed arch occurs. (Fellowes' 'Lycia;' and the works of Forbes and Spratt.) Etruria seems, from the best evidence that can be obtained, to have been the first place in Europe where the arch was employed; and to the Etrurians may be assigned the honour of its earliest applications, as far as our positive and undisputed information goes, in works of an important size and character, in a pointed as well as in the circular form. The great sewer of Rome, commonly called the Cloaca Maxima, is an arched construction, which can hardly be referred to any period in the history of the city with so much probability as to that to which it is assigned by uniform tradition, namely, the age of the Tarquins. But though we may readily admit this early date, we cannot say whether the architects were Roman or Etrurian, though the latter would seem the more probable.

The application of the arched structure is one of the most useful mechanical contrivances ever discovered by man. By means of it, small masses of burnt clay, and conveniently sized pieces of soft and friable sandstone, are made more extensively useful for the economic of Stertinius and Scipio were ornamented with gilded statues; and that of Scipio with two horses also. Whether they precisely resembled the later arches as to their columns, rilievos, and other accessory parts, we cannot say. As far as we can judge from medals, these early triumphal arches consisted of a single arch with a column on each side, without a stylobate; the arch was surmounted by a simple border as a kind of architrave.

Under the emperors these monuments became very numerous, and were overcharged with ornaments. Drusus, the step-son of Augustus, is mentioned as the first who had one raised to him after death, and Livia, the wife of Augustus, was the first woman to whom a similar honour was decreed. Augustus himself had several triumphal arches erected to him, of which the one at Rimini, where the Flaminian Way terminated, still remains, and serves as a gate to the town on the side towards Rome. Another arch, also erected to Augustus, though inferior in beauty to that of Rimini, exists at Susa, at the commencement of the road which leads over Mont Genèvre into France. Of the triumphal arches remaining at Rome, that of Titus is the oldest. It was erected to him after his death by the senate, in memory of his conquest of Judæa. This arch is ornamented with sculptures representing the triumph of the conqueror, and with the ornaments of the temple of Jerusalem which he brought as spoils to Rome. But arches were not erected solely to commemorate victories and conquests; they were also raised in honour of emperors for benefits conferred on their country on some particular occasions: such is the fine arch of Trajan, on the old mole of Ancona. It is of white marble, and chaste in its style; the inscription states that it was raised "by the senate and people of Rome to Trajan, Emperor and Cæsar, son of Nerva, the conqueror of the Germans and Dacians, high pontiff, &c., a most provident prince, for having at his own expense constructed the mole, and thus rendered the access to Italy on this side safer to navigators." Bronze statues of Trajan, of his wife Plotina, and his sister Marciana, were placed on the summit of the arch, but they have been destroyed. Another fine arch in memory of Trajan exists at Benevento; it is



Arch of Constantine.

ornamented with fine rilievos, and is in very good preservation. All these are single arches; but others have two smaller archways, one on each side of the great central one. These are consequently oblong in their shape, and have a heavier appearance than the single arch. Two of these triple arches still exist at Rome, that of Septimius Severus, and that called the arch of Constantine, which we have chosen for our illustration. The view here given is from an original drawing. The arch of Constantine is in the valley at the foot of the Palatine Hill, and near the Colosseum. It is the most complete of all the triumphal arches at Rome; that of Titus has only a central archway, and that of Septimius Severus is more dilapidated, and more encumbered by accumulations of soil. The style of Constantine's arch is also, for the most part, superior to that of the age in which it was executed, as it consists, in great measure, of the materials of a similar monument which had been erected to Trajan. But at the same time, owing to its being chiefly built of old materials, and owing to want of skill in the architect and sculptor, it presents some striking discrepancies of parts, and some specimens of bad taste. The captive Parthians, and other sculptures, which were historically appropriate on the arch of Trajan, are here employed to decorate that of Constantine. Our view indicates an excavation, bounded by a wall of an elliptical form, within which the monument stands. Accumulations of soil had raised the level of the ground nearly up to the bases of the columns; the excavation was made for the purpose of clearing away the rubbish, and the wall with the view of protecting the monument.

The number of marble arches, in honour of emperors and other personages, existing in ancient Rome alone, is stated to have been at one time thirty-six: only five or six are now remaining. Other arches are found in various parts of Italy, at Aquino, Aosta, Pola in Istria, &c.; several in the south of France, of which those of Nîmes and Orange are the best preserved; several in Macedonia, Athens, and in other parts of Greece, all however belonging to the Roman period: several in Syria, and in Barbary, particularly one at Tripoli; and another at Constantina, described by Shaw. In modern times, triumphal arches have been raised in imitation of the Roman ones. Those of the gate St. Denis and the gate St. Martin at Paris were raised in honour of Louis XIV. Bonaparte also had one constructed on the Place du Carousel; it is a triple arch, and has all the heaviness of that particular species of structure. Another, and a much finer one, was begun by his order at Milan, on the opening of the famous road across the Simplon. It was interrupted by the overthrow of the French empire, but has since been completed by order of the Austrian government, under the appellation of the Arch of Peace. In London, two structures of the same kind have been raised of late years, a single arch at Hyde Park Corner, and a triple one of marble originally erected in front of Buckingham palace, but removed on the erection of a new front to that building, to the north-eastern entrance of Hyde Park. On Roman triumphal arches the reader may consult Pitiscus, 'Lexicon Antiquitatum Romanorum,' art. Arcus.

The arch of Augustus at Rimini is 60 feet in height and 27 in depth or thickness; the gateway is 31 feet, being the widest opening among all the ancient arches in Italy. The front is decorated with two Corinthian columns 32 feet high. It is made of Istrian marble.

The arch of Septimius Severus is 61 feet high, 71 feet long, and 22 feet deep. The central archway is 36 feet high, and 22 feet wide. The side arches are 22 feet high and 10 wide.

The arch of Orange, in the south of France, supposed, but upon no certain grounds, to have been erected in honour of Caius Marius, is 70 feet high and 66 long. It is a triple arch.

Arches bearing a great resemblance to triumphal arches, but simpler in form and less ornamented, were also erected at the entrances to the road-way of bridges in Italy, Spain, and France; though comparatively few of them remain. There is one on the bridge erected by Trajan at Alcantara in Spain. Two of very elegant form and in good preservation occur at the bridge of St. Chamas in Provence; and there is a similar double-arch bridge at Saintes in the South of France. These bridge-arches all bear inscriptions recording the date, &c., of their erection.

ARCHÆO'LOGY, literally 'the study of antiquity or ancient things,' from ἀρχαῖος, *ancient*, and λόγος, *a discourse*. Though the term is often used, its meaning in this country has not always been very exactly fixed; but there is nothing properly belonging to it which is not included under the heads of ANTIQUITY and ANTIQUITIES. Like the latter term, the term archæology has been somewhat capriciously confined to the study of Greek and Roman art; but it is now usually employed to express generally the study of all that concerns the early history of any civilised nation or country. The great extension which the study of archæology has received of late years, and is still receiving, has led to the formation of various associations, both in this country and throughout Europe, in order to unite the exertions of all who devote themselves to the study. One of the first of these was the Archæological Institute of Rome, founded in 1829. In our own country, not only are there metropolitan institutes, which have for their object the investigation of the antiquities of the country generally, but in several counties associations have been established, having for their special object the study and preservation of local antiquities.

ARCHBISHOP. For what belongs to the episcopal character and office generally, we refer to the word BISHOP: we mean to confine ourselves in this article to what belongs more peculiarly to the archbishop. For though, in this country, and generally throughout Europe, the archbishop has his own diocese in which he exercises ordinary episcopal functions like any other bishop in his diocese, yet he has a distinct character, having an admitted superiority and a certain jurisdiction over the bishops in his province, who are sometimes called his suffragans, together with some peculiar privileges. This superiority is indicated in the name. The word or syllable *arch* is the Greek element αρχ (which occurs in ἀρχὴ, ἀρχὸς, ἄρχων, &c.), and denotes precedence or authority. It is used extensively throughout ecclesiastical nomenclature, as may be seen in Du Cange's 'Glossary,' where there are the names of many ecclesiastical officers into whose designations this word enters, who were either never introduced into the English Church or have long ceased to exist. Exalted officers of state have sometimes designations into which this word enters, as arch-duke. Why this word was used peculiarly in ecclesiastical affairs rather than any other term denoting superiority is probably to be explained by the fact that the term ἀρχιερεὺς, for chief-priest, occurs in the Greek text of the Christian Scriptures. Patriarch is a less obvious compound of the same class, denoting the chief father, and is used in ecclesiastical nomenclature to denote a bishop who has authority not only over other bishops, but over the whole collected bishops of divers kingdoms or states; it is analogous in signification to the word *pope* (papa), a bishop to whom this extended superintendence is attributed.

Whatever might be the precise functions of the episcopus (ἐπίσκοπος, bishop), the term itself occurs in the writings of St. Paul, Phil. i. 1, 1 Tim. iii. 2, and elsewhere; but the word ἀρχιεπίσκοπος, or archbishop, is not found till about or after the 4th century. Cyrillus Archiepiscopus Hierosolymitanorum, and Celestinus Archiepiscopus Romanorum, occur under these designations in the proceedings of the Council held at Ephesus, A.D. 431. Other terms by which an archbishop is sometimes designated are primate and metropolitan. The first of these is formed from the Latin word *primus*, 'the first,' and denotes simple precedency, the first among the bishops. The latter is a Greek term, which rendered literally into English would be *the man of the mother-city*, that is, the bishop who resides in that city where is the mother church of all the other churches within the province or district in which he is the metropolitan.

The term metropolitan, when thus analysed, points out to us the origin of whatever real distinction there is between bishop and archbishop, or, in other words, the cause of that elevation which is given to the archbishop above the bishops in his province, when it is not to be attributed to mere personal assumption, or to be regarded only as an unmeaning title. The way in which Christianity became extended over Europe was this: an establishment was gained by some zealous preacher in some one city; there he built a church, performed in it the rites of Christianity, and lived surrounded by a company of clerks engaged in the same design and moving according to his directions. From this central point, these persons were sent from time to time into the country around for the purpose of promoting the reception of Christianity, and thus other churches became founded, offspring or children, to use a very natural figure, of the church whence the missionaries were sent forth. When one of these subordinate missionaries had gained an establishment in one of the more considerable cities, remote from the city in which the original church was seated, there was a convenience in conferring upon him the functions of a bishop; and the leading design, the extension of Christianity, was more effectually answered than by reserving all the episcopal powers in the hands of the person who presided in the mother church. Thus other centres became fixed; other bishoprics established; and as the prelate who presided in the first of these churches was still one to whom precedence at least was due, and who still retained in his hands some superintendence over the newer bishops, *archbishop* became a suitable designation. Thus, in England, when there was that new beginning of Christianity in the time of Pope Gregory, Augustine, the chief person of the mission, gained an early establishment at Canterbury, the capital of the kingdom of Kent, through the favour of King Ethelbert. There, in this second conversion, as it may be called, the first Christian church was established, and thence the persons were sent out who at length Christianised the whole of the southern part of England. Paulinus, in like manner, a few years later, gained a similar establishment in the kingdom of Northumbria, through the zeal of King Edwin, who received Christianity, and built him a church at York, one of his royal cities, which may be regarded as the chief city of Edwin's kingdom. From York the light of Christianity was diffused over the northern parts of England, as from Canterbury over the southern. It seems to have been the peculiar diligence and dignity of Paulinus which procured for him the title of archbishop, and gave him a province, instead of a diocese only, as was the case with the other members of the Augustinian mission. This was done by special act, under the authority, it is said, of Justus, an early successor of Augustine. But the precedence of the real English metropolitan is acknowledged in two circumstances: in the style, the one being a primate of England, and the other the primate of all England; and in the rank, precedence being always given to the Archbishop of Canterbury, and the Lord Chancellor of England being interposed in processions between the two archbishops.

Under the later empire the name metropolis was applied to various cities of Asia and conferred on them as a title of rank. The emperors Theodosius and Valentinian conferred on Berytus in Phœnicia the name and rank of a metropolis "for many and sufficient reasons." ('Cod.' xi. tit. 22 (21).) Accordingly the bishop of a metropolis was called metropolitan (μητροπολίτης), and the bishop of a city which was under a metropolis was simply called bishop. All the bishops, both metropolitan and others, were subject to the archbishop and patriarch of Constantinople, who received his instructions in ecclesiastical matters from the emperor. ('Cod.' i. tit. 3, s. 42, 43.)

The precise amount of superintendence and control preserved by the archbishops over the bishops in their respective provinces, does not seem to be very accurately defined. Yet if any bishop introduces irregularities into his diocese, or is guilty of scandalous immoralities, the archbishop of the province may, as it seems, inquire, call to account, and punish. He may, it is said, deprive. In 1822 the archbishop of Armagh deposed the bishop of Clogher from his bishopric. In disputes between a diocesan and his clergy an appeal lies to the archbishop of the province in all cases except disputes respecting curates' stipends. (1 & 2 Vict. c. 106.) Rolle, a good authority, says that the archbishop may appoint a co-adjutor to one of his suffragans who is infirm or incapable. This right is now confirmed by 6 & 7 Vict. c. 62, intituled 'An Act to provide for the Performance of the Episcopal Functions in case of the Incapacity of any Bishop or Archbishop.'

An archbishop has a right to name one of his clerks or chaplains to be provided for by every bishop whom he consecrates. The present practice is for the bishop whom he consecrates, to make over by deed to the archbishop, his executors and assigns, the next presentation of such benefice or dignity which is at the bishop's disposal within his see, as the archbishop may choose. This deed only binds the bishop who grants, and, therefore, if a bishop dies before the option is vacant, the archbishop must make a new option when he consecrates a new bishop. If the archbishop dies before the benefice or dignity is vacant, the next presentation goes to his executors or assigns according to the terms of the grant.

The archbishop also nominates to the benefices or dignities which are at the disposal of the bishops in his province, if not filled up within six months from the time of the avoidance. During the vacancy of a see, he is the guardian of the spiritualities.

Certain of the bishops are nominally officers in the Cathedral of Canterbury, or in the household of the archbishop. The archbishop has also certain honorary distinctions; he has in his style the phrase "by Divine providence," but the bishop's style runs "by Divine permission;" and while the bishop is only installed, the archbishop is enthroned.

The archbishops may nominate eight clerks each to be their chaplains. The archbishop of Canterbury claims the right of placing the crown upon the head of a king at his coronation; and the archbishop of York claims to perform the same office for the queen consort. The archbishop of Canterbury is the chief medium of communication between the clergy and the king, and is consulted by the king's ministers in all affairs touching the ecclesiastical part of the constitution; and he generally delivers in parliament what, when unanimous, are the sentiments of the bench. The two archbishops have precedence of all temporal peers, except those of the blood-royal; and except that the lord chancellor has place between the two archbishops. Before the Reformation, the archbishop of Canterbury occupied a very elevated station with reference to the whole church, having at general councils the precedence of all archbishops, and being regarded somewhat in the light of a patriarch, presiding, as he was supposed to do, over the several kingdoms of England, Wales, Scotland, and Ireland.

The province of the archbishop of York consists of the six northern counties, with Cheshire and Nottinghamshire; to these were added, by Act of Parliament in the time of Henry VIII., the Isle of Man: in this province he has six suffragans, the bishop of Sodor and Man, the bishop of Durham, the only see in his province of Saxon foundation, and the bishops of Carlisle, Chester, Ripon, and Manchester. Of these, the bishopric of Carlisle was founded by king Henry I. in the latter part of his reign, and the bishopric of Chester by king Henry VIII.; so thinly scattered was the seed of Christianity over the northern parts of the kingdom in the Saxon times. The rest of the kingdom forms the province of the archbishop of Canterbury, in which there are twelve bishoprics of Saxon foundation; the bishopric of Ely, founded by Henry I.; the bishoprics of Bristol, Gloucester, Oxford, and Peterborough, founded by Henry VIII.; and the four Welsh bishoprics, of which St. David's and Llandaff exhibit a catalogue of bishops running back far beyond the times of St. Augustine. The twelve English bishoprics of Saxon foundation are London, Winchester, Rochester, Chichester, Salisbury, Exeter, Bath and Wells, Worcester, Hereford, Lichfield and Coventry, Lincoln, and Norwich. The dioceses of the two English archbishops, or the districts in which they have ordinary episcopal functions to perform, are, for Canterbury, the greater part of the county of Kent, a portion of that county forming the diocese of Rochester, a number of parishes distinct from each other, and called Peculiars, in the county of Sussex, with small districts in other dioceses, particularly London, which belonging in some form to the archbishop, acknowledge no inferior episcopal authority. The diocese of the archbishop of York consists of a great portion of the county of York, and the whole county of Nottingham, with some detached districts.

Lives of all the archbishops and bishops of England and Wales are to be found in an old book entitled 'De Præsulibus Angliæ Commentarius.' It is a work of great research and distinguished merit. The author was Francis Godwin, or Goodwin, bishop of Llandaff, and it was first published in 1616. A new edition of it, or rather the matter of which it consists, translated and recast, with a continuation to the present time, would form a useful addition to our literature. There is also an 8vo. volume, published in 1720, by John le Neve, containing lives of all the Protestant archbishops, but written in a dry and uninteresting manner. Of particular lives there are many, by Strype and others; many of the persons who have held this high dignity having been distinguished by eminent personal qualities, as well as by the exalted station they have occupied.

St. Andrew's is to Scotland what Canterbury is to England: and while the episcopal form and order of the church existed in that country, it was the seat of the archbishop, though till 1470, when the pope granted him the title, he was known only as the Episcopus Maximus Scotiæ. In 1491, the bishop of Glasgow obtained the title of archbishop, and had three bishops placed as suffragans under him.

In Ireland there are two archbishoprics, Armagh and Dublin; two, Tuam and Cashel, having been, by the Act 3 & 4 Will. IV. c. 37, reduced to bishoprics. Armagh, of which the archbishop is styled Primate of all Ireland, has five suffragan bishops, Meath, Tuam, Derry, Down, and Kilmore; the archbishop of Dublin is styled Primate of Ireland, and has also five suffragan bishops, Ossory, Cashel, Cork, Killaloe, and Limerick. Catalogues of the archbishops of Ireland and Scotland may be found in that useful book for ready reference the 'Political Register,' by Robert Beatson, Esq.

To enumerate all the prelates throughout Christendom, to whom the rank and office of archbishop are attributed, would extend this article to an unreasonable length. The principle exists in all Catholic countries, that there shall be certain bishops who have a superiority over the rest, forming the persons next in dignity to the great pastor pastorum of the church, the pope. The extent of the provinces belonging to each varies, for these ecclesiastical distributions of kingdoms were not made with foresight, and on a regular plan, but followed the accidents which attended the early fortunes of the Christian doctrine. In Germany, some of the archbishops attained no small portion of political independence and power. Three of them, namely, those of Treves, Cologne, and Mentz, were electors of the empire. In France, under the old régime, there were eighteen archbishoprics, all of which, except Cambray, claimed to have been founded in the 2nd, 3rd, and 4th centuries; the foundation of the archbishopric of Cambray was referred to the 6th century. The French have a very large and splendid work, entitled 'Gallia Christiana,' containing an ample history of each province, and of the several subordinate sees comprehended in it, and also of the abbeys and other religious foundations, with lives of all the prelates drawn up with the most critical exactness.

The word *suffragan*, used in this article, may require some explanation. A suffragan, in the more ordinary sense of the term, is a kind of titular bishop, a person appointed to assist the bishop in the discharge of episcopal duties; and among the reforms meditated at the close of the reign of King Henry VIII., was the introduction of a considerable number of suffragan bishops of this class, and some persons were actually consecrated. But every bishop within his province is sometimes spoken of as a suffragan of the archbishop, being originally, in fact, little more. Questions have been raised respecting the origin of the word suffragan, which is by some supposed to be connected with *suffrages* or votes, as if the bishops were the voters in ecclesiastical assemblies; but more probably, if connected with suffrages at all, the term has a reference to their claiming to vote in the election of the archbishop. A great question respecting the right of election of an Archbishop of Canterbury, between the suffragans of his province and the canons of Canterbury, arose in the time of King John, and is a principal occurrence in the contest which he waged with the pope and the church.

ARCHDEACON. In contemplating the character and office of the bishop in the early ages of the church, we are not to regard him as a solitary person acting alone and without advice. He had a species of clerical council around him, persons who lived a kind of collegiate life in buildings attached to the great cathedral church, each of whom, or at least several of whom, possessed distinct offices, such as those of chancellor, treasurer, precentor, and the like. These persons are now often called canons; but the most general name by which they are to be known, as the institution existed in remote times, is that of deacon, a term of which dean is a contraction. Deacon appears to come from the Greek term *διάκονος*, the name of that officer in the church of whose appointment we have an account in Acts, vi. 3—6. To one of these deacons precedence was given, and no doubt some species of superintendence or control, and to him the title of *archdeacon* was assigned.

In the name there is no indication of any peculiar employment. What now belongs to the archdeacon was anciently performed by the officer in the bishop's court called the chorepiscopus. The chorepiscopus (*Χωρεπίσκοπος*) was the bishop's deputy or vicar in small towns and country places, in which he discharged the minor episcopal functions. He might be of episcopal rank or not (Ducange, 'Glossarium'). The chorepiscopus is mentioned in a Constitution of Justinian. ('Cod.' i. tit. 3, s. 41 (42).) The manner in which the archdeacon usurped upon this obsolete officer and attracted to himself the functions which belonged to him, is supposed to have been this:—being near the bishop and much trusted by him, the archdeacon was often employed by the bishop to visit distant parts of the diocese, especially when the bishop required particular and authentic information, and to report to the bishop the actual state of things. Hence deacons were spoken of by very early Christian writers as being the *bishop's eye;* and from this power of inspection and report the transition was easy to the delegation, to one of the deacons, of a portion of episcopal authority, and empowering him to proceed to reform and redress, as well as to observe and report.

If this is a just account of the origin of the archdeacon's power, it is manifest that originally the power would be extended over the whole of a diocese; but at present it is confined within certain limits. In England, according to the 'Valor Ecclesiasticus' of King Henry VIII., there are 54 archdeaconries, or districts through which the visitorial and corrective power of an archdeacon extends. Godolphin and Blackstone state that there were 60 archdeaconries: the number has since been increased, and there are now above 60 in England and Wales. Seven new archdeaconries were erected by 6 & 7 Will. IV. c. 97. These are the archdeaconries of Bristol, Maidstone, Monmouth, Westmoreland, Manchester, Lancaster, and Craven; and archidiaconal power was given by the same act to the dean of Rochester, in that part of Kent which is in the diocese of Rochester.

This distribution of the dioceses into archdeaconries cannot be assigned to any certain period, but the common opinion is, that it was made some time after the Conquest. It is said that Stephen Langton, archbishop of Canterbury, was the first English bishop who established an archdeacon in his diocese, about A.D. 1075. The office of archdeacon is mentioned in a charter of William the Conqueror. (Phillimore.) The bishops had baronies, and were tied by the Constitutions of Clarendon to a strict attendance upon the king in his great council, and they were consequently obliged to delegate their episcopal powers. Each archidiaconal district was assigned to its own archdeacon, with the same precision as other and larger districts are assigned to the bishops and archbishops; and the archdeacons were entitled to certain annual payments, under the name of procurations, from the benefices within their archdeaconries. The act already cited (6 & 7 Will. IV. c. 97) directed a new arrangement of all existing deaneries and archdeaconries, so that every parish and extra-parochial place shall be within a rural deanery, and every deanery within an archdeaconry, and that no archdeaconry extend out of the diocese.

As the archdeacon in ancient times intruded upon the chorepiscopus, so in recent times he has extinguished the authority and destroyed almost the name of another officer of the church, namely, the rural dean.

The archdeaconries are still subdivided into deaneries, and it is usual for the archdeacon, when he holds his visitations, to summon the clergy of each deanery to meet him at the chief town of the deanery. Formerly, over each of the deaneries a substantive officer, called a dean, presided, whose duty it was to observe and report, if he had not even power to correct and reform; but the office has been laid aside in some dioceses, though in others it has been re-established. But where it has been superseded, the duties are discharged by the archdeacon. Though the office of rural dean has been found extremely useful, no emolument whatever is attached to it.

Archdeacons must have been six full years in priest's orders (§ 27, 3 & 4 Vict. c. 27), and they are appointed by the respective bishops; they are inducted by being placed in a stall in the cathedral by the dean and chapter. By virtue of this *locus in choro* a *quare impedit* lies for an archdeaconry. (Phillimore.) The duty of archdeacons now is to visit their archdeaconries from time to time: to see that the churches, and especially the chancel, are kept in repair, and that everything is done conformably to the canons and consistently with the decent performance of public worship; and to receive presentations from the churchwardens of matter of public scandal. The visitation of the archdeacon may be held yearly, but he must of necessity have his triennial visitation. Archdeacons may hold courts within their archdeaconries, in which they may hear ecclesiastical causes, but an appeal lies to the superior court of the bishop. (24 Hen. VIII. c. 12.) By § 3 of 3 & 4 Vict. c. 86, the archdeacon may be appointed one of the assessors of the bishop's court in hearing proceedings against a clergyman. The judge of the archdeacon's court, when he does not preside himself, is called the Official. Sometimes the archdeacon has a peculiar jurisdiction, in which case his jurisdiction is independent of that of the bishop of the diocese, and an appeal lies to the archbishop. [PECULIAR.] By 6 & 7 Will. IV. c. 97, § 19, it is enacted that all archdeacons throughout England and Wales shall have and exercise full and equal jurisdiction within their respective archdeaconries, any usage to the contrary notwithstanding.

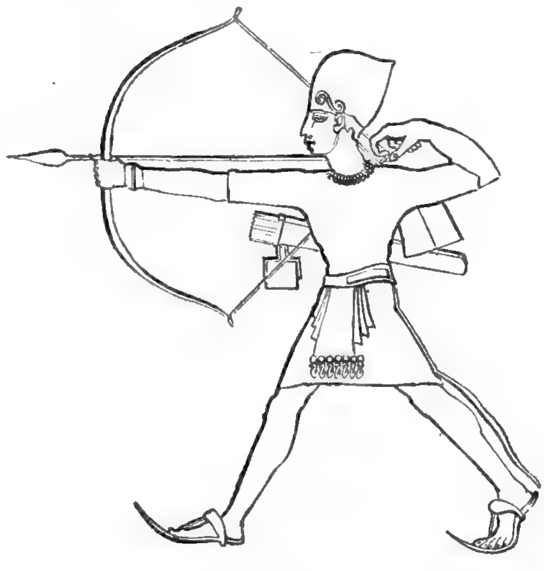
In the revenue attached to the office of archdeacon, we see the inconvenience which attends fixed money payments in connection with offices which are designed to have perpetual endurance. It arises chiefly from the payments by the incumbents. These payments originally bore no contemptible ratio to the whole value of the benefice, and formed a sufficient income for an active and useful officer of the church; but now, by the great change which has taken place in the value of money, the payments are little more than nominal, and the whole income of the archdeacons as such is very inconsiderable. The office, therefore, is generally held by persons who have also benefices or other preferment in the church. There have been in recent times cases where archdeacons have held prebends of cathedrals in other dioceses than that in which their jurisdiction was situated; and also instances in which they have had no cathedral preferment. The 1 & 2 Vict. c. 106, § 124, specially exempts archdeacons from the general operation of the Act, by permitting two benefices to be held with an archdeaconry. An archdeacon is said to be a corporation sole. Among the recent Acts which affect archdeacons the most important are 1 & 2 Vict. c. 106; 3 & 4 Vict. c. 113; and 4 & 5 Vict. c. 39.

Catalogues of the English archdeacons may be found in a book entitled 'Fasti Ecclesiæ Anglicanæ,' by John le Neve. Archdeaconries have been established in some, if not in all, of the dioceses of the new colonial bishops.

ARCHERY, the art of shooting with a bow and arrow. With respect to the origin of archery, the use of the bow may be traced to the remotest antiquity, and it occurs in the history of many different nations; but some people, the ancient Britons for instance, did not use the bow. The first notice which we find of it is in Genesis (xxi. 20), where it is said that Ishmael the son of Abraham "dwelt in the wilderness and became an archer:" a bow-shot too is mentioned in an earlier verse of the same chapter as a measure of distance. In the Greek mythology we find Apollo armed with the bow and arrow (Homer, 'Iliad,' i. 45), and Hercules also, as described in the 'Odyssey' (xi. 606). The use of these weapons we may therefore conclude to be of very high antiquity among the Greeks. In the war of Troy, the main force of the Greeks appears to have consisted of soldiers who had heavy defensive armour; but the soldiers of Philoctetes were archers. The Cretans maintained their reputation as skilful bowmen to a late period in their history; and we find Meriones, the companion of the Cretan king Idomeneus, carrying off the prize from Teucer himself ('Iliad,' xxiii. 882). Teucer, the brother of Ajax, who came from the island of Salamis, excelled in the use of the bow and arrow, which appear however to have been considered less honourable weapons than the spear and sword. Ulysses in the 'Iliad' fights with the spear and sword, but in the 'Odyssey' we find the strength of the suitors tested by the bow which Ulysses had left at home, and which he afterwards uses against his domestic enemies.

In the later times of Greece, archers formed a part of the light-armed troops, in the same manner as the Sagitarii among the Romans afterwards formed a part of the Velites. Procopius records it as a great improvement when the Roman auxiliaries were instructed to draw the right hand to the ear. But the practice itself is of much greater antiquity, as we see in the representations of the sea-fight on the walls of Medinet-Habou, at Thebes in Egypt. ('Egypte, Antiq.,' vol. ii.)

Representations of archers frequently occur in the sculptured slates found at Khorsabad and Nineveh (Botta and Layard, *passim*); indeed the bow seems to have been a common weapon in the Assyrian armies. Archery was also, as we learn from Procopius, the fashion with the ancient Persians.



Egyptian Archer.

The time when the use of the long-bow commenced in England, as a military weapon, is unknown. That which the Normans used at the battle of Hastings was the arbalest or cross-bow. In the reign of Henry II. we find several facts recorded which show the continuance of the use of the cross-bow; and in that of Henry III. we find cross-bowmen forming the vanguard of the army. As a military weapon of England, the arbalest, in all probability, was last used at the battle of Bosworth in 1485, though as late as 1572 Queen Elizabeth engaged by treaty to supply the King of France with 6000 men, armed partly with long, partly with cross-bows. It was also used on the Continent in the wars of the 16th century.

From the reign of Edward II. the mention of the long-bow becomes frequent in our history. At Crécy, at Poictiers, and at Agincourt, as well as in several battles which were gained over the Scotch, the victory is ascribed to the English bowmen; and it is particularly noticed that at Crécy the rain, which had slackened the strings of the Genoese cross-bows, had not weakened the effect of the long-bows which our countrymen used. Edward III. enjoined the use of the long-bow in two precepts addressed to the sheriffs of counties; and in the reign of Richard II. an act was passed to compel all servants to shoot with it on Sundays and holidays. By the 7 Hen. IV. the heads of arrows were to be well boiled or brazed, and hardened at the points with steel; all heads otherwise manufactured were to be forfeited, and the makers imprisoned: all arrow-heads, moreover, were to be marked with the maker's name. Henry V. ordered the sheriffs of several counties to procure feathers from the wings of geese, picking six from each goose. Two feathers in an arrow were to be white, and one brown or grey; and this difference in colour informed the archer in an instant how to place the arrow. In the time of Edward IV. an Act passed ordaining that every Englishman should have a bow of his own height; and butts were ordered to be constructed in every township for the inhabitants to shoot at on feast days; and if any neglected to use his bow, the penalty of a halfpenny was incurred. An Act, 1 Richard III., complains, that by the seditious confederacy of Lombards using divers ports of this realm, bow-staves were raised to an outrageous price; that is to say, to 8*l.* a hundred, whereas they were wont to be sold at 40*s.* This Act provided that ten bow-staves should be imported with every butt of malmsey or Tyre wines, brought by the merchants trading from Venice to England, under a penalty of 13*s.* 4*d.* for every butt of the said wines in case of neglect. By 6 Hen. VIII. c. 2, all male servants were to provide themselves with one bow and four arrows, which their master was to pay for, stopping the purchase-money out of their wages. Another statute, enjoining the use of archery more extensively, was passed in 33 Henry VIII. It ordained that every man under sixty, except spiritual men, justices, &c., should use shooting with the long-bow, and have a bow and arrows continually in his house: that he should provide bows and arrows for his servants and children; that every servant, above seventeen and under sixty years of age, should pay 6*s.* 8*d.* if he was without a bow and arrows for one month. The inhabitants of every city, town, and place were to erect butts, and practice shooting on holidays, and at every other convenient time. Latimer, in one of his sermons before King Edward VI., published in 1549, enforced the practice of archery from the pulpit. "Men of England in times past," he says, "when they would exercise themselves (for we must needs have some recreation, our bodies cannot endure without some exercise), they were wont to go abroad in the fields of shooting, but now it is turned into glosing, gulling, and whoring within the house. The art of shooting hath been in times past much esteemed in this realm; it is a gift of God that he hath given us to excel all other nations withal; it hath been God's instrument whereby he hath given us many victories against our enemies. But now we have taken up whoring in towns instead of shooting in the fields. A wondrous thing, that so excellent a gift of God should be so little esteemed! I desire you, my lords, even as ye love the honour and glory of God, and intend to remove his indignation, let there be sent forth some proclamation, some sharp proclamation to the justices of peace; for they do not their duty. Justices now be no justices; there be many good Acts made for this matter already. Charge them upon their allegiance that this singular benefit of God may be practised . . . . for they be negligent in executing these laws of shooting. In my time, my poor father was as diligent to teach me to shoot, as to learn me any other thing, and so I think other men did their children. He taught me how to draw, how to lay my body in my bow, and not to draw with strength of arms as other nations do, but with strength of the body. I had my bows bought me according to my age and strength; as I increased in them, so my bows were made bigger and bigger; for men shall never shoot well except they be brought up in it. It is a godly art, a wholesome kind of exercise, and much commended in physic." Holinshed reports that Henry VIII. shot as well as any of his guards.

The encouragement thus given to shooting with the long-bow caused archery to become a fashionable amusement after the bow had ceased to be used as an instrument of war. Edward VI. was fond of this exercise; and there seems every reason to believe that it was practised by King Charles I. This monarch issued a proclamation in the eighth year of his reign, to prevent the fields near London from being so inclosed as "to interrupt the necessary and profitable exercise of shooting." He is also represented in the frontispiece of Markham's 'Art of Archery,' 1634, in the dress and attitude of a bowman. Public exhibitions of shooting with the bow were continued in the reigns of King Charles II. and King James II.; and an archers' division, at least till within the present century, formed a branch of the Artillery Company.

The most important society of this kind now existing is "The Royal Company of Archers, the King's body-guard of Scotland." The exact time of its institution is unknown, but it is referred by the Scottish antiquaries to the reign of their James I., when a commission being appointed to oversee and enforce the exercise of archery in different counties of that kingdom, the most expert bowmen were selected from the mass of those raised, to form a body-guard for the king on perilous occasions, and are stated to have conducted themselves with skill, loyalty, and courage. The rank of the King's body-guard for Scotland was understood from tradition to be vested in the Royal Company, and they accordingly claimed the honour of acting in this capacity to his majesty King George IV. on the occasion of his visit to Scotland in 1822. They attended his majesty at court and on all state ceremonies during his residence in Scotland, and accompanied him on his visit to Hopetoun House, from whence he embarked for London. The Royal Company of Archers now forms part of the royal household in Scotland; it has a captain-general, four lieutenants-general, four majors-general, four ensigns-general, and fifteen brigadiers-general, offices held by persons of distinguished rank.

From their own minutes, still extant, it appears that an Act of the privy council of Scotland was passed in 1677, conferring on this body the name and title of "His Majesty's Company of Archers," and granting a sum of money for a piece of plate to be shot for as a prize. No permanent king's prize, however, was established till 1788, when a sum of money was granted by King George III. to be shot for annually, with which a piece of plate was to be purchased.

During the Revolution of 1688 the Royal Company were opposed to the principles then espoused, and were all but suppressed. On Queen Anne's succession they were revived, and in 1703 received a royal charter confirming all their former rights and privileges, and conferring others upon them. The affairs of the Royal Company, which now consists of about 500 members, are managed by a council of seven, who are chosen annually by the members at large, and in whom is vested the power of receiving or rejecting candidates for admission, and of appointing the officers of the company civil and military. The field uniform of the Royal Company is of dark green cloth, faced with black braiding, with a narrow stripe of crimson velvet in the centre. The hat is of the same colour, with a handsome medallion in front, and a plume of black feathers. They have two standards. New colours, as well as a confirmation of the Royal Company to be the king's body-guard for Scotland, were given to them by King William IV.

Towards the end of the last century, the revival of archery as a general amusement was attempted, under the patronage of the then Prince of Wales; and at that time, and subsequently, numerous societies of archers were formed, many of which printed their rules and orders. Archery-meetings are still held in various parts of the country, and ladies are frequently competitors for the honorary prizes given.

The distance to which an arrow could be shot from the long-bow depended much upon the strength and art of the bowman; but, in general, the distance was reckoned from eleven to twelve score yards. In 1794, the Turkish ambassador's secretary, in a field behind Bedford Square, near the Toxophilite ground, with a Turkish bow and arrow, shot 415 yards partly against the wind, and 482 yards with the wind. He said that the then Grand Sultan shot 500 yards, which was the greatest performance of the modern Turks; but that pillars stood on a plain near Constantinople, commemorating ancient distances about 800 yards. The Baron de Tott says, in his 'Memoirs,' Paris, 1785, tom. ii. p. 107, "Nearly all the Turkish emperors have had the vanity of pretending to this kind of celebrity."

Ascham has enumerated fifteen sorts of wood, of which arrows were made in England in his time, namely, brazell, turkiewood, fusticke, sugercheste, hardbeame, byrche, ashe, oak, service-tree, alder, blackthorn, beach, elder, aspe, and salow. Of these, asp and ash were preferred to the rest, the one for target-shooting, the other for war. Whistling arrows have been once or twice found on fields of battle of the time of Edward VI. They were chiefly used, it is believed, for giving signals in the night. The Chinese have used whistling arrows from time immemorial. The arrows shot from cross-bows were called quarrels, or bolts. They were usually headed with a large square pyramid of iron; but had sometimes other forms given to them.

(Ascham's *Toxophilus*, 1515; Markham's *Art of Archerie*, 1634; Barrington's *Observations on the Practice of Archery in England*, printed in the 'Archæologia;' and the late Mrs. Banks's *Manuscript Collections on Archery*, preserved in the British Museum.)

ARCHES, COURT OF, is the supreme court of appeal in the archbishopric of Canterbury. It derives its name from having formerly been held in the church of St. Mary le Bow (*de Arcubus*), from which place it was removed about 1567 to the Common Hall of Doctors' Commons, where it has since been held. The judge of the court is termed Official Principal of the Court of Arches, or more commonly Dean of the Arches. This court has ordinary jurisdiction in all spiritual causes, other than those prosecuted under the Church Discipline Act, 3 & 4 Vict. c. 86, and the statute 1 & 2 Vict. c. 106, s. 98, arising within the parish of St. Mary le Bow and twelve other parishes, which are called a deanery, and are exempt from the authority of the Bishop of London. It has also a general appellate jurisdiction in ecclesiastical causes, other than those above referred to, arising within the province of Canterbury. Extensive as this jurisdiction appears to be, the court has now practically little or nothing to do, as the ecclesiastical offenders whose correction formerly constituted the business of the court, can now be prosecuted only under the provisions of the statutes above mentioned. (Blackst. 'Comm.' Mr. Kerr's ed., vol. i. p. 384.)

The Dean of the Arches for the time being is president of the College of Doctors of Law, who had, until recently, the exclusive privilege of practising in the Ecclesiastical and Admiralty Courts, and who received their admission in the Arches Court. The statute transferring the testamentary jurisdiction of the Ecclesiastical Courts to the Crown (20 & 21 Vict. c. 77) has provided for the dissolution of the College of Doctors of Law; and that, and the statute 20 & 21 Vict. c. 85, have thrown open the practice in the Probate and Divorce Courts to the bar and to the attorneys. The Dean of the Arches, who is the deputy of the archbishop, has always been selected from the College of Doctors of Law. There is no salary attached to the office of judge; and his income arising from fees, as also that of the registrar, is very small.

The court of the province of York, which corresponds to the Court of Arches, is called the Chancery Court of York. The number of advocates practising in this court has never exceeded four. They are admitted by fiat of the archbishop, directed to his chancellor, and have power to practise in all the courts of the archbishop; but it is not necessary that they should be Doctors of Civil Law. [ECCLESIASTICAL COURTS.]

ARCHIATER (in Greek ἀρχίατρος), an honorary distinction conferred on physicians in the times of the Roman emperors, and still employed in some of the Continental countries. Physicians generally occupied a very subordinate station in Rome during the republican period: in fact, no well-educated medical men existed among the Romans at that time; and the Greek physicians who went to Rome were not at first favourably received. Julius Cæsar at length bestowed the rights of Roman citizenship on the foreign physicians practising at Rome; and the Emperor Augustus, after his recovery from a dangerous illness, not only conferred on his own physician, Antonius Musa, the honours of knighthood, but is said to have exempted all physicians from the payment of taxes and other public burdens. The Emperor Nero first gave the title Archiater (chief of the physicians) to his medical attendant, Andromachus the elder, well known as the inventor of a celebrated compound preparation called Theriaca. It is probable that the emperor only intended to express, by this title, the consideration in which he held his own physician; but it appears that, soon afterwards, the Archiatri were charged with some kind of superintendence over the medical profession. Thus Galen says of Andromachus: "It appears to me that he was appointed by the emperor at that time to reign over us;" and we also find that the word *Archiater* was translated into Latin by the words *superpositus medicorum*, 'superintendent of the physicians.' At a later period, however, the rank or office of the Archiatri seems to have undergone some change; and we find two classes of them distinguished, namely, the Archiatri of cities, and those of the court. The first law regarding the Archiatri of cities (*Archiatri populares*) was given by Antoninus Pius. He ordered each smaller town to have five, the larger seven, and the largest cities to have ten physicians, distinguished by the above name, and wholly exempted from the payment of taxes and public burdens: thus it appears that the exemption of all practitioners, if it ever existed, was found too extensive a privilege. At Rome, there were fourteen Archiatri appointed for the different districts of the city, besides one for the vestal virgins, and another for the gymnasia: they were elected by the citizens and proprietors, and approved by their colleagues. In later times, the Archiatri of a higher rank appear to have had the sanction of the emperor; and it is not improbable that some sort of examination was also requisite for their admission. Besides enjoying the privileges alluded to, the Archiatri derived from the towns certain remunerations in kind (*annonaria commoda*), as well as salaries. It was their business to treat poor patients gratuitously, but in treating other persons they were authorised to take fees like their professional brethren. They formed medical committees or colleges in each city, and superintended the public health, and the state of the medical profession, and they also taught the principles and practice of medicine. Thus a decree of Constantine the Great says, "We order rewards and salaries to be given to them, that they may the more readily imbue many pupils with liberal studies and the said arts." There is a variety of laws relative to the Archiatri, showing that the Romans regarded the members of the medical profession as deserving and requiring the attention and protecting care of government. The physicians attached to the imperial court took the title of Archiatri of the palace, and also formed a corporation, with certain rights, privileges, and distinctions of rank, which became more important during the reigns of the later emperors, when strict rules of precedency were established for all persons connected with the court and government. The Count of the Archiatri was a *vir spectabilis*, and equal in rank to the dukes and to the vicars of the emperor.

In modern times, the name of Archiater has, in imitation of the ancient fashion, sometimes been assumed by physicians holding public appointments in cities, but more frequently by the physicians of kings and princes. In Sweden and Denmark, however, the dignity of Archiater still exists, as the highest honour conferred on medical men: in Sweden there are only two Archiatri, who act as physicians to the king.

ARCHIL, *orchil, litmus*, or *tournsole*, is a blue dye procured from the *Rocella tinctoria* and *Ceanora tartarea*, which are lichens growing abundantly in the Canary and Cape Verd islands. The colouring matter of these plants appears to be a peculiar vegetable principle which has been called *erythrine*. It may be extracted either by means of alcohol or ammonia, but the latter is employed by those who manufacture the colour, which is generally sold in small flat pieces, and known by the name of litmus.

The blue colour of litmus is soluble in water and in alcohol. A strong infusion, when looked at in mass, is purple; but a diluted one is of a pure blue colour by day-light, and red by candle-light. Acids redden the colour of litmus, and this effect is produced even by the weakest of them, as carbonic acid and sulphuretted hydrogen; when mixed with the latter, and kept for some days in a well-stopped bottle, the colour is destroyed; but by exposure to the air, or by boiling, the colour is restored. Sulphureous acid and the hypo-sulphites also bleach litmus. These effects appear to be the result of deoxidisement, for the blue colour is restored by the absorption of oxygen.

Archil is brought to market in three states—violet-red liquid paste, blue lumps, and powder. It is employed by chemists to ascertain the presence of acids in solution, because it has the property of changing from blue to red by contact with acids; and it also detects alkalies, by restoring the blue which had been changed by acids. Archil is never used alone as a dye, on account of its want of permanence. It is however employed for the purpose of deepening and improving the tints of other dyes, and it imparts a bloom which it is difficult to obtain from other substances. Liquid archil is much used for staining wood, and tinting silk stockings.

M. Clenchard, a French chemist, in 1850 patented a mode of using archil in the dyeing and printing of woollen and silk goods, in which the archil is combined with alkalies and lime, and applied to the woven material with a more direct action than in the ordinary mode of its use.

Archil communicates a beautiful violet colour to marble.

The island of Teneriffe yields a great portion of the lichen from which archil is prepared.

ARCHIL. [LICHENS, COLOURING MATTERS OF.]

ARCHIMANDRITE, the title of a dignitary in the monastic orders of the Greek church, answering to that of Father Provincial among the monks and friars of the Roman Catholic Church. The archimandrite is a superior abbot, having under his jurisdiction several convents of the same district or province. The Russian Church, which is a branch of the Greek, has its archimandrites, as well as the Greek Church in other places where that religion is recognised.

ARCHIMEDIAN SCREW. A machine frequently used for the purpose of raising water, when the height to which the water is to be raised is not considerable; for laying in the foundations of bridges, and for draining the marsh lands of the low countries, this machine appears to be peculiarly adapted, and it is principally in the Netherlands that it may be seen at work.

In ordinary Archimedian screws three threads are formed on a central core, enclosed in an exterior envelope; the exterior diameter of the threads being usually made from 1 foot 2 inches to 2 feet 4 inches, and about three times the diameter of the core; and the length of the screw is made from twelve to eighteen times the external diameter of the thread, whatever that may be. These threads and core are enclosed in a water-tight case, and the water rises, by following their movement, towards the upper end of the screw; for the inclination of the threads upon the axis, and their uninterrupted course, enables the water which enters in the continually turning tube to flow over the curved surface formed by the threads, as it would do on an inclined plane. The inclination of the axis with the horizon is usually made to vary between 35° and 45°; and the screw works the most favourably when the level of the water in the lower basin rises a little above the centre of the base of the enveloping case, without entirely submerging the latter. Occasionally the outer envelope is dispensed with, and the water is made to rise upon a close masonry channel; in which cases the loss of power entailed by moving the envelope is avoided. It is calculated that a workman can exercise, in a day of six hours' constant labour in turning an Archimedian screw, a useful effect equal to 637,283 lbs. raised 1 foot in height. [PROPELLER.]

ARCHITECTURE is sometimes defined to be 'the art of building.' We shall presently examine in what sense this definition ought to be explained, and how it ought to be limited.

The Greek term for architect is ἀρχιτέκτων (*architectōn*), which we find employed by Herodotus (iii. 60) in the same sense as the word *architect* now is: he informs us, that Rhœcus, a Samian, was the *architectōn* or architect of the great temple of Samos. We thus learn from positive testimony, that before the great buildings of Athens were erected, the term architect and the profession of an architect were distinctly recognised among the Greeks. But Herodotus also uses the word *architectōn* in the passage just referred to in another sense: he applies it to a person who made a tunnel by which the city of Samos was supplied with water; and this is an instance in which *building*, or *construction*, properly speaking, can hardly be said to have been employed. The great increase in works of this class in modern times has led to new designations, such as that of civil engineer, which we apply to those who construct artificial ports, roads, railways, tunnels, &c.; and though the engineer may often have occasion to *build*, and may also with propriety *decorate*, common usage has placed a determinate boundary between civil engineering and architecture.

In ascertaining the present meaning of terms, it is sometimes useful and often necessary to ascend to their primary signification, and to trace their historical progress. The Greek word *archi-tectōn* signifies the chief *fabricator* or *maker*; and the word *tectōn* itself (τέκτων) appears to mean, originally, a *worker in wood*, a *carpenter*, a *house-builder*, a *ship-builder*, &c. (See 'Iliad,' xv. 411; xxiii. 712; 'Od.' xvii. 384.) It is not, however, limited to those who were skilful in the working of wooden materials, but when coupled with a qualifying term (as in 'Il.' iv. 110; 'Hymn to Venus,' l. 12) it had a more extensive signification.

It is impossible to assign any exact meaning to the term architecture by any short definition. Architecture is not merely the 'art of building,' or of working materials of earth, timber, or stone, into the form of mounds, huts, caves, and walls. Thus we do not admit such mounds of earth as that raised to the memory of Alyattes, by Lake Gygæa, or of Silbury Hill near Marlborough, to possess an architectural character. Neither are the kraals of the Hottentot, nor the rude huts of other nations, entitled to this name, though such habitations undoubtedly have in each nation a particular and a tolerably uniform style of construction.

An excavation in a rock is not an architectural work, unless it possesses a certain symmetry and certain ornaments which characterise other similar works, so as to enable us to refer it to some class or kind of construction. Where such instances of excavations occur, the ornamental or architectural part is obviously only the copy of models in wood or stone previously erected on the earth. Such is the character of the rock temples of Elephanta, and the rock-cut tombs or temples in Nubia. The rude Pelasgic or Cyclopian walls of Tiryns in the Peloponnesus, and other similar structures in Italy, possess a distinctive character, which is seen in a more advanced and improved state in the military fortifications of Mycenæ, where we find also in what is known as the Treasury, or the Tomb of Atreus, a very remarkable subterraneous structure of nearly as early a date, and the oldest instance, as far as we know, now existing in Europe, of a construction in stone combined with the sister art of sculpture. We refer to the sculptured figures in high relief, commonly called lions, which stand over the great gateway. But even these can hardly be considered as architectural works.

The existing monuments in Great Britain which are supposed to be anterior to the Roman invasion of this island, are classed, whether correctly or not we shall not here inquire, under the general term of Druidical or Celtic. The most remarkable of these monuments, both for preservation and arrangement, is Stonehenge on Salisbury Plain in Wiltshire. Here we find stones, some of very large dimensions, placed upright in the ground, and forming a series of concentric circles. They are not merely rude masses, like those of Avebury near Silbury Hill, but they have evidently undergone some shaping and rubbing down so as to form tolerably regular parallelopipedons. We here observe also two stones placed upright, like posts or pillars, and another large stone placed over them like an architrave or lintel: the lintel is also secured by means of mortises and tenons: all this indicates certainly a regular principle of construction. But, with the exception of a few inquirers who are, perhaps, disposed to over-value Celtic remains, can any careful antiquarian trace the forms of our oldest churches and other ancient edifices, to the rude masses of the British monuments in this island? It is an historical fact, that the Romans introduced into England their own principles of building; and it is equally demonstrable that, with the exception, probably, of the arch, Roman architecture, as it is known to us, both from existing specimens and written books, is a modification and adaptation of Grecian architecture; it was probably introduced among the Romans by Greeks, and certainly generally practised by them even under the emperors. If we then trace the progress of architectural construction from the Greeks, through the Romans, to its introduction into western Europe, we may fairly assert that the term *architecture*, in its strictest historical sense, implies the adaptation of Grecian models to the buildings of our own times.

A building may be well arranged for all purposes of mere convenience, but if this is all it is not an architectural construction. To possess an architectural character it must combine internal convenience and fitness with beauty of external form, and with durability. If the external arrangement of a building should be compounded of those of several nations, such as Hindoo, Egyptian, and Greek, we should not admit this to be an architectural construction, even if the external form gave pleasure, which, however, is hardly a possible result; for it is essential to the character of an architectural structure, that the general arrangement and ornaments should have a unity of character and be referable to some one model.

Architecture arose, in fact, from the combination of sculpture with construction. *Building* may be older than sculpture, but sculpture combined with building produced architecture. From the Homeric poems we deduce only very vague ideas as to the structure of temples and palaces; we find no distinct indication of the arrangement of columns, which are the very essence of Greek architecture. But the arts of design, and even the arts of working in metal, had attained some excellence. (See in the 'Iliad,' book 18, the description of the shield of Achilles.) We find epithets derived from metal applied to the house of Alcinous and other buildings, from which we infer that they were structures of wood, and that the decorations were of metal; but we find no trace of columnar arrangement, or of an edifice of stone. ('Odyss.' vii. 84, &c.; iv. 45, &c.) Even in the time of Pausanias (x. 5, 11) there still existed at Lacedæmon the temple of Minerva, called the 'house of copper,' from which it would appear, that this and other ancient temples were mainly of wood, and ornamented with metal.

That the oldest material of sculpture was wood, is a fact in itself probable enough, and attested by the authority of Pausanias (viii. 17). Many of these wooden statues of high antiquity remained after the wooden temple itself had been exchanged for a more substantial edifice of stone. The ornamental parts of the stone structure, even in their simplest form, were no doubt derived from the art of the sculptor. The sculptor and the architect, in fact, were often united in the same person; and even when it became usual to separate these arts into two distinct branches, we can have no doubt that the skill of the architect, and the taste, at least, of the sculptor, were generally combined in the same individual. This was the case also with the mediæval architects, and not least with those of England, who frequently not only adapted the exterior forms of their edifices for the reception and display of sculpture, but had good taste enough to take care that these ornaments were in harmony with the whole design, and worthy of the edifice which was to receive them.

Further it is worthy of remark, though it seems to have escaped the observation of many writers, that the nation to which Europe is indebted for the elements of its architecture is also the nation to which we are indebted for our knowledge of geometry. That law of the mind which gave birth to the simple forms of the triangle, the circle, and the square, gave to man the elements of all his works of art. We are not aware of any nation that has had a system of architecture which has not also had a style of sculpture; nor do we know of any nation that has carried architecture to perfection, or even to a degree of excellence in its kind, that has not also had a system of geometry and arithmetic.

We have endeavoured briefly to show, what we believe to be strictly demonstrable, that the term architecture, *historically* explained, is the mode of constructing edifices which we have received from the Romans and the Greeks. But with the establishment of Christianity, and its diffusion over western Europe, a gradual modification was made in the forms of buildings devoted to religious worship: for it must be observed, that it is principally in the religious edifices of a nation that we find the essential principles of its architecture exhibited and preserved. This remark applies with equal truth to all nations that have left behind them examples of some definite style of building. The great ecclesiastical structures of western Europe now exhibit a character in appearance very different indeed from the models of Greek and Roman buildings. They gradually deviated from the heavy and rounded Norman arch, the type of which is undoubtedly the Roman arch, to the pointed and light constructions generally denominated the Gothic. That foreign ornaments of a barbarous or at least incongruous style were occasionally mingled with them by the numerous architects of the middle ages, cannot be denied; but still in the early ecclesiastical, and also in many of the civil structures of Italy, Germany, France, Flanders, and England, a distinct and new character of architecture may be seen; and this distinction became again so marked in the several countries of Europe, that the Gothic or pointed styles of England and various Continental countries have each a distinctive character, though they may all have had a common origin.

The architecture of a people is an important part of their history. It is the external and enduring form of their public life; an index of the state of knowledge and social progress. Architecture, therefore, to be understood aright, must be considered historically; must be considered, that is, in connection with the whole public and social life of the several nations in which it has been practised, and the particular times and circumstances in which it flourished. The architecture of the ancient Greeks, or that of the various European nations during the middle ages, would be very imperfectly understood if the architectural remains were studied apart from the external and inner history of the countries in which they are found. On the other hand, the existing edifices serve to illustrate and elucidate much that would, without their assistance, be but imperfectly comprehended.

No national architecture has ever been self-originated or invented. The architecture of every age and country where true architecture has existed, has grown out of some previous architecture. The architecture of Greece, the purest architecture which the world has ever seen, may be traced back to Assyria and Egypt. The architecture of Rome was derived immediately from Greece. The Oriental imagination transformed this into Byzantine; the Occidental into Romanesque; and borrowing something from both of these, the mind of the 13th century produced the Pointed or Gothic style, which the architects of Italy, Germany, France, and England, modified to suit the wants and characters of their respective countries.

But always it was a modification, adaptation, or development of a previous system, not a reproduction of it. No true architecture has ever been merely mimetic. Though the architecture of Greece derived its germ from Egypt and Assyria, it developed into its perfect beauty and suitableness only by the free influence of the Greek mind. So that of Rome owed whatever of beauty and fitness it possessed to its departure from, not to its conformity with the Greek type. So whatever there is of grandeur and glory in the wondrous Gothic of the middle ages, dates from its emancipation from the classic form. No imported architecture has ever been lasting. In our own country we have tried this, and the failure is palpable. Our architects have erected copies of the temples of Greece and Rome, alike for churches, museums, and town-halls: and, however much they may have been admired whilst the fashion lasted, and scholars imbued with classic ideas gave tone to public opinion, almost before they were finished, the fashion passed away, and they are now regarded with general dissatisfaction. To the Greek succeeded the Gothic, and though the passion for it be still fervid, the opinion is evidently fast gaining ground, that Gothic reproduction is as essentially vicious and untrue as that which it has supplanted.

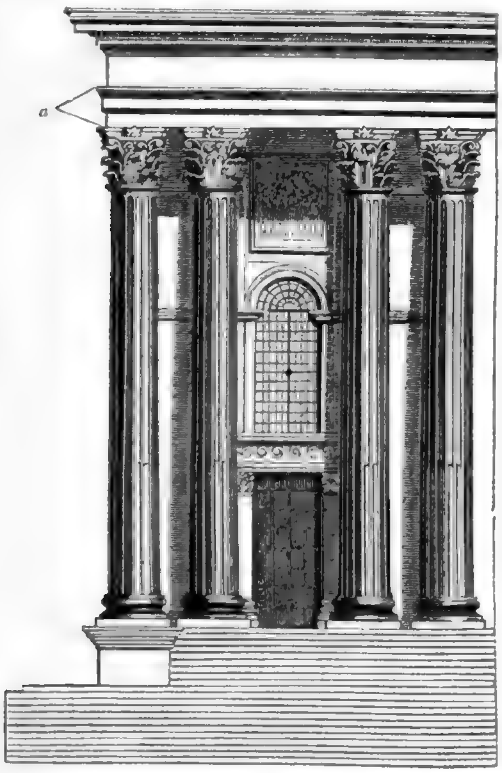
In fact, we may hope that we are in this country coming to understand that whilst an absolutely new style is a thing neither to be desired nor looked for, and that an eclectic style is an absurdity, the architecture of every age as well as every country, to be a true living architecture, must be a product of that age and country—adapted to its special wants, and circumstances, and character: developed out of some previously existing architecture, but adapted with perfect freedom to present purposes, and embodying to the fullest possible extent the scientific knowledge and artistic feeling of the present time.

And if this be so, the question of style will eventually, perhaps at no very distant day, settle itself. It will be felt that in every building there is a matter to be determined antecedent to all considerations of style. The first grand requisite is, as Vitruvius long ago pointed out, that a building shall be designed so as to answer as perfectly as possible the purpose for which it is erected: shall, in other words, possess the greatest attainable convenience and stability. When that is arrived at, the feeling for beauty and grandeur in the architect who has rightly studied his art, will suggest a style—an outward and visible clothing of the actual body—which shall be as evidently in conformity with it, and the most beautiful, because the most suitable, for it—be as properly adapted to the purpose it has to fulfil, and the locality in which it is placed—as the form and clothing and colour of an animal or a flower are recognised to be the most beautiful as well as the most suitable with which it could have been endowed.

Ornament then is an essential part of architecture. Without ornament there is no true architecture, only building. But it is a misconception of the true purpose of art to say that an edifice is erected for the sake of ornament. Architecture consists of construction and ornament. But ornament must not be a thing extraneous to the construction, a something added to it merely to please the eye. True ornament is the expression of the idea of a building. Equally with the building itself the ornament must possess unity, proportion, congruity; be a well considered whole, to which every part conduces, and of which every part *is* a part.

The history of the several great styles of architecture will be given and their distinctive characteristics be pointed out, under the names of the countries in which they flourished, or the terms by which they are best known, as EGYPTIAN, GRECIAN, ROMAN ARCHITECTURE, &c.; or BYZANTINE, GOTHIC, RENAISSANCE ARCHITECTURE, &c. The great architectural features will be found under their respective heads, as ARCH, ARCHITRAVE, COLUMN, &c. Some of the more important classes of buildings will also be separately described, as AMPHITHEATRE, Triumphal Arch [ARCH, TRIUMPHAL], CHURCH, TEMPLE, THEATRE. Constructive architecture will likewise be found fully treated of in a distinct series of articles. [ARCH; HOUSE; ROOF, &c.]

ARCHITRAVE, from a Greek word and a Latin one, meaning, when put together, *the principal beam*, is the lower part of any structure supported by pillars, or the lower beam which rests upon the columns



Part of the West front of St. Paul's Cathedral.

and joins them together, on which the whole entablature (or ornamental part which comes immediately above the columns) rests. It was also called by the Greeks and Romans *epistylion*, or *that which is on the columns*. Thus, when pillars support an arch, the voussoirs, or wedge-shaped stones which form the arch [ARCH], supply the place of an architrave, by which name they are sometimes called. In the same way the flat beam, or row of stones coming immediately above a door or window, is called the architrave. The architrave may have only one face or two, that is, may appear as one beam, resting on and joining the contiguous columns (as in the temple of Pæstum), or as two beams, the upper of which projects a little in front of the lower, as at *a* in the preceding cut. [COLUMN.]

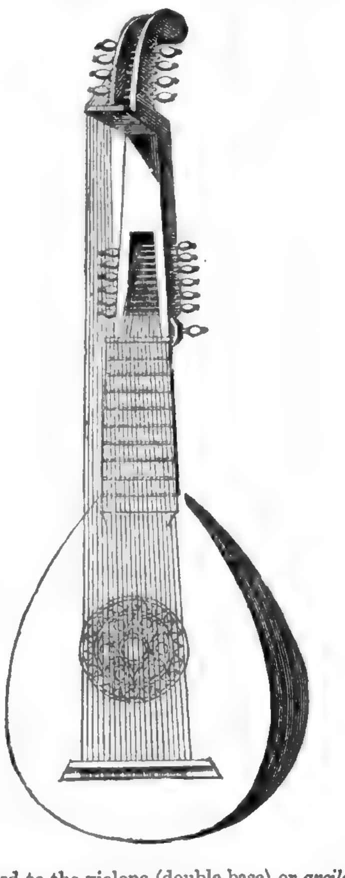
ARCHIVE, or ARCHIVES, a chamber or apartment where the public papers or records of a state or community are deposited: sometimes, by a common figure, applied to the papers themselves.

By some the word archive is supposed to have been derived from the Greek 'Αρχεῖα (*archeia*), a term used by Josephus in the sense of public registers, and considered to have been transmitted to us through the Latin of the middle ages. The Greek *archeion* seems, in its primary signification, to mean 'a council-house or state-house,' or 'a body of public functionaries,' as the Ephori at Sparta. (See Aristot. 'Polit.' book ii.; and Pausan. iii. 11.) Others derive it from *arca*, 'a chest;' such being, in early times, a usual depository for records. So Isidorus, 'Orig.' lib. xx. c. 9—"Archa dicta, quod arceat visum atque prohibeat. Hinc et archivum, hinc et arcanum, id est secretum, unde cæteri arcentur." "It is called Archa, because it does not allow (*arc*-eat) us to see what is in it. Hence also Archivum and Arcanum, that is, a thing kept secret, from which people are excluded (*arc*-entur)."

The Temple of Saturn, built in the time of the Republic, was the chief repository of the archives as well as of the public treasure of ancient Rome. In England the archives are kept in various and too often inconvenient places, but a Record Office has been partly completed in Fetter Lane, London, where some have been transferred. Some pains have also been taken to classify them, and make them more generally useful. Under the direction of the Record Commissioners, with the active assistance of Sir J. Romilly, the Master of the Rolls, several volumes of detailed catalogues of these papers have been published, and more are in preparation. The building was intended for the reception of all the archives, but the portion at present erected will contain only a very small part, and the work has for a considerable time been discontinued. The national archives of France are preserved in the Hôtel Soubise at Paris; those of the Courts of Justice, in La Sainte Chapelle at the Palais de Justice.

ARCHIVOLT, or ARCHIVAULT, means, literally, the *principal turning*, or *arch*, and is applied to any ornamented band or moulding which runs round the lower part of all the voussoirs of an arch. When this part of the arch is plain, with square edges, as in arches of the Romanesque style, it is called a *soffit*.

ARCH-LUTE, a large lute, or double-stringed theorbo (THEORBO), formerly used by the Italians for the base parts, and for accompanying the voice. In the early editions of Corelli's 'Sonatas,' the principal



base staff is assigned to the violone (double-base) or *arcileuto*. According to Kircher ('Musurgia,' lib. vi.), this instrument had fourteen notes, the highest whereof was A, the fifth line in the base, the lowest the double G below; and possessed considerable power. It was about five feet in extreme length, and proportionally large in the body. At the commencement of the last century this instrument (invented, as is supposed, in the 16th century) was much in use; Handel employed it in many of his early operas. The office of Lutenist still continues as part of the establishment of the Chapel-royal, though the place has been a sinecure for nearly a century.

A'RCHON, a Greek word written in Roman characters, signified originally one who had rule or command, either civil or military. In modern usage it is known only as the title of certain magistrates of the Athenians, of whom we propose to give some account in this article.

On the abolition of regal government at Athens, on the death of Codrus, the chief power was still intrusted to a single magistrate, or archon, without the title of king (βασιλεύς), which was more directly associated with the idea of arbitrary rule. The new office was hereditary; at least it is said to have been enjoyed successively by lineal descendants of Medon, the first archon, who was himself a son of

Codrus, the last king. The Athenians were fond of attributing to Theseus the origin of their democracy; by which probably they meant that many of his regulations had a popular tendency, and that his general reformation of the state, which was favourable to that part of the population which had possessed no political rights, was accompanied by a permanent relaxation of regal authority. (Plut., 'Vit. Thes.' c. 25.) The prerogative of the archon was still further limited; for he was made responsible to his fellow citizens for the acts of his government. (Paus. iv. 5, 10.) Tradition told of thirteen hereditary archons, after whom, about B.C. 752, the chief magistrate was appointed to his office for ten years, but was still at first taken from the Medontidæ, or descendants of Medon. We have the name of Charops and of six others after him as decennial archons; but in B.C. 714 the archonship was thrown open to all the order of nobles, and the last three of the decennial archons were not of the family of Medon. (Vell. Paterc. 1, 8.) Another revolution, which is placed by Mr. Grote B.C. 683, limited the duration of the office to a single year, at the same time dividing the charge of administration between the chief magistrate and eight others, thus forming a council of state, which consisted of nine magistrates or archons. Hence they are sometimes mentioned by the Greek writers under the general designation of The Nine. These officers had their distinguishing titles and duties, of which we shall presently speak, when we have carried a little farther the general history of this new constitution. We have seen that the first archon was, like his royal predecessor, the head of the government. The decennial archons had doubtless the same place and character, and the annual magistrates for a time exercised collectively the political power before vested in a single ruler. Their names and number, and in great measure the particular civil duties assigned to them, remained unaltered whilst Athens continued to possess an independent government; but the course of events wrought a most important change as to their position in the state. This change, to which in earlier times there was a gradual approximation, was effected mainly by the increased activity of the ecclesia, or popular assembly, which received its first impulse from the regulations of Solon, about B.C. 594, was urged on more effectually by the reformation of Cleisthenes (B.C. 509), and was confirmed by the consequences of the Persian war, by which the *thetes*, or lowest class of citizens, which supplied the naval strength of Athens, were taught to know their power. (Aristot., 'Polit.' 2, 9, 4.) From the time that the ecclesia interfered habitually and directly with the government of the republic, the actual minister of state was the person who enjoyed the confidence of the people, which neither the office of archon nor any other office could procure. The inevitable consequence was, that the archons sunk from ministers of state into municipal officers of high rank. We have thought it worth while to point attention to this fact, from having had occasion to observe that young students of Athenian history are sometimes perplexed by the apparent inconsistency of the accounts given them of the first appointment of archons with the little notice bestowed upon these magistrates in the general history of the republic. They read of important public measures, and of the persons who originated and executed them, whilst the name of archon seldom occurs in Grecian history, except as marking the year in which certain events took place. (See Thucyd. ii. 2.) Pericles, without the office of archon, to which it was not his chance ever to attain, enjoyed a degree of power which was not possessed during the freedom of the republic by any other citizen. Perhaps no one who read with the least attention would find the difficulty, if he were not in some measure led to it by popular works on Grecian antiquities, which too commonly present an accumulation of facts and authorities without sufficiently discriminating the times to which the different statements refer.

The annual archons, from their first appointment down to the time of Solon, were taken from the eupatridæ, or nobles, to which class all political power seems to have been confined. This is rather assumed from what we know of the progress of civil and political society at Athens, than asserted on any authority of much weight. The establishment by Solon of a timocracy, or government in which political power was distributed with reference to property, put an end to the claims of noble blood; but since the archons were by this regulation taken from the wealthiest class of citizens (οἱ πεντακοσιομέδιμνοι), the noblest families probably still continued chiefly to supply the archons for each year, till the celebrated law of Aristeides, enacted about B.C. 479, threw open the offices of state to the whole body of the people. (Plut., 'Vit. Arist.' c. 1, and c. 22.) From this time no qualification was requisite in an Athenian citizen for the office of archon but fair fame and freedom from bodily defect.

The mode of appointment presents some difficulties, from the want of precise information. It appears that the archons were originally elected by suffrage, and the elective franchise was probably confined to the noble class from which they were taken. By Solon, eligibility to the office, and perhaps the right of suffrage, were enlarged, but the mode of appointment remained the same. In after times, and even as early as the first Persian invasion of Greece, the appointment was by lot. The case of Aristeides seems to have been an exception to the general rule, and may be attributed perhaps to his high character and eminent services. (Aristot. 'Polit.' 2, 9, 2; Herod. 6, 109; Plut. 'Vit. Arist.' c. i., p. 481, ed. Reisk, compared with p. 479.) We have no information which enables us to fix the time when the change was effected. It has been attributed, with some probability, to Cleisthenes, but we know only with certainty that they were at one time elected and at some subsequent period appointed by lot. It must not be supposed that all the citizens were eager to avail themselves of the double opportunity offered by the new mode of appointment and the law of Aristeides. It seems that the poorest of them declined the hazard of the lot, which might throw upon them a burdensome honour. (Xen. 'Rep. Athen.' 1, 3.)

Of the nine archons, one, usually termed *the* archon, was chief, and had the title of *epónymus* (ἐπώνυμος), or name-giver, because the year in which he served the office was called by his name, as among the Romans the year was distinguished by the names of their consuls. Thus his name appears at the head of all public decrees (see Dem. 'De Cor.;' Thucyd. 5, 19), and generally in all solemn records of state. The list, from the time of Creon, the first annual archon, is nearly complete and trustworthy. Of the remaining eight, one was called the king (βασιλεύς), another the *polemarch*, and the last six had the general title of *thesmothetæ*. Before admission to their office, they were subjected, like other public officers, to the examination called *dokimasia* (that is, trial or examination), for the purpose of ascertaining that they were Athenians of pure blood, whole of limb, and without blemish in their characters. With reference to the last point, they were asked if they had treated their parents kindly. When once invested with their office and adorned with the chaplet, the distinguishing mark of it (Æsch. 'contra. Tim.' p. 3, 33), they were especially protected by the laws from all insult and outrage, and were exempted even from those public burdens which were not included in the general exemption granted to their most favoured citizens, the descendants of Harmodius and Aristogeiton. (Dem. 'contra. Lept.' p. 462, 20; and p. 465, 17.) There is reason to believe that they were members of the council of Areopagus by virtue of their office. [AREOPAGUS.] It is certain that they passed from their annual magistracy to a permanent seat in that council.

Their public duties had reference for the most part to the administration of justice. In some courts, and in certain causes, they were the presiding judges. On some occasions they had the execution only of the sentence pronounced by other judges; but it seems to have formed a large if not the most considerable part of their legal duties to bring causes into court (εἰσάγειν, Dem. 'contra Lacr.' p. 940, 5–20) to be tried before the proper tribunal, not in the character of public prosecutors, but on application from the plaintiff or accuser, in which case their province was somewhat similar to that of an English grand jury in finding and ignoring bills. Sometimes, perhaps, the application to the archon was a form of little more importance as to the responsibility of the archon than that in English law of suing out a writ. To each of the first three archons, and collectively to the six thesmothetæ, a distinct province and peculiar duties were assigned. Incidental notices of these are to be found scattered over the Greek classics, especially in the Attic orators; more systematic accounts occur in the earlier lexicographers and antiquarians, among whom Julius Pollux may be particularly distinguished, whose authority would have more weight if we were better acquainted with the sources from which their information was derived and the times to which their accounts refer. Copious collections have been made from them by modern compilers, of whom, perhaps, the most popular in our language is that of Archbishop Potter. We shall present our readers with only a brief outline, sufficient to convey a general view of the separate jurisdiction of these magistrates in the later times of the Athenian republic.

It seems to have been the duty of the chief archon, or epónymus, to throw his official protection around those whose interests were most liable to be overlooked in the ordinary execution of the law. Hence he was the appointed guardian of orphans and minors. He was also charged with a more general superintendence in matters which concerned the safety and good order of the state than was committed to his colleagues.

The king archon was more especially concerned with religious matters. He was required to preside at the performance of the most solemn sacrifices. He had a certain control over the ministers of religion, and either himself tried offenders, or originated trials, in cases of impiety. It is hardly necessary to observe, that in the early periods of regal government kings were almost universally the chief ministers of religion. It is commonly supposed that the title of this archon was intended to denote the transfer of an important part of the king's prerogative to the magistrate who, in the department of religion, supplied his place.

The office of the polemarch was doubtless in its first institution that which the name implies, to command in war; and even as late as the battle of Marathon, we find the polemarch Callimachus acting an important part in the council of war which preceded it, and commanding in virtue of his office the right wing of the Athenians in the engagement; but in later times, when the generals of the republic were immediately chosen by the people, the polemarch was confined to the discharge of civil duties, and particularly had cognisance of matters which concerned the strangers and *metics* (resident aliens) at Athens, exercising a jurisdiction in this respect not unlike that of the prætor peregrinus at Rome.

The thesmothetæ should, according to the meaning of their title, have been legislators, or propounders of laws. It was not however their office to introduce laws, but rather to watch over the conduct of those who put themselves forward as legislators, and also annually to examine the existing laws for the purpose of removing contradictory and superfluous enactments—to keep, as it were, the statute-book in a pure and consistent state. (Dem. 'contra Lacr.' p. 940, 10, and 12; 'contra Zenoth.' p. 890, 10; Lys. 'contra Andoc.' p. 104, 15; Herod. 6, 109, 111; Lys. 'contra Panc.' p. 166, 32, and 40.) It appears that the whole college of archons was sometimes assembled in council (Dem. 'contra Meid.' p. 542, 2); but we have no information respecting the authority which they collectively exercised.

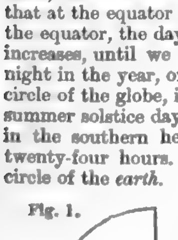
For further information on the various and important duties assigned to the different archons, in addition to this brief and general notice, the reader is referred to the authorities mentioned above; but we would remind the young student, in his inquiries, that the reliance to be placed on the accuracy of even a credible and well-informed author must depend in some measure on the circumstances under which his information is given; and this should especially be kept in mind when, as in the subject of the present article, all our information, so far as it is supplied by the Greek classics, is obtained, not from regular essays, but from incidental notices. Our meaning in this caution will be best explained by an instance. The subject of inquiry may be the manner in which certain officers were appointed; and this, as in the case of the archons, may have varied at different times. The mode of appointment may, according to a common practice with the Athenians, be implied by an epithet familiarly joined with the title of the office. Now, it is possible that an author, who when writing professedly on the subject would have given minutely accurate information, may use this epithet, familiar to him, inaccurately with reference to the times of which he is speaking, if the circumstance indicated by it is of no importance to the subject immediately before him. Evidence drawn from a casual expression must often be taken into account, but then it should be carefully rated at its proper value.

ARCOGRAPH. [CYCLOGRAPH.]

ARCTIC CIRCLE. The term *arctic* is derived from the Greek, and signifies literally *of* or *belonging to the bear*, meaning the constellation of that name. *Arctic circle* had formerly a different signification from that which it now has. Among the Greeks it meant the parallel to the equator which just touches the horizon, being entirely above it, and which therefore separates those parallels which are always above, from those which are partly above and partly below, the horizon. (See Strabo, Casaub. p. 95.) Similarly the antarctic circle (if the phrase were used) would be a parallel to the equator which touches the horizon, being entirely below it, and which therefore separates those parallels which never rise above, from those which are partly below and partly above, the horizon. Thus every different latitude had a different arctic circle; and in the latitude in which astronomy was first cultivated, the great bear just swept the sea, and did not set, whence the boundary circle obtained its name.

In the modern sense of the term, it is one fixed circle, or very nearly so; and the first use of it as such is found in the celebrated treatise on the sphere, by Holywood, better known by the name of Sacrobosco, published in the twelfth century. For the complete meaning of the term, we refer to DAY. We can only here briefly remind the reader that at the equator all days are equal; that in going northwards from the equator, the day of the summer solstice lengthens as the latitude increases, until we reach the pole, where there is but one day and night in the year, of six months each. There must therefore be some circle of the globe, in the northern hemisphere, at which the longest or summer solstice day is just twenty-four hours; and an opposite circle in the southern hemisphere, at which the sun does not appear for twenty-four hours. The first is the *arctic*, the second the *antarctic*, circle of the *earth*. We need hardly say, that at the day of the *winter* solstice in the northern hemisphere, there is a day of twenty-four hours in length at the *antarctic* circle.

Fig. 1.



P and p (*fig.* 2.) are the north and south poles of the earth, the lines through which serve to remind us of the earth's axis. A B is the equator, and O H and O L are the directions in which the sun is seen at the northern summer and winter solstices, that is, the line which points to the sun rises and falls between H O and O L twice in a year. We do not consider the *apparent* motion of the sun *round* the earth, because, as the sun is always on the meridian of some place, and any conclusion respecting day and night drawn from one meridian holds good for any other, we may conceive the meridian P B p A to move round with the sun. Or, to consider it in another point of view, instead of supposing the sun to appear to move round, let it remain in the fixed meridian, P B p A, and increase the daily rotation of the earth by a quantity equal to the daily motion of the sun on the equator, which will preserve the *relative* rotations, leaving us only to take notice of the rise and fall of the sun in the ecliptic; which is the cause of the peculiar phenomena of the arctic circle. The semicircle O V, in the first figure, is supposed to be cut out and applied to the right hand figure, O to O, in such manner that the needle, V, shall always be directly opposite to the sun. In the figure (2.) are given the extreme positions of O V; namely, M U m, at the northern summer, N W n, at the northern winter, solstice. The semicircle O V covers all those parts of the earth which do not see the sun, and the rotation round the axis, P p, brings every part of the earth under O V when its night begins. M N and $m\,n$ are the arctic and antarctic circles. By cutting out a semicircle equal to O V, and placing it

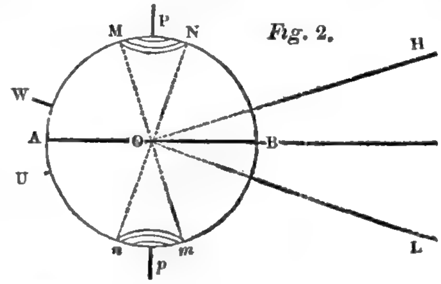


Fig. 2.

in different positions on the second figure, the following will appear, on a little consideration:

1. At the summer solstice (when V is at U) all circles above M N will be in light for twenty-four hours, and all below $m\,n$ in darkness: and *vice versâ* at the winter solstice.

2. At the equinoxes (V is at A) every circle will be in light for twelve hours, and the same time in darkness.

3. During the passage from the equinox to the summer solstice (V moves from A to U), at every moment some circle above M N emerges entirely into light, and an opposite circle below $m\,n$ begins to be entirely covered by darkness: and both states remain until the return of the circle O V in the next quarter of the year. And *vice versâ* for the passage from the equinox to the winter solstice (when V moves from A to W).

4. No circle lying between M N and $m\,n$ is ever entirely in light or entirely in darkness.

Hence, to find the duration of light at any place above the arctic circle, that is, to find during what part of the year the sun performs his daily rotation entirely above the horizon, look in an almanac for the times before and after the summer solstice, at which the *declination* of the sun is equal to the *polar distance* (or latitude subtracted from 90°) of the place. Between those two times there is perpetual light. For example, the north point of Nova Zembla (latitude 75°, polar distance 15°) will have perpetual light between May 1 and August 12, 1859. For the time of perpetual darkness do the same with the winter solstice: thus there will be perpetual darkness at the above-mentioned place from November 3, 1859, to February 9, 1860.

The north polar distance of the arctic circle is equal to the angle H O B, the greatest declination of the sun, or the OBLIQUITY of the ecliptic. The south polar distance of the antarctic circle is the same. This quantity changes very slightly from year to year. It is as follows:

January 1, 1858, 23° 27′ 28″·29
January 1, 1859, 23° 27′ 27″·84

decreasing at present by about half a second yearly.

The arctic and antarctic circles are the boundaries which separate the frigid from the temperate zones, as they are called. The part of the earth included within each of the two is about $4\frac{1}{10}$ per cent. of the whole surface of the globe. The best known points through or near which the arctic circle passes are Cape North in Iceland, the Maelstrom whirlpool, the mouth of the Oby, Behring's Straits, and the south of Melville Island. For discoveries of land within the antarctic circle, see ANTARCTIC OCEAN, in GEOG. DIV. of ENG. CYC.

The arctic and antarctic circles of the heavens occupy positions with respect to the celestial poles similar to those occupied by the same circles on the earth. Thus a traveller going round the arctic circle would always have some point of the celestial arctic circle directly over head, or in his zenith. But the term is hardly ever employed by astronomers.

In all that precedes we have taken no notice of REFRACTION, the effect of which is to raise the sun a little towards the nearest pole at every point of the globe, thus lengthening the day and diminishing the night. In some latitudes the effect would be very considerable, and would increase the duration of light by as much as a day.

ARCTURIN. [ARBUTIN.]

ARCTU'RUS, or α Boötis, a star of the first magnitude in the constellation Boötes. It derives its name from two Greek words, signifying the tail of the bear, and, though not in the latter constellation, it is very nearly in a right line drawn through the two hinder stars of the tail (ζ and η). It rises N.E. by E. at Greenwich, and is on the meridian in about $7\frac{3}{4}$ hours after rising; which takes place at half-past seven A.M. on the 1st of January, and about two hours later for the first of every succeeding month. Its mean places are as follows:

	Right Ascension.	Declination.
Jan. 1, 1859 . .	14^h 9^m $13^s{\cdot}8$	19° 55′ 5″·5
Jan. 1, 1860 . .	14 9 16·6	19 54 46·6

Its annual increase of right ascension is $2^s{\cdot}8$; its annual decrease of declination is 18″·9. This is not all owing to precession and nutation, as the star has a proper motion (or change of place relatively to surrounding stars), the value of which is thus given in the catalogue of stars published by the British Association in 1845.

Mean Annual Decrease in R. A.	Decl.
1''·17	1''·96

Formerly the conclusion was sometimes drawn that Arcturus was the nearest star to our system, from its being a brilliant star with so decided a proper motion. This, which was but a faint presumption at the time, is now overturned by the known fact that there are much smaller stars (μ Cassiopœiæ, for example) which have much larger proper motions.

ARE, the modern French measure of surface, forming part of the new decimal system adopted in that country after the revolution. It is obtained as follows:—the metre, or measure of length, being the forty-millionth part of the whole meridian, as determined by the survey, is 3·2809167 English feet; and the *are* is a square, the side of which is 10 metres long. The following denominations are also used:—

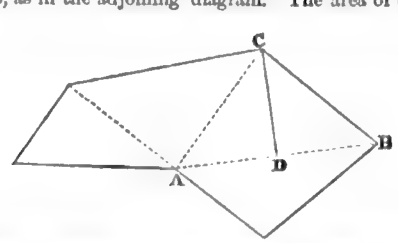
Decare	is 10 ares.
Hectare	„ 100 „
Chilare	„ 1000 „
Myriare	„ 10,000 „
Deciare	„ $\frac{1}{10}$ of an are.
Centiare	„ $\frac{1}{100}$ „
Milliare	„ $\frac{1}{1000}$ „
The are is	100 square metres.
or	947·68175 French sq. feet.
or	1076·44144 English sq. feet.

The hectare is generally used in describing a quantity of land. It is 2·4711695 English acres, or $404\frac{2}{3}$ hectares make 1000 acres, which disagrees with the first result by less than 1 part out of 50,000.

A'REA. This term is a Latin word, and means the same thing as *superficies*, or *quantity of surface*, but is applied exclusively to plane figures. Thus we say, "the *surface* of a sphere, the *area* of a triangle," and "the *surface* of a cube is six times the *area* of one of its faces." The word is also applied to signify any large open space, or the ground upon which a building is erected; whence, in modern built houses, the portion of the site which is not built upon is commonly called the *area*.

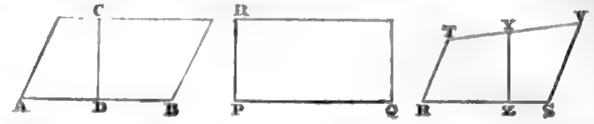
Returning to the mathematical meaning of the term, the measuring unit of every area is the square described upon the measuring unit of length: thus, we talk of the square inches, square feet, square yards, or square miles, which an area contains. And two figures which are *similar*, as it is called in geometry,—that is, which are perfect copies one of the other on different scales, have their areas proportional to the *squares* of their linear dimensions. That is, suppose a plan of the front of a house to be drawn so that a length of 500 feet would be represented in the picture by one of 3 feet. Then the area in the real front is to the area of the front in the picture in the proportion of 500 times 500 to 3 times 3, or of 250,000 to 9. Similarly, if the real height were 20 times as great as the height in the picture, or in the proportion of 20 to 1, the real area would be to that of the picture as 20 times 20 to once one, or as 400 to 1; that is, the first would be 400 times as great as the second.

Any figure which is entirely bounded by straight lines may be divided into triangles, as in the adjoining diagram. The area of every triangle



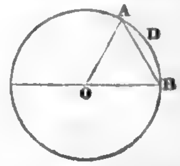
may be measured separately by either of the following rules, in which the word in italics may mean inches, yards, miles, or any other unit, provided only that it stands for the same throughout. 1. Measure a side, A B, of the triangle A B C, and the perpendicular C D which is let fall upon it from the opposite vertex, both in *units*. Half the product of A B and C D is the number of square *units* in the triangle A B C. Thus, if A B be 30 yards, and C D 16 yards, the triangle contains 240 *square* yards. 2. Measure the three sides, A C, C B, B A, in *units*; take the half sum of the three, from it subtract each of the sides, multiply the four results together, and extract the square root of the product; this gives the number of square *units* in the triangle. For instance, let the three sides be 5, 6, and 7 inches; the half sum is 9, which, diminished by the three sides respectively, gives 4, 3, and 2. 9, 4, 3, 2, multiplied together, give 216, the square root of which is 14·7, $14\frac{7}{10}$ very nearly. The triangle therefore contains about $14\frac{7}{10}$ *square* inches.

The following rules may be applied in the following cases:—for a parallelogram, multiply A B, a side, by C D, its perpendicular distance from the opposite side; for a rectangle, multiply together adjoining sides, P Q and P R; for a four-sided figure, in which R T and S V are



parallel, but T V and R S converge, multiply R S, one of the converging sides, by Y Z, its perpendicular distance from the middle point of the other. When R T and S V are perpendicular to R S, then Y Z is half the sum of R T and S V.

To find the area of a circle, multiply the radius O A by itself and the result by 355; then divide by 113. To find the area of the sector O A D B, see ANGLE. To find the area of the portion A B D, find those of the sector O A D B, and the triangle O A B separately, and subtract the second from the first. In all these cases, the result is in the *square* units corresponding to the *linear* units in which the measurements were made.

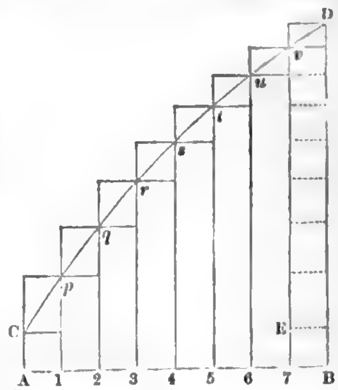


The area of a curvilinear figure can only be strictly found by mathematical processes too difficult to be here described, but the following method will give an idea of the principles employed. Let A C D B be a curvilinear figure bounded by the curve C D and the lines C A, A B, B D, of which the first and third are perpendicular to the second. Divide A B into any number of equal parts (eight is here supposed) by the points 1, 2, 3, &c., and construct the accompanying obvious figure by making A p, 1 q, &c., parallelograms. It is plain that the area sought, A C D B, is greater than the sum of the inscribed rectangles, denoted by the letters or numbers at opposite corners,

1 C, 2 p, 3 q, 4 r, 5 s, 6 t, 7 u, B v;

and that it is less than the sum of the circumscribing rectangles

A p, 1 q, 2 r, 3 s, 4 t, 5 u, 6 v, 7 D.



Therefore the area sought does not differ from either of these sums by so much as they differ from one another; but the sums differ from one another by the sum of the rectangles

C p, p q, q r, r s, s t, t u, u v, v D,

which, placed under one another, give the rectangle D E, which is less than D 7: consequently neither sum differs from the area sought by so much as D 7. But by carrying the division of A B, with which we set out, to a sufficient degree, the area of D 7 might have been reduced to any extent which might have been thought necessary; that is, name any fraction of a square inch, however small, and A B can be divided into such a number of equal parts that D 7 shall be smaller than that fraction of a square inch. Hence the sum of the inscribed or circumscribed parallelograms may, by dividing the line A B sufficiently, be made as nearly equal to the area as any practical purpose can require.

The accuracy of the preceding process will be increased by summing, not the parallelograms, but the figures

A C p 1, 1 p q 2, 2 q r 3, &c.,

considering C p, p q, q r, &c., as straight lines. This will be equivalent to adding half the rectangle D E to the sum of the rectangles aforesaid. The practical rule is—Add all the intermediate ordinates, 1 p, 2 q, &c., to the half sum of the extreme ordinates A C and B D: multiply the total by the common value of A 1, or 1 2, &c. This approximation is the first step of the method of QUADRATURES, which see.

The mathematical process of finding the area carries the preceding approximation one step further, and finds what is the limit to which the sum of the inscribed parallelograms approaches nearer and nearer, as the number of divisions of A B is increased. This limit, it is easy to show, is an exact expression for the area required. If x represent one of the lines A 1, A 2, &c., and y the corresponding line 1 p, 2 q, &c., the area of the curve is found by the process of the integral calculus thus represented:

$$\int y\, d\, x,$$

or, in the language of fluxions,

fluent of $y\,\dot{x}$.

A process similar to the preceding is employed by surveyors in measuring a field whose boundaries are curvilinear. [SURVEYING; OFFSET.]

The investigation of the area of a curve was formerly called the *quadrature* of the curve (*quadratum*, a square), because, before the application of arithmetic to geometry, the most convenient method of representing an area was by giving the square to which it is equal.

For some practical purposes the following experimental method of finding the above area might suffice. Cut out the figure A B C D in pasteboard (heavy wood or metal would be better); out of the same pasteboard cut a square inch or other unit; and weigh both the pieces thus cut out accurately. Then the weight of the first piece divided by that of the second will give the number of square units in the area required, if the pasteboard or other material be of moderately uniform thickness. A method similar to that of Archimedes (see his Life, in BIOG. DIV.) might easily be devised.

AREOPAGUS, COUNCIL OF, a celebrated council, so called from the hill of that name, on which its sessions were held. It was also called the council above (ἡ ἄνω βουλή), to distinguish it from the council of five hundred, whose place of meeting was in a lower part of the city, known by the name of the Ceramicus (Paus. 1, 3, 4). Its high antiquity may be inferred from the well-known legends respecting the causes brought before it in the mythical age of Greece, among which that of Orestes, who was tried for the murder of his mother, has obtained especial celebrity (Æschyl. 'Eumen.'); but its authentic history commences with the age of Solon. There is, indeed, as early as the first Messenian war, something like historical notice of its great fame, in the shape of a tradition preserved by Pausanias (iv. 51), that the Messenians were willing to commit the decision of a dispute between them and the Lacedæmonians, involving a case of murder, to this council of Areopagus. We are told that it was not mentioned by name in the laws of Draco, though its existence in his time, as a court of justice, can be distinctly proved (Plut. 'Vit. Sol.' c. 19). It seems that the name of the Areopagites was lost in that of the Ephetæ, who were then the appointed judges of all cases of homicide, as well in the court of Areopagus, as in the other criminal courts. (See Müller, 'History of the Dorians,' vol. i. p. 352, English translation.) Solon, however, so completely reformed its constitution, that he received from many, or, as Plutarch says, from most authors, the title of its founder. It is, therefore, of the council of Areopagus, as constituted by Solon, that we shall first speak; and the subject possesses some interest from the light which it throws on the views and character of Solon as a legislator. It was composed of the archons of the year [ARCHON], and of those who had borne the office of archon. The latter became members for life; but before their admission, they were subjected, at the expiration of their annual magistracy, to a rigid scrutiny (*dokimasia*) into their conduct in office, and their morals in private life. Proof of criminal or unbecoming conduct was sufficient to exclude them in the first instance, and to expel them after admission. Various accounts are given of the number to which the Areopagites were limited. If there was any fixed number, it is plain that admission to the council was not a necessary consequence of honourable discharge from the dokimasia. But it is more probable that the accounts which limit the number are applicable only to an earlier period of its existence. (See the anonymous argument to the oration of Demosthenes against Androtion.) It may be proper to observe, that modern histories of this council do not commonly give the actual archons a seat in it. They are, however, placed there by Lysias the orator ('Areop.' p. 110, 16-20), and there is no reason to think that in this respect any change had been made in its constitution after the time of Solon. To the council thus constituted Solon entrusted a mixed jurisdiction and authority of great extent, judicial, political, and censorial. As a court of justice, it had direct cognizance of the more serious crimes, such as murder and arson. It exercised a certain control over the ordinary courts, and was the guardian generally of the laws and religion. It interfered, at least on some occasions, with the immediate administration of the government, and at all times inspected the conduct of the public functionaries. But, in the exercise of its duties as public censor for the preservation of order and decency it was armed with inquisitorial powers to an almost unlimited extent.

It should be observed, that in the time of Solon, and by his regulations, the archons were chosen from the highest of the four classes into which he had divided the citizens. Of the archons so chosen, the council of Areopagus was formed. Here, then, was a permanent body, which possessed a great and general control over the state, composed necessarily of men of the highest rank, and doubtless in considerable proportion of eupatridæ, or nobles by blood. The strength of the democracy lay in the *ecclesia* or popular assembly, and in the ordinary courts of justice, of which the *dikasts*, or jurors, were taken indiscriminately from the general body of the citizens; and the council of Areopagus exercised authority directly or indirectly over both. The tendency of this institution to be a check on the popular part of that mixed government given by Solon to the Athenians, is noticed by Aristotle ('Polit.' ii. 9, and v. 3, ed. Schneid). He speaks, indeed, of the council as being one of those institutions which Solon found and suffered to remain; but he can hardly mean to deny what all authority proves, that in the shape in which it existed from the time of the legislator, it was his institution.

The council, from its restoration by Solon to the time of Pericles, seems to have remained untouched by any direct interference with its constitution. But during that interval two important changes were introduced in the general constitution of the state, which must have had some influence on the composition of the council, though we may not be able to trace their effects. The election of the chief magistrates by suffrage was exchanged for appointment by lot, and the highest offices of state were thrown open to the whole body of the people. [ARCHON.] But about the year B.C. 459, Pericles attacked the council itself, which never recovered from the blow which he inflicted upon it. All ancient authors agree in saying that a man called Ephialtes was his instrument in proposing the law by which his purpose was effected, but unfortunately we have no detailed account of his proceedings. Aristotle and Diodorus state generally that he abridged the authority of the council, and broke its power (Arist. 'Polit.' ii. 9; Diodor. Sic. xi. 77). Plutarch, who has told us more than others ('Vit. Cim.' c. 15; 'Vit. Pericl.' c. 7), says only that he removed from its cognisance the greater part of those causes which had previously come before it in its judicial character, and that, by transferring the control over the ordinary courts of law immediately to the people, he subjected the state to an unmixed democracy. Little more than this can now be told, save from conjecture, in which modern compilers have rather liberally indulged. Among the causes withdrawn from its cognisance, those of murder (φονικαὶ δίκαι) were not included; for Demosthenes has assured us ('Contr. Aristocr.' p. 641-2), that none of the many revolutions which had occurred before his day had ventured to touch this part of its criminal jurisdiction. There is no reason to believe that it ever possessed, in matters of religion, such extensive authority as some have attributed to it, and there is at least no evidence that it lost at this time any portion of that which it had previously exercised. Lysias observes ('Areop.' p. 110, 46), that it was in his time charged especially with the preservation of the sacred olive-trees; and we are told elsewhere that it was the scourge of impiety. It possessed, also, long after the time of Pericles, in some measure at least, the powers of the censorship. (Athenæus, 4, 64, ed. Dindorf.)

Pericles was struggling for power by the favour of the people, and it was his policy to relieve the democracy from the pressure of an adverse influence. He assigned salaries to the numerous dikasteries, which sat in the market-place, and thus popularised the jurisprudence. By increasing the business of the popular courts, he at once conciliated his friends, and strengthened their hands. The council possessed originally some authority in matters of finance, and the appropriation of the revenue. In later times, the popular assembly reserved the full control of the revenue exclusively to itself, and the administration of it was committed to the popular council, the senate of five hundred. It seems that, at first, the Areopagites were invested with an irresponsible authority. Afterwards they were obliged, with all other public functionaries, to render an account of their administration to the people. (Æsch. 'Contr. Ctes.' p. 56, 30.) Both these changes may, with some probability, be attributed to Pericles. After all, the council was allowed to retain a large portion of its former dignity and very extensive powers. The change operated by Pericles seems to have consisted principally in this: that, from having exercised independent and paramount authority, it was made subordinate to the ecclesia. The power which it continued to possess was delegated by the people, but it was bestowed in ample measure. Whatever may have been the effect of this change on the fortunes of the republic, it is probable that too much importance has been commonly attached to the agency of Pericles. He seems only to have accelerated what the irresistible course of things must soon have accomplished. It may be true that the unsteady course of the popular assembly required some check, which the democracy in its unmitigated form could not supply, but the existence of an independent body in the state, such as the council of Areopagus as constituted by Solon, seems hardly to be consistent with the secure enjoyment of popular rights and public liberty; which the Athenian people, by their naval services in the Persian war, and the consequences of their success, had earned the right to possess, and the power to obtain. It ought not, however, to be concluded, that institutions unsuitable to an altered state of things were unskilfully framed by Solon, or that he surrounded the infancy of a free constitution with more restrictions than were necessary for its security. He may still deserve the reputation which he has gained of having laid the foundation of popular government at Athens.

With respect to the censorship, we can show, by a few instances of the mode in which it acted, that it could have been effectually operative only in a state of society from which the Athenians were fast emerging before the time of Pericles. The Areopagites paid domiciliary visits, for the purpose of checking extravagant housekeeping (Athenæus, 6, 46). They called on any citizen at their discretion to account for the employment of his time (Plut. 'Vit. Sol.' c. 23). They summoned before their awful tribunal a little boy for the offence of poking out the eyes of a quail (Quinctil. 5, 9, 13). They fixed a mark of disgrace on a man who had dined in a tavern (Athenæ, 13, 21). Athens in the prosperity which she enjoyed during the last fifty years before the Peloponnesian war, might have tolerated the existence, but certainly not the general activity, of such an inquisition.

It appears from the language of contemporary writers, that, while there were any remains of public spirit and virtue in Athens, the council was regarded with respect, appealed to with deference, and employed on the most important occasions (Lys. 'Contr. Theomnest.,' p. 117, 12; 'De Evandr.,' p. 176, 17; 'Andoc.,' p. 11, 32; Dem.

Contr. Aristocr., p. 641-2). In the time of Isocrates, when the dokimasia had ceased, or become a dead letter, and profligacy of life was no bar to admission into the council, its moral influence was still such as to be an effectual restraint on the conduct of its own members (Isocr. 'Areop.,' p. 147). In the corruption of manners and utter degradation of character which prevailed at Athens, after it fell under the domination of Macedonia, we are not surprised to find that the council partook of the character of the times, and that an Areopagite might be a mark for the finger of scorn (Athenæus, 4, 64). Under the Romans it retained at least some formal authority, and Cicero applied for and obtained a decree of the council, requesting Cratippus, the philosopher, to sojourn at Athens, and instruct the youth (Plut. 'Vit. Cic.,' c. 24). It long after remained in existence, somewhat superior in dignity, and perhaps equal in power, to a modern court of aldermen in a municipal corporation. The old qualifications for admission were neglected in the days of its degeneracy, nor is it easy to say what were substituted for them. Later times saw even a stranger to Athens among the Areopagites.

We shall conclude this article with a few words on the forms observed by the council in its proceedings as a court of justice in criminal cases. The court was held in an unenclosed space on the Areopagus, and in the open air; which custom, indeed, it had in common with all other courts in cases of murder, if we may trust the oration ('De Cæde Herodis,' p. 130) attributed to Antiphon. The Areopagites were in later times, according to Vitruvius, accommodated with the shelter of a roof. The prosecutor and defendant stood on two separate rude blocks of stone (Paus. 1, 28), and, before the pleadings commenced, were required each to take an oath with circumstances of peculiar solemnity; the former, that he charged the accused party justly; the defendant, that he was innocent of the charge. At a certain stage of the proceedings, the latter was allowed to withdraw his plea, with the penalty of banishment from his country (Dem. 'Contr. Aristocr.,' p. 642-3). In their speeches both parties were restricted to a simple statement, and dry argument on the merits of the case, to the exclusion of all irrelevant matter, and of those various contrivances known under the general name *paraskue* (παρασκευὴ), to affect the passions of the judges, so shamelessly allowed and practised in the other courts (Or. Lycurg., p. 149, 12-25; Lucian. 'Gymn.,' c. 19). Of the existence of the rule in question in this court, we have a remarkable proof in an apology of Lysias for an artful violation of it in his Areopagitic oration (p. 112, 5). Advocates were allowed, at least in later times, to both parties. Many commentators on the New Testament have placed St. Paul as a defendant at the bar of the Areopagus, on the strength of a passage in the Acts of the Apostles (xvii. 19). The apostle was indeed taken by the inquisitive Athenians to the hill, and there required to expound and defend his new doctrines for the entertainment of his auditors; but, in the narrative of Luke, there is no hint of an arraignment and trial.

Some of our readers may perhaps be surprised that we have made no mention of a practice so often quoted as peculiar to the Areopagites, that of holding their sessions in the darkness of night. The truth is, that we are not persuaded of the fact. It is, indeed, noticed more than once by Lucian, and perhaps by some other of the later writers; but it is not supported, we believe, by any sufficient authority, whilst there is strong presumptive evidence against the common opinion. It was, as it should seem, no unusual pastime with the Athenians to attend the trials on the Areopagus as spectators (Lys. 'Contr. Theomn.,' p. 117, 10). We suspect that few of this light-hearted people would have gone at an unseasonable hour in the dark to hear such speeches as were there delivered, and see nothing. Perhaps there may be no better foundation for the story, than there is for the notion, till lately so generally entertained, that the same gloomy custom was in favour with the celebrated Vehmic tribunal of Westphalia.

ARES (Ἄρης), the god of war and strife among the Greeks, generally considered as corresponding to the Roman Mars. Homer makes him a native of Thrace, and others consider him the father of several Thracian rivers and races. It is therefore highly probable that he was the god particularly worshipped by some northern people, though nearly all other traces of this circumstance have disappeared. The Scythian deity known to Herodotus as the god of war, whom he calls by the Greek term *Ares* (iv. 62), was worshipped under the form of an iron scimitar, to which horses and other quadrupeds were annually offered; and also every hundredth man of captives taken in war. In the later genealogy of the gods he was considered the son of Zeus and Hera (Jupiter and Juno), and, as such, took part in the war against the giants, and slew Mimas and Pelorus. In the contest with Typhon he fled with the other gods into Egypt, and was changed into a fish. He was not more successful in his engagement with Otus and Ephialtes, the children of Aloüs, by whom he was imprisoned for thirteen months. To a still later period we must refer the murder of Halirrhotius, and his trial before the court of Areopagus, as well as his combat with Hercules.

It is a curious circumstance that the Greeks, though constantly engaged in war, should have paid little attention to the worship of Ares. There were few temples erected to his honour in Greece. Geronthræ, a village of Laconia, had a temple and grove where a yearly festival was celebrated, to which no female was admitted (Paus. iii. 22): there was another on the road from Amyclæ to Therapne in Laconia (iii. 19), and a third at Athens (i. 8). Though, as we have remarked, Ares seems to be a Thracian god, yet the element of the word Ares is an integral part of the Greek language, and the word which denoted best and bravest, *aristos* (ἄριστος), is the superlative of *ares*. The Sanscrit *ari*, nom. *aris*, signifies an enemy. In early times human sacrifices were offered to him by the Lacedæmonians, dogs by the Carians, and asses by the Scythians (Apollod. 'Fragm.' p. 394, ed. Heyne).

It is difficult to say what distinctive character ancient artists wished to give to this god, because no Greek state honoured him as their principal deity. We have no distinct account of his statues by Alcamenes and Scopas in the temple at Athens, but we can collect, from some that have been preserved, and also from heads of the god on gems, that the following is the general character under which he is represented. The expression is stern and thoughtful; firm nervous muscles, a strong fleshy neck, and short bristly hair; the mouth is small, the lips full, and the eyes deep-set. It is only in later times that he appears with a strong beard as the Roman Marspiter. He is represented always as a young man in the prime of vigorous strength. When not naked, his dress is a chlamys (*sagum*). See a beautiful head on a gem (Millin, P. Gr. 20); a standing figure on a basso-rilievo (Pio Clem. iv. 7); head on the coins of the Mamertini (Magnani, iv. 31, 32); on the Denarii of Fonteius Capito (Patin. p. 114). In later art he wears only the helmet. In groups he is often figured with Aphrodite. On gems he occurs as the giant-slayer: but in sculpture he is seldom represented as a combatant or engaged in strife. Hirt, 'Bildende Kunst,' 1833; Müller, 'Archäologie der Kunst,' §§ 372, &c.

Mars or *Mavors* (called *Mamers* in the Oscan language), the god of war among the Romans, was regarded by them as identical with the Greek *Ares*, but there can be little doubt he had originally a different origin. He was also called Marspater or Marspiter (Gell., v. 12), and was worshipped in peace under the name of Quirinus, and in war under that of Gradivus. There was a temple in Rome sacred to Quirinus, and another outside the city, in which he was worshipped under the name of Gradivus, on the Appian Way, near the gate Capena (Servius on 'Æneid,' i. 296). Among the Romans Mars was honoured next to Jupiter. According to tradition, Romulus was the son of Mars, by Rea Silvia; and it was perhaps owing to his being the tutelar god of the Romans that the husbandmen were accustomed, according to Cato ('De Re Rust.,' c. 141), to present their prayers to this deity, when they purified their fields by performing the sacrifice called *suovetaurilia*, which consisted of a pig, a sheep, and a bull. He is also called by Cato, Mars Silvanus (c. 83). According to a principle in Roman mythology, by which a male and a female deity are always supposed to preside over the same object of fear or desire, the Romans had a goddess of war called BELLONA.

A round shield (*ancile*), which was supposed to have been the shield of Mars, is said to have fallen from heaven during the reign of Numa, and was entrusted to the care of the Salii, the priests of Mars. Eleven other shields were made like it, in order that it might not be stolen.

The first month (Martius) of the old Roman year, which consisted of ten months only, derived its name from this god.

Mars is generally represented with a beard, but in other respects like the Greek Ares, and is frequently placed in the same group with Rea Silvia. In the Townley Collection in the British Museum, on the base of a candelabrum of Roman workmanship, there is a group of three little figures carrying the armour of Mars, and the helmet borne on the shoulders of one of the figures, is marked in front with the head of a ram, which animal was consecrated by the Romans to Mars as well as to Mercury.

ARGAND LAMP, so called from the name of its inventor, who was a native of France. This lamp has been made of various forms, for the different purposes of reading and of diffusing general light. In the simplest form of the Argand reading-lamp, there is a reservoir from which oil descends gradually to a cistern, and is thence conveyed by a pipe to the burner containing the wick, placed between two tubes and immersed in oil. The wick rises a little above the upper surface of the burner; there is a glass chimney, the lower part of which is enlarged, in order to increase the current of air upwards; the chimney rests on a gallery or stand, where it is kept in its place by four wires. By turning the gallery, the wick is either raised or lowered. The wick is hollow and cylindrical, and receives a current of air both internally and externally; the former enters through open work near the bottom of the burner, and the latter at the gallery: this indeed constitutes the peculiar principle and merit of the lamp. There is a shade surrounding the light, so as to prevent its acting too powerfully on the eyes. Below the reservoir is a handle, which, when the lamp is burning, is depressed, to allow of a supply of oil to descend into the cistern, and which is raised to cut it off when the lamp is not in use. A small cup is screwed below the burner, to receive any drops of oil which may fall. The internal mechanism is thus arranged: The reservoir terminates in a neck, which screws into the upper part of the oil cistern; when it is unscrewed and inverted, the oil is poured into the reservoir through a small hole; by moving a small handle or lever, a short tube is made to cover this hole and prevent the oil from running out, and the reservoir is then screwed into its place, and the handle depressed so as to uncover the hole and to allow the passage of the oil into the cistern. Within the perpendicular tube of the burner there is placed a smaller tube, and both are closed at bottom and open at the top; the space between these contains oil and the wick, stretched over a short tube which rises a little above the other tubes. The outer surface of the inner tube has a spiral groove formed round it; and a tooth in the ring or gallery entering this groove, when it is turned round, causes the tube and wick attached to it to ascend or descend, so as to regulate the flame. On account of the nature of the reservoir which contains the oil, a constant supply will be kept up at the proper level, both in the cistern and in the wick-tubes.

It has been mentioned that various forms are given to the Argand lamps. In those employed for the purpose of giving a general and diffused light, the reservoir of oil is circular, and surrounds the cistern and wick, and is nearly on a level with the latter; a ground-glass shade, which in the smaller lamps is frequently globular, and in larger ones rather flat, rests upon a groove.

The chemical Argand lamp is a very useful instrument—comprising a reservoir of oil; an opening at which the oil is poured into it; a short copper chimney; a pinion by which motion is given to a rack, so as to raise or depress the wick; apertures to supply air; and a dish, in which the lamp stands, to retain any oil which drops from the reservoir.

It will be seen, from the above description, that in the Argand lamp the wick, and consequently the flame also, is in the form of a hollow cylinder, through the interior of which a current of air is made to ascend, in order to afford a free supply of air to the interior as well as to the exterior of the flame; and thereby to ensure more perfect combustion and greater brilliancy of light than could be obtained either by the use of a single large wick, or by a series of small wicks arranged in a straight line. These objects are more perfectly attained by the addition of a glass chimney, which confines the air immediately surrounding the flame, and produces an upward current, which causes it to rise high above the wick. The principle is also extensively applied to gas-burners.

Mr. Hemmenway took out an American patent in 1841, for a means of avoiding the necessity of removing the oil-chamber when an Argand lamp is to be replenished with oil. The fountain or reservoir is to be supplied with oil by a short pipe at the top, which is hermetically closed by a leather valve and screw cap; and between the bottom of this reservoir and the pipe that conducts the oil to the burner is an air chamber, which is supplied with air by a tube passing up through the oil reservoir. This air is made one of the means of filling the vessel with oil.

Messrs. Bedington and Docker registered an improvement in 1849, whereby an Argand lamp is enabled to maintain a clear light for a greater number of hours than under ordinary circumstances. The central air-tube, instead of terminating, as in the usual Argand lamps, nearly on a level with the top edge of the perforated air-cone, is carried about half an inch higher, and has apertures made near its upper end. The outer case is also prolonged at top to a similar extent, and is similarly perforated near the top. By this arrangement currents of air are directed through the apertures into the wick, just below the point of inflammation, and thus the oil is prevented from becoming thickened or carbonised at that spot, a result so likely to occur in the ordinary form of Argand.

In 1858 a new burner was patented, to produce steady flame and complete combustion without a glass chimney. A central ring of orifices is surrounded by an additional ring of lesser orifices, equidistant from the central row and from each other. The object is, that the outer row of jets may obviate flickering and smoking.

Many other improvements have from time to time been introduced in the Argand lamp; and our manufacturers, within the last few years, have shown how much external beauty as well as practical convenience may be imparted to these contrivances.

The name of Argand having become associated with the means of producing a bright light by a judicious arrangement of air-holes, it has been applied not only to lamps, but also to candles and furnaces. During more than forty years, attention has from time to time been directed to the possibility of producing Argand candles—that is, candles constructed on the Argand principle. As, in the Argand lamp, air is supplied *within* the circle of the flame, so it has been thought that if air could ascend through the wick of a candle, the flame produced would be more brilliant. Many varieties have been tried, and some of them patented; but none of them have yet become permanently and commercially successful.

The designation Argand Furnace has been lately given to an arrangement in which a stream of air is made to mingle with the inflammable gases in the furnace, but is previously divided into a number of minute streamlets by passing through small apertures. The principle has been known and partially acted on for a considerable time, but it was brought into a practical form a few years ago by Mr. Williams.

Other contrivances, partaking more or less of the principle of the Argand lamp, are described under LIGHTS, ARTIFICIAL.

ARGEII, a name sometimes applied by Homer to the whole body of Greeks assembled at Troy; it is derived, probably, from the inhabitants of Argos, who had even in those early times raised their city to considerable celebrity. Homer, indeed, employs the word Argos not only to designate the name of a town, but also the whole Peloponnesus: Agamemnon is styled the sovereign of all Argos and the islands (See Strabo, viii. 369.) The capital of Agamemnon's kingdom of Argos, which certainly did not comprise all the Peloponnesus, was Mycenæ. Homer often qualifies it with some epithet, as Achaiicum ('Iliad,' ix. 141), when Argos of the Peloponnesus is meant, and Pelasgicum when the Thessalian city or district of that name is intended. Strabo (viii. 372) tells us that in later times the word Argos in the Thessalian and Macedonian dialects signified a plain or field, and we may therefore perhaps consider it as having the same root with *ager* in the Latin language. What connection this has with the several cities named Argos, the geographer does not think proper to inform us, though he may perhaps intend us to infer that they were so called from being situated in a plain. Pausanias (viii. 7) mentions a plain (called the πεδίον ἀργὸν) close to the mountain Artemisium, but we doubt if this has any reference to the use of the word Argos, of which we are here speaking. The early inhabitants of the Peloponnesian Argos and of the district around it were, we have good reason to believe, Pelasgi. (Strabo, viii. 371; Eurip. 'Orest.,' 931; Æschyl. 'Suppl.,' 268.) The arrival of Danaüs from Egypt, according to tradition, caused their name to be changed to Danaï, a term that occurs in the 'Iliad,' but the mass of the population no doubt still remained the same. Eighty years after the Trojan war, or B.C. 1104, the invasion of the Peloponnesus by the Heraclidæ took place, and Argos, like most of the other cities of southern Greece, was obliged to submit to the Dorians. Still this was only a change of dynasty, and all the older Achæan inhabitants were not compelled to leave their country. From this time the names Argos and Argeii lost their more extensive signification; but the city Argos itself continued an important place under this new race. [ARGOLIS, ARGOS, and ACHÆI, in the GEOG. DIVISION.]

ARGE'NTEUS CODEX, or Silver Book, the name given to a very curious manuscript, or rather fragment of a manuscript, containing the greater part of the Four Gospels in the Mœso-Gothic language, preserved in the library at Upsala, in Sweden. It is believed to be a relic of the Gothic Bible, all or the greater part of which was translated by Ulphilas, bishop of those Goths who were settled in Mœsia and Thrace, and who lived under the emperor Valens about A.D. 360. This curious fragment was discovered in the library of the abbey of Werden, in Westphalia. The leaves are of vellum, some purple, but the greater part of a violet colour; all the letters being of silver, except the initials, which are of gold. These letters, which are all capitals, appear not to have been written with the pen, but stamped or imprinted on the vellum with hot metal types, in the same manner as book-binders at present letter the backs of books. This copy is judged to be nearly as ancient as the time of Ulphilas, or at least not later than a century or two after.

Michaelis and one or two other learned men have opposed the current opinion, that the Silver Book contains part of Ulphilas's Gothic version, and have offered arguments to prove that it is rather a venerable fragment of some very ancient Francic Bible: but they have been confuted by Knittel and others. The letters used in the Gothic Gospels, being twenty-five in number, are formed, with slight variations, from the capitals of the Greek and Latin alphabets, and are believed to have been really the invention or application of Ulphilas. See the notes to Bishop Percy's 'Translation of Mallet's Northern Antiquities,' vol. i. p. 366.

Palimpsest fragments of this Gothic version of the Scriptures, though not in the silver character, have been since found in other places. Knittel printed a fragment, containing part of the Epistle to the Romans, which was discovered in the library at Wolfenbuttel: it was reprinted in 1763, by Professor Ihre; and again in the Appendix to Lye's Saxon Dictionary. In 1819, some further fragments were published by Angelo Mai and Car. Oct. Castillonei, in 4to, at Milan, containing small portions of Esdras and Nehemiah, parts of the 25th, 26th, and 27th chapters of St. Matthew, of St. Paul's Epistles to the Philippians, Titus, and Philemon, and of a homily and calendar; these were discovered in separate leaves in the Ambrosian library at Milan.

The Gothic Gospels of the Silver Book were first printed in types approaching to a fac-simile, by Junius, in 1665; again in common type at Stockholm, in 1671; by Mr. Lye at Oxford, in 4to, 1750, with a Gothic grammar prefixed; by Zahn, 4to, Weissenfels, 1805; by Massmann, 4to, Munich, 1834; by Gabelentz and Löbe (with a glossary and grammar, and the palimpsest fragments of Mai), 3 vols. 4to, Leips. 1836-47; and by Uppström, 4to, Upsala, 1854.

A 'Dissertation on the Argenteus Codex,' by Ericus Sotberg, printed at Stockholm, in 1752, contains two of its pages in fac-simile. Knittel and Mai have also engraved some of the palimpsest fragments which they respectively published.

ARGO, the ship, a southern constellation, the greater part of which, containing all the more important stars, is not visible in this country. It has one star of the first magnitude, CANOPUS (which see). The part of it which is visible in our latitude may be found in and above a line drawn through Orion's belt, and continued beyond Sirius. The star Cor Hydræ is just above the end of the mast, and the direction of the mast is that of a line passing through Regulus and Cor Hydræ. The latter comes on the meridian at six in the evening in the middle of May.

The principal stars in Argo are as follows :

Character.	No. in Catalogue of Lacaille.	No. in Catalogue of British Association.	Magnitude.
α	2291	2096	1
ν	2386	2188	3
τ	2505	2256	4
π	2720	2414	3
σ	2837	2482	4
ξ	1763	2602	3·5
R	3068	2644	4
χ	3102	2665	4
ζ	3136	2710	2·5
ϵ	3327	2832	2
o	3482	2950	4
δ	3532	2979	3
b^1	3639	3073	4
b^2	3661	3089	4
λ	3699	3126	3
β	3791	3177	1
ι	3792	3186	2
K	3816	3213	3
M	3952	3300	4
υ	4051	3365	3
ϕ	4093	3410	4
q	4212	3509	4
ω	4243	3516	4
p	4348	3619	4
θ	4447	3686	3
η	4457	3695	2
μ	4461	3702	3

Owing to the extent of this constellation, it is usual to subdivide it into four regions. They are named as follows: Argo, Argo in Carina (in the keel), Argo in Puppi (in the stern), Argo in Velis (in the sails).

ARGOL. [TARTARIC ACID.]

ARGONAUTS, a term signifying the crew of the Argo, or members of the Argonautic expedition. This is one of the most remarkable of those mythological tales in which, as in the legends of the Trojan war, and the war of the Seven against Thebes, there is reason to believe that a substratum of truth exists, though overlaid by a mass of fiction. Anterior to these events (it is placed by Newton B.C. 937, by Blair B.C. 1263), the Argonautic expedition has a larger share of what is purely fabulous; the licence of the poet being of course curtailed in proportion as the events which he related came nearer to his own times. No story has been more frequently treated by Grecian writers. We shall give a brief outline, and then offer a few remarks upon it.

Jason, the son of Æson, king of Iolcos in Thessaly, having been defrauded of his father's kingdom by his father's brother Pelias, in hope of recovering his paternal inheritance, undertook to bring from Colchis the golden fleece of the ram which carried Phrixus thither. Argus, the son of Phrixus, by the help of Athene (Minerva), built the ship Argo, of fifty oars, at Pagasæ, and it was manned by the most celebrated heroes of Greece, in number fifty. The lists differ, for every state in later times wished to include its own national hero among them; but by general consent the most distinguished warriors, as Heracles (Hercules), the Æacidæ, the Dioscuri, Orpheus, Theseus, &c., were on board the vessel, which was steered by Tiphys, the son of Agnius. Embarking from Iolcos (or, some say, Aphetæ, *departure*), they steered first to Lemnos; thence to Mysia, where Hercules remained behind, seeking his favourite Hylas, who had been carried off by the Naiades, and drowned. (See Theocr. 'Idyll.' 13.) They touched next at Bebrycia, where Amycus, king of the country, was slain by Polydeukes (Pollux), in boxing with the *cestus*, or weighted glove. (Theocr. 'Idyll.' 22.) Apollonius next conducts them to the coast of Bithynia, where Zetes and Calais, the winged sons of Boreas, delivered the seer Phineus from certain winged monsters called Harpies, and in return he gave the Argonauts instructions for the conduct of their voyage. ('Apoll. Rhod.' ii. v. 178-425.) The entrance to the Euxine sea was fabled to be closed up by certain rocks, called *Symplegades*, *clashers*, or *Planktai* ('Od.' xii. 61), or *Cyanean*, which floated on the water, and when anything attempted to pass through, came together with such velocity that not even the birds could escape. Phineus advised them to let fly a pigeon, and to venture the passage if the bird got through safe. It passed, with only the loss of its tail; and the Argo, favoured by Juno, and impelled by the utmost efforts of its heroic crew, passed also, though so narrowly that the meeting rocks carried away part of her stern-works. Thenceforward they remained fixed. The expedition reached the river Phasis without any more adventures worthy of notice. Æetes, king of Colchis, hearing from the strangers the cause of their arrival, promised to give Jason the golden fleece, which was suspended on a tree in the sacred grove of Ares, on condition of his yoking two bulls with brazen feet, which breathed flames, ploughing a piece of land with them, and sowing part of the teeth of the serpent slain by Cadmus, which had the peculiar property of producing a crop of armed men. These difficult tasks he performed by the help of the celebrated sorceress Medea, daughter of Æetes, who fell in love with him, placed the fleece, which Æetes ultimately refused to surrender, in his possession, and became his partner in flight.

How the Argo got back to Greece, it is not easy to say; but somehow or other she found her way from Colchis, at the eastern end of the Euxine, to the western extremity of the Mediterranean. Here the Argonauts touched at Æea, the island of Circe (see 'Od.' xii. 69), which by Homer is placed in the westernmost part of the Mediterranean, and by some later writers has been said to be the promontory of Circeum, on the Latian coast. Hence they passed all the wonders of the western world described by Homer; the Sirens; Scylla and Charybdis; Trinakria (Sicilia), the isle of the sun; and Phæacia, or Corcyra. Near Anaphe, one of the Sporades, they narrowly escaped shipwreck, but were saved by Phœbus. They touched at Crete, proceeded to Ægina, thence to Iolcos, where Jason delivered up the fleece to Pelias; after which he sailed to the Isthmus, and dedicated the Argo to Poseidon, or Neptune.

For a full account of the adventures of the Argonauts, see, besides the passages referred to, Pindar, 'Pyth.' IV.; Apollonius Rhodius; the Orphic Argonautica; Diodorus, book iv. c. 40; see also Hesiod. 'Theog.' 992; Ovid, and the Latin poem of Valerius Flaccus, entitled 'Argonautica.'

The reader will readily understand that it was a difficult matter to get the Argo home from Colchis to Greece, by way of the Mediterranean. Besides numerous large streams, two very great rivers, the Ister and Tanais (Danube and Don), flowed into the Euxine sea, from the west and north-east respectively, in addition to the Phasis (Faz), which entered it on the east side, within the limits of Colchis. Of none of these did the early Greeks know either the rise or course; and this was convenient, for they could do as they liked with them. Pindar ('Pyth.' iv. 44 and 448) conducts the Argonauts into the 'Red Sea' (probably the Indian Ocean), and by the ocean to the coast of Libya, where they carried their ship over land for twelve days, and launching her into Lake Tritonis, entered the Mediterranean. According to the tradition preserved by Herodotus (iv. 179), Jason was driven off the south coast of the Peloponnesus into the shallows of the Lake Tritonis, while he was on his voyage (apparently before the commencement of the great expedition) to carry a hecatomb and a brazen tripod to the god of Delphi. He only got out of the difficulty by surrendering the tripod to Triton, the god of the lake, who on no other terms would consent to pilot him out. Hecatæus of Miletus improved the story, by making them sail from the ocean down the Nile, into the Mediterranean. Pisander and Timagetes, followed by Apollonius Rhodius, carried them up the Ister, and down one of its branches, by which they perhaps meant the Rhone, into the Keltic or Tyrrhene sea. Timæus and others took them up the Tanais to its source, from which they dragged the Argo to an unnamed stream, which carried them to the ocean, and they sailed home by Gades (Cadiz), that is, the straits of Gibraltar. The poet who writes under the name of Orpheus took them up the Phasis, down another branch of it to the Palus Mæotis, at the head of which they entered a river, probably the Tanais, and crossed the Rhipæan mountains to the Cronian or Baltic sea. They passed by the land of the Cimmerians, and the isle Iernis (Ireland?), and home by the strait of Tartessus (Gibraltar) into the Mediterranean.

The gross geographical ignorance involved in each of these routes need not be pointed out. Why later writers should have laboured to solve such an impossible problem it is hard to say, except that Homer brings the Argonauts into the Mediterranean ('Od.' xii. 70), and they may have thought themselves bound to follow him. Diodorus however takes them quickly home by the Euxine Sea.

The name of Minyans, which was given to the Argonauts, according to the mythologists, because most of them were descended from Minyas, son of Poseidon on the maternal side, has led Mr. Keightley ('Mythology') to suggest that the expedition may have been in fact undertaken by the Minyans, an early race in Greece, probably a branch of the Æolian tribe, who inhabited the southern part of Thessaly, and whose port was Iolcos, and their dockyard Pagasæ, and who are conjectured to have been a wealthy and commercial race. (Müller's 'Orchomenos;' and Buttmann's 'Mythologus,' ap. Keightley.)

Mr. Keightley further suggests, that the voyage may in fact have been to the west, for the wool and gold of Spain, and that this explains the universal agreement of all writers in bringing the Argonauts home by the Mediterranean; while at the same time the commodities for which the voyage was undertaken might readily be mythologised into the legend of the golden fleece. We prefer however the simpler belief of Mitford and others, that the expedition was of a piratical nature, on a large scale; in which, according to the notions of honour of the age, a number of young men of the highest rank and spirit engaged under one celebrated leader. The notion of the expedition being a western one seems to be untenable: the bold attempt of exploring the Black Sea, with the mingled objects of plunder, curiosity, and traffic, appears to be a more natural story. (See Herod. i. 2.) As to the Argonauts being found in the western part of the Mediterranean on their return, this notion arose, as we have already intimated, from the ignorance of the later Greeks as to the true course and character of the great streams which enter the Euxine or Black Sea on the north. When the geographers of Strabo's time (Strabo, 'Casaub.' p. 121) could believe, in opposition to the earlier statement of Herodotus, that the Caspian lake was an inlet or bay of the ocean running southward into the land, we may easily conceive how the ignorance of a previous age connected the Euxine with the waters of the ocean. When the Euxine was explored, so as to leave no doubt of its true character, ignorance and credulity merely transferred the same hypothesis to the Caspian. The wanderings of Io, as given in the 'Prometheus' of Æschylus, are a good sample of poetical geography, which may be compared with that of the Argonautic voyage.

Bryant, in his learned work on ancient mythology, considers this expedition of the Argonauts as one of those corrupt traditions in which the recollection of the Deluge, and the preservation of mankind in the ark, was long maintained. Jason, therefore, he believes to be the arkite deity, and the name of Argo to be connected with and derived from the ark itself. The reader will find this question discussed with great research and ingenuity in his 'Ancient Mythology;' but the author's prejudices in behalf of one favourite theory are so strong, that his arguments require to be examined with more than usual care.

ARGOSIE, a ship of great burden, whether for merchandise or war. Shakspere, in his 'Merchant of Venice' (act i. scene 1), says—

"Your mind is tossing on the ocean,
There where your *Argosies* with portly sail,
Like signiors and rich burghers on the flood,
Or as it were the pageants of the sea,
Do over-peer the petty traffickers."

It is mentioned in the same sense by Chapman, Drayton, Beaumont and Fletcher, and other writers. In Rycaut's 'Maxims of Turkish Polity,' chap. xiv., it is said, "Those vast carracks called Argosies, which are so famed for the vastness of their burden and bulk, were corruptly so denominated from Ragosies;" that is, ships of Ragusa, a city and territory on the Gulf of Venice, then tributary to the Porte. We have no proof however that the Ragusan vessels were particularly large; and it seems more likely that the Argosie derived its name from the classical ship Argo. Indeed, Shakspere himself has hinted as much in the play just quoted, when he makes Gratiano, in allusion to Antonio's argosie, say (act iii. scene 2)—

'We are the Jasons; we have won the fleece."

Sandys, in his 'Travels,' p. 2, applies the term argosie to a ship of force. Describing the boldness of pirates in the Adriatic, he observes, that from the timorousness of others, they "gather such courage that a little frigot will often not fear to venture on an argosie."

ARGUMENT, in astronomical tables, is the angle on which the tabulated quantity depends, and with which, therefore, in technical language, the table must be *entered*. If, for example, a table of the sun's declination were formed, corresponding to every degree, &c., of longitude, so that the longitude being known, the declination might be found opposite to it in the table, then the longitude would be made the *argument* of the declination.

ARIA. [AIR.]

ARIADNE, one of the group of small planets revolving between Mars and Jupiter. [ASTEROIDS.]

ARIADNE, according to Apollodorus, was the daughter of Minos and Pasiphaë. Having become enamoured of Theseus, she provided him with a sword with which he slew the Minotaur, and the thread clue by means of which he found his way out of the labyrinth. Theseus carried Ariadne with him from Crete to the island of Naxos, or Dia, where, according to Homer, she was killed by Artemis ('Odys.' xi. 324). But other accounts make him to have abandoned her there, after she had borne him twin sons, Oenopion and Stapylus. Dionysus (Bacchus), according to this version of the story, saw her, and, enchanted by her beauty, raised her to a place among the immortals, and made her his wife. Ariadne was a great favourite with the Greek artists, who represented in her the type of human female loveliness. She is usually seen crowned with ivy and fully draped. On vases, cameos, gems, &c., she is figured as meeting with or forsaken by Theseus; along with Dionysus in a chariot, or accompanied with Erotes, Bacchantes, &c. There is a very fine statue in the British Museum (Third Græco-Roman Saloon), of a female draped in a long tunic and peplus, and crowned with ivy, which is described in the official catalogue as a 'Libera, the female Bacchus, or perhaps Ariadne,' but which Müller ('Archäologie der Kunst,' § 388) without hesitation calls an Ariadne.

ARIANS, a name applied in common to all who entertain opinions concerning the relations between Jesus Christ and the Father similar to those entertained by Arius, although they have not always derived their notions from him. According to the second oration of Athanasius against the Arians (§ 24), Eusebius of Nicomedia, Asterius, and Arius, agreed in the following opinion: God being willing to create the universe, and seeing that it could not be subject to the working of his almighty hand, made first a single being whom he called Son, or Logos, to be a link between God and the world, by whom the whole universe was created. (Compare Athanas. 'Orat. c. Arian.' i. § 5.) The Arians formed a more exalted idea of Christ than the Socinians and the modern Neologians, or Rationalists, in Germany. According to the Rationalists, Jesus was a sort of Socrates among the Jews, and Socrates was a Grecian Jesus. But the Arians did not deny that Christ, in the New Testament, was called God, and they ascribed to him a sort of divine dignity; but asserted that he had this dignity, not by his own essence, but merely by the grace of God the Father. (Athanas. 'Orat. c. Arian. i. § 6.) The Arians fully admitted the incomprehensibility of God, and that Christians ought to pay divine worship to Jesus Christ. This they proved from Christ's saying, "That all men should honour the Son, even as they honour the Father. He that honoureth not the Son, honoureth not the Father who hath sent him." (St. John, v. 23.) Hence the Arians were accused by Athanasius of idolatry, because, according to their own notions, they offered to a creature that tribute which belonged to the Creator alone. The Arians distinguished the Logos in God from the Logos improperly so called.

These were the characteristic doctrines of the strict Arians. But in the western part of the Roman empire, all adversaries of the doctrine of Athanasius, that the Son was *homoousios*, or of the *same* essence with the Father, were called Arians; although some of these opponents taught a doctrine which had already been propagated in the school of Origen, namely, that the Son was *homoousios*, or of *similar* essence. These, afterwards called semi-Arians, were first compelled, by the opposition of the Homoousiasts, to join the Arians, but, owing to the persecutions which they suffered from the strict Arians (who asserted the Son to be *ἀνόμοιος κατ' οὐσίαν, dissimilar in essence*), they were driven back into the orthodox church. The party of Aëtius, and of his pupil, Eunomius, went a step farther than Arius, by asserting the comprehensibility of the divine essence, and by considering the *precision of doctrine* (*δογμάτων ἀκρίβεια*) of chief importance in Christianity. The Antiochene church, under the Arian bishop Eudoxius, afforded an asylum to the ultra-Arian followers of Eunomius. The difference between Arians and semi-Arians became more evident from these extreme opinions, and contributed to the gradual assimilation of the latter to the orthodox church. This assimilation was easily effected, because the semi-Arians had constantly used an orthodox phraseology, which was taken by the people in an orthodox sense. According to Hilarius Pictaviensis, 'Contra Aurentium' (§ 6), the ears of the people were holier than the hearts of their priests. At Constantinople, however, a dogmatising spirit pervaded all ranks of society. Of this we have a graphic description in the 'Oratio de Deitate Filii et Spiritus Sancti,' by Gregorius of Nyssa (Opp. t. iii. p. 466). "The town is full of those who dogmatise concerning incomprehensible matters,—they are in the streets and markets, among the clothiers, money-changers, and victuallers. If you ask any one how much you have to pay, they dogmatise about being begotten and not being begotten. If you ask the price of bread, the reply is, 'The Father is greater than the Son, and the Son is subordinate to the Father.' If you ask, 'Is the bath ready?' the answer is, 'The Son is created from nothing.'" Compare Neander's 'Kirchengeschichte,' b. ii. pp. 767-904.) [ARIUS, in BIOG. DIV.]

ARICINE. [CINCHONA, ALKALOIDS OF.]

ARIES (constellation), the Ram, is the first constellation of the ancient zodiac. The sign of the zodiac, so called, including the first thirty degrees of the ecliptic, reckoning from the vernal equinox, owing to the precession of the equinoxes, now begins in the constellation Pisces.

The Greek mythology makes Aries to be the commemoration of the golden fleece, in quest of which the Argonautic expedition was undertaken. Owing to the difficulty of separating any account of discussions relating to the origin of this constellation in particular, from the general description of the ZODIAC, we refer to the latter term for further mythological elucidation.

This constellation is surrounded by Cetus, Taurus, Perseus, Andromeda, and Pisces, the first of which is directly below it. In the horns are two stars, α and β, the only two of any note, which are near together, and may be found by continuing the line drawn from Procyon through Aldebaran; or, by continuing the line drawn through the pole star, and ϵ Cassiopeiæ, the nearest to the Great Bear of the five. These stars (α and β Arietis) are on the meridian at midnight in the middle of October.

The following are the principal stars in this constellation:

Character.	No. in Catalogue of Flamsteed.	No. in Catalogue of British Association.	Magnitude.
β	6	577	3
α	13	648	2
..	35	831	4
..	39	861	4
..	41	872	3
δ	57	986	4

ARIETTA in music (the diminutive of the Italian word *aria*), a short air.

ARIMA'NES and AREIMA'NIOS are Greek corruptions of the Persian name Ahriman or Aheriman, which, according to the ancient doctrine of Zoroaster, is the appellation of the author of evil and the opponent of Ormuze, who is the author of good. The general form of the word, as it occurs in the original text of the Zend-Avesta, is Anra Mainyu (pronounce Ahroman), a compound term, the meaning of which might be expressed by perhaps an etymological equivalent in the Greek *ἀγριομενής*, "hostile, of evil disposition." The Zend original of the word Ormuzd is Ahuro-Mazdâo, coming near the forms Oromazes and Oromasdes, under which the name occurs in Greek authors (for example, Plutarch, 'De Iside et Osir.' p. 660, ed. Steph.) In the Sanscrit paraphrase of a portion of the Zend-Avesta by Neriosengh, the name Ahur-Mazdâo is interpreted "the king of great wisdom." This interpretation is adopted by M. Eugène Burnouf, 'Commentaire sur le Yaçna, vol. i. p. 72, &c., and Dr. H. Brockhaus, in his 'Heiligen Schriften Zoroasters,' Leipzig, 1840.

The two individual beings, Ormuzd and Ahriman were, according to the 'Zend-Avesta,' the offspring of Zeruane-Akerene, the indefinite and impersonal divine substance and cause of all existence. Both were primarily equal in intellect and power; but Ormuzd was, from the beginning, pure, good, and luminous; while Ahriman was dark and wicked, and bent on destruction and mischief. Ormuzd is represented as the creator of the world: Ahriman constantly counteracts the designs of his goodness. Ormuzd created the six Amshaspands, or ministering angels of good: Ahriman, in opposition, created the six Deeves, to be subservient to his evil purposes. "I produced a place of delight," says Ormuzd, who relates the matter to the holy Zoroaster; "for had I not, the whole inhabited world would have gone to Airyana-vaejo," (wo nirgends geschaffen was eine Moglichkeit;) "but this which I created first was not the best. The second was by the man-ruining Agra-maingus." This second creation was full of death, where there are great snakes, ten winter months, and only two summer months. They create in turns different and opposed places of delight and suffering, but they all appear to have reference to known existing countries. In the one division is found unbelief, labour, and poverty; in the other, beautiful towns, with banners, and full of houses. This is from the first chapter of the 'Vendidad.' The subsequent chapters contain further conversations, with moral precepts and directions for prayers, by which "praising the highest purity," the Deevas are to be expelled, adding, "Long sleep, men, is not fitting for you. Turn towards the three good things, good thinking, speaking, and acting; and from the three bad things, evil thinking, speaking, and acting." Thus Ormuzd is always taking the lead by pure and good productions, and Ahriman follows, sowing the seeds of natural and moral evil in the new creations. Mithra, who is of a later introduction, was the mediator between Ormuzd and his creatures. The struggle of the two deities will, according to the doctrine of Zoroaster, continue during 12,000 years, after the lapse of which Ormuzd will defeat his opponent. Ahriman himself will then become a convert to truth and goodness, and a new world, happier and better than the present, will be created. Plutarch gives similar details, but fixes the period of contest at 3000 years.

The Persian doctrine of the two opposite principles was known to Aristotle, who, according to Diogenes Laertius ('De Vit. Philos. Procem.' 2), distinguished them as ἀγαθὸς δαίμων and κακὸς δαίμων.

The most ancient foreign authors that have given some interesting details regarding the doctrine of Zoroaster are the Armenian chroniclers of the fifth century, especially Elisæus and Esnac. See Elisæus's 'History of Vartan,' &c., translated by C. F. Neumann, London, 1830, 4to, and an extract from the Chronicle of Esnac, in the appendix to P. Aucher's 'Grammar, Armenian and English,' Venice, 1819, 8vo, p. 198, &c.; M. Anquetil du Perron, the 'Zend-Avesta;' but his translation, though valuable at the time, has been found too loose and too often incorrect to allow of the true doctrines of the ancient Persian faith to be drawn from it. Westergaard has published the text of the 'Zend-Avesta,' Copenhagen, 1854; and Dr. F. Spiegel, a translation in German of the 'Vendidad,' which is a portion of it, in Leipzig, 1852.

ARIO'SO, in music (an Italian adjective, *airy*), used to signify 'in the manner of an air,' as contradistinguished from recitative. When applied to instrumental music, it denotes a sustained, a vocal style. It is sometimes, but improperly, used substantively.

ARISTO'CRACY, according to its etymology, means a government of the *best* or *most excellent* (ἄριστοι). This name, which, like *optimates* in Latin, was applied to the educated and wealthy class in the state, soon lost its moral and obtained a purely political sense: so that aristocracy came to mean merely a government of a *few*, the rich being always the minority of a nation. When the sovereign power does not belong to one person, it is shared by a number of persons either greater or less than half the community: if this number is less than half, the government is called an *aristocracy;* if it is greater than half, the government is called a *democracy*. Since however women and children have in all ages and countries (except in cases of hereditary succession) been excluded from the exercise of the sovereign power, the number of persons enumerated in estimating the form of the government is confined to the adult males, and does not comprehend every individual of the society, like a census of population. Thus, if a nation contains 2,000,000 souls, of which 500,000 are adult males, if the sovereign power is lodged in a body consisting of 500 or 600 persons, the government is an aristocracy; if it is lodged in a body consisting of 400,000 persons, the government is a democracy, though this number is considerably less than half the entire population. It is also to be remarked, that where there is a class of subjects or slaves who are excluded from all political rights and all share in the sovereignty, the numbers of the dominant community are alone taken into the account in determining the name we are to give to the form of the government. Thus, Athens at the time of the Peloponnesian war had conquered a number of independent communities in the islands of the Ægean Sea and on the coasts of Asia Minor and Thrace, which were reduced to different degrees of subjection, but were all substantially dependent on the Athenians. Nevertheless, as every adult male Athenian citizen had a share in the sovereign power, the government of Athens was called, not an aristocracy, but a democracy. Again, the Athenians had a class of slaves, four or five times more numerous than the whole body of citizens, of all ages and sexes; yet as a majority of the citizens possessed the sovereign power, the government was called a democracy. In like manner, the government of South Carolina in the United States of America is called a democracy, because every adult freeman, who is a native or has obtained the rights of citizenship by residence, has a vote in the election of members of the legislative assembly, although the number of the slaves in that state exceeds that of the free population.

An aristocracy therefore may be defined to be a form of government in which the sovereign power is divided among a number of persons less than half the adult males of the *entire* community where there is not a class of subjects or slaves, or the *dominant* community where there is a class of subjects or slaves.

Lord Brougham, in his 'Political Philosophy,' vol. ii., gives a somewhat different definition. He says, "Where the supreme power in any state is in the hands of a portion of the community, and that portion is so constituted that the rest of the people cannot gain admittance, or can only gain admittance with the consent of the select body, the government is an aristocracy; where the people at large exercise the supreme power it is a democracy. Nor does it make any difference in these forms of government, that the ruling body exercises its power by delegation to individuals or to smaller bodies. Thus, a government would be aristocratic in which the select body elected a chief to whom a portion or even the whole of its power should be intrusted." He illustrates this by historical examples, and it is perhaps more in accordance with the general acceptation of the word than the previous definition. England can scarcely be termed an aristocratic government, though far less than the half of its adults have any acknowledged power.

Sometimes the word aristocracy is used to signify, not a form of government, but a class of persons in a state. In this sense it is applied not merely to the persons composing the sovereign body in a state of which the government is aristocratical, but to a class or political party in any state, whatever be the form of its government. When there is a privileged order of persons in a community having a title or civil dignity, and when no person, not belonging to this body, is admitted to share in the sovereign power, this class is often called the aristocracy, and the aristocratic party or class; and all persons not belonging to it are called the popular party, or, for shortness, the people. Under these circumstances many rich persons would not belong to the aristocratic class; but if a change takes place in the constitution of the state, by which the disabilities of the popular order are removed, and the rich obtain a large share of the sovereign power, then the rich become the aristocratic class, as opposed to the middle ranks and the poor. This may be illustrated by the history of Florence, in which state the *nobili popolani*, or popular nobles (as they were called), at one time were opposed to the aristocratic party, but by a change in the constitution became themselves the chiefs of the aristocratic, and the enemies of the popular party. In England, at the present time, aristocracy, as the name of a class, is generally applied to the *rich*, as opposed to the rest of the community: sometimes, however, it is used in a narrower sense, and is restricted to the *nobility*, or members of the peerage.

The word *aristocracy*, when used in this last sense, may be applied to an order of persons in states of any form of government. Thus, the privileged orders in France from the reign of Louis XIV. to the revolution of 1789, have often been called the aristocracy, although the government was during that time purely monarchical; so a class of persons has by many historians been termed the aristocracy in aristocratical republics, as Venice and Rome before the admission of the plebeians to equal political rights; and in democratical republics, as Athens, Rome in later times, and France during a part of her revolution. It would therefore be an error if any person were to infer from the existence of an aristocracy (that is, an aristocratical class) in a state, that the form of government is therefore aristocratical, though in fact that might happen to be the case.

The use of the word *aristocracy* to signify a *class of persons* never occurs in the Greek writers, with whom it originated, nor (as far as we are aware) is it ever employed by Machiavelli and the revivers of political science since the middle ages: among modern writers of all parts of Europe this acceptation has, however, now become frequent and established.

The word *oligarchy* is likewise of Greek origin, and it means, according to its etymology, a government of *a few*. By the Greek historians it is used as synonymous with aristocracy, nor did it convey any offensive meaning; among modern nations, however, it generally has an opprobrious force, and when used, it commonly implies that the writer or speaker disapproves of the government or dislikes the class of persons to which he applies that name.

There is scarcely any political term which has a more vague and fluctuating sense than *aristocracy;* and the historical or political student should be careful to watch with attention the variations in its meaning: observing, first, whether it means a form of government or a class of persons: if it means a form of government, whether the whole community is included, or whether there is also a class of subjects or slaves: if it means a class of persons, what is the principle which makes them a political party, or on what ground they are jointly opposed to other orders in the state. If attention is not paid to these points, there is great danger, in political or historical discussions, of confounding things essentially different, and of drawing parallels between governments, parties, and states of society, which resemble each other only in being called by the same name.

It has been proposed by Mr. Austin, in his work on 'The Province of Jurisprudence,' to use the term *aristocracy* as a general name for governments in which the sovereignty belongs to several persons, that is, to all governments which are not monarchies. There would, however, be much inconvenience in deviating so widely from the established usage of words, as to make democracy a kind of aristocracy; and it appears that the word republic has properly the sense required, being a general term including both aristocracy and democracy, and signifying all governments which are not monarchies or despotisms.

ARISTOLOCHIA, *Medical uses of.* The most valuable of the species is the *A. Serpentaria*, which grows in North America, chiefly in Virginia, and hence is called Virginian snake-root. Though the whole root is used, the rootlets are more powerful than the solid root. These consist of a large portion of woody fibre and gummy matter, which have no virtues, along with some resin, bitter extractive, and a little essential or volatile oil, on which principles its virtues depend. It communicates its properties to water and to alcohol, which are employed as the means of extracting them, by forming an infusion or a tincture. Decoction should never be employed, as the heat drives off the volatile oil.

Its odour and taste resemble valerian, angelica, and camphor. In its action on the human system it most nearly approaches to camphor, but its effects are more permanent. It chiefly influences the nervous system, and seems to act most beneficially in those cases where the capillaries, either from not receiving an adequate supply of blood, or of nervous energy, are incapable of producing upon the blood those changes which form secretions in the glands, the skin, and other secreting surfaces, or which are essential for the maintenance of a sufficient degree of vital action in every part of the body. The diseases or disordered states of the system in which it may be advantageously employed can, therefore, be easily inferred.

In protracted fevers, whether of a continued or intermittent kind, it is often eminently serviceable. In those cases of continued fever, which do not assume a very active character, but run on to a lengthened period, commonly called *low* nervous fever, it is preferable to every other agent, and may either be used alone, or in conjunction with cinchona bark, or some of its preparations. Hence, under the title of Huxham's tincture of bark, it is very much used: but a safer mode of administration is that of an infusion of the serpentaria, to which sulphate of quinine, and orange-peel, or other aromatic, may be added; as recommended under AGUE.

In eruptive or exanthematous fevers, such as small-pox and measles, when the eruption is imperfectly formed or threatens to recede, an occurrence always betokening great danger, and indicating much feebleness in the powers of the system, serpentaria is an invaluable agent.

In the sore throat of scarlet fever, or in other affections of the throat, where gangrene is to be apprehended, from the depression of the vital powers, serpentaria, given internally, and used as a gargle, alone, or with tincture of capsicum, is more likely to prevent so serious a termination than any other medicine. In none of these diseases should it be exhibited till after the bowels have been thoroughly cleared out by proper purgative medicines. But there are other diseases, not attended with fever, in which serpentaria is extremely useful. In that form of indigestion where no inflammatory state of the mucous membrane of the stomach exists, and where the skin is harsh and dry, serpentaria alone, or better with sulphate of quinine, is eminently serviceable. On the same principle, in the state of torpor or exhaustion to which literary persons are subject, from long-continued or intense mental exertion, this combination is highly useful.

In America, the infusion or tincture of serpentaria is sometimes taken every morning in damp aguish situations, to prevent intermittents. It is likewise said to prove useful in the treatment of a kind of pleurisy accompanied with great derangement of the biliary system, of frequent occurrence in autumn, among persons exposed to the exhalations of the marshes in America.

This species, and several others, both in America and the East and West Indies, are much employed as antidotes against the bite of serpents; and hence the name snake-root. Dr. Hancock states, that the quaco, used by the South Americans in such cases, belongs to this tribe.

ARISTOLOCHIN. The name given to a non-azotised bitter principle contained in snake-root, *Aristolochia serpentaria.* Its nature and composition are unknown.

ARITHMETIC, from the Greek ἀριθμητική (*arithmétike*), 'the art of numbering,' should mean the science of numbers in general, including a great part of what is commonly called *algebra*. It is however usually restricted to mean only the science of the expression of numbers by symbols, and the application (not investigation) of all rules relating to them which are useful in the arts of life. Under this general head we shall here confine ourselves to the elucidation, philosophical and historical, of the method of naming and representing numbers; in doing which we shall refer to such other articles as will, all together, furnish the most complete view of the subject our work can afford. For the method of applying principles in practice, see the names of the various rules, ADDITION, SUBTRACTION, &c. For the account of what we must call the psychology of arithmetic, see NUMBER; and for the history of this branch, see PYTHAGORAS, PLATO, THEON, EUCLID, DIOPHANTUS, FERMAT, &c., in the BIOGRAPHICAL DIVISION. For that part of algebra which particularly concerns pure arithmetic, see NUMBERS, THEORY OF. For the arithmetic of concrete numbers, see WEIGHTS and MEASURES, and such articles as YARD, POUND, &c.

All the information possessed on the main points of arithmetical history has been presented to the world in so complete a shape, that it would be little better than affectation to make any more references than one, in an article which has no pretensions to original research. Of course we allude to Dr. Peacock's History of Arithmetic contained in the 'Encyclopædia Metropolitana', which is certainly the most complete treatise yet written on any one point of mathematical history. In using this work as our universal reference, we regret that our limits will not allow us to make such a formal abstract of it, as would oblige us to ask the permission of its owners before we published this number. But as the treatise itself is of a length answering to more than 60 pages of this Cyclopædia, such an account of its contents would be impossible; and we therefore use it only as an authority for citations of fact, in which we shall refer to the paging of the 'Encyclopædia Metropolitana.' We however feel bound to bear testimony to its correctness on all points which our access to books has enabled us to investigate.

We find ourselves in possession of a method of representing numbers so simple and powerful, that the principle and practice of the most complicated rules follow from it with ease. It is so well known that we need not explain it; but when we separate from the rest the part which particularly distinguishes our *Numeration* from that of the ancient Europeans, we shall find that our superiority consists in the adoption of the following conventions:—

1. The value of a figure depends not only upon the simple number for which it stands when alone, but upon the place in which it stands. Thus, in 888, the three eights mean eight, eight tens, and eight hundreds.

2. The place of a figure, considered as affecting its value, is determined by the column in which it stands, and in the absence of succeeding figures to indicate the existence of other columns, their place is supplied by ciphers, which of themselves are considered as having no value. Thus the 8 in 800 is of the same value as that in 863.

To complete our particular system, on which however none of its advantages depend, we must add that each figure is increased *tenfold* for every place which it is removed to the left. In the first two conventions consists what is called the 'local value' of the figures; in the last is found the reason for the term 'decimal notation,' from the Latin word *decem*, ten.

There can be no doubt that the mere decimal notation, which has been in use in almost every age and country, has arisen from the facility which the ten fingers afford for making calculations. The names of numbers have been almost universally formed distinct as far as ten, after which compound names have been employed. The exceptions to the rule are additional proofs of the generality of the principle; they are either deduced from five or from twenty, the number of fingers on one hand, or the number of fingers and toes together. We call the simple symbols of numbers *digits*, or fingers; the Caribbees call the number ten by a phrase which signifies 'all the children of the hand' (Peacock, 390); and in many languages the phrases for five, ten, and twenty are connected, either by direct derivation or common etymology, with those for the hand or fingers. In France the scale from 60 to 100 is strictly vicenary (by twenties), and in the Indian Archipelago the ancient scales are vicenary. For more discussion on this point we refer to NUMERALS. We shall here only quote two results of observation, as laid down by Dr. Peacock (371), which appear to be very well borne out. They are, that "the natural scales of numeration alone have ever met with adoption," meaning, by natural scales, those derived from the hands, or hands and feet; and that "amongst all nations, practical methods of numeration have preceded the formation of numerical language."

But this does not mean that every nation has gone high in the scale of numbers. There are tribes which have never even risen to a *quinary* scale (by fives), owing to their never wanting, and therefore never giving names to, numbers as high as five. Aristotle (P. 391) mentions a tribe of Thracians which never counted higher than four; and the Yancos on the Amazon have been stopped by the complexity of their language. They count no higher than three, the name for which in their language is (P. 390), according to La Condamine, *Poettarrarorincoaroac.*

One of the Abipones, in describing a number of men greater than ten, would mark out a space of ground sufficient to contain them. This is, in its principle, the same resource as that to which the Greeks were driven by their cumbrous notation, namely, the substitution of geometry for arithmetic. [SQUARE; EUCLID, BIOG. DIV.]

To enable our readers rightly to estimate the advantage which we possess in our notation, we will here describe that of the Greeks, which is only equalled by that of the Chinese in its near approach to the Indian, or generally received system, and is very much superior to that of the Chinese in the simplicity of its symbols. We shall omit the substitution of letters for numbers, and content ourselves with abandoning the principle of 'local value,' and substituting in its place such a system of symbols as, without departing from the *principle* of Greek notation, will not confuse the reader by the adoption of new digits. For the actual signs used by the Greeks, see NUMERATION; NUMERALS. Let the first nine numbers be represented as usual, but let *ten* (instead of 10, in which 1 has local value) be represented by 1′, twenty by 2′, &c. Let 1″ be one hundred, 2″ two hundred, and so on; 1‴ one thousand, 2‴ two thousand, and so on. Let M stand for ten thousand, and let M affixed to a number make its value ten thousand times as great; thus, 4′2M is 420,000 in our notation. We have here improved upon the system of the Greeks, unavoidably, in order not to confuse the reader, since 2000, 200, 20, and 2, would not among them present to the eye that analogy which exists between 2‴, 2″, 2′, and 2, being in fact denoted by

$$\beta', \ \sigma, \ \kappa, \text{ and } \beta.$$

We now write some high numbers in our own decimal scale, accompanied by our imitation of the Greek.

46379268	4‴6″3′7M.9‴2″6′8
6007.0030	6‴7M.3′
72007106	7‴2″M.7‴1″6

In the first number, *where there is no cipher*, the Greek looks so like our own that we might be led to imagine there was no essential difference. We might say, that as it would be natural, and was in fact usual, to write the higher numbers first, the mere occurrence of a fourth column would suggest the idea of thousands, so that a notion, which we must call one of *local value*, would be inevitably formed. And perhaps it was so: indeed, it is surprising that neither Archimedes, Apollonius, or Diophantus, ever detected and improved the idea. But when we come to look at the second and third number, we see immediately that the continual derangement of the columns would prevent this notion from acquiring consistence. The symbol of *vacuity* is wanting; and we cannot see how great an impediment that defect presented, because we learn 20, 30, &c., as soon as we learn *twenty, thirty*, &c. And though perhaps 2′, 3′, &c., might have suggested such a contrivance, yet there was no analogy between κ (20) and λ (30) and β (2) and γ (3).

The ingenuity both of Archimedes and Apollonius was employed in the extension of the preceding system, without alteration of its principle. That of the latter we shall imitate. Calling 10,000 M_1, let ten thousand times ten thousand be called M_2, ten thousand times that number M_3, and so on, and let any one of these placed immediately after a number mean that the preceding is to be taken ten thousand times if followed by M_1, ten thousand times ten thousand if by M_2, and so on. The following number,

1768,9360,0142,0193,

would then be represented by

1‴7″6′8M_3.9‴3″6′M_2.1″4′2$M_1$1″9′3,

on which we may make the same remaks as before. The method of Archimedes (which preceded this) differed from it only in making ten million the *radix* of the system. We now see why our arithmetic was called *ciphering*, cipher coming from an Arabic word signifying *vacant*. One such thought as occurred to Archimedes in the bath [ARCHIMEDES, BIOG. DIV.] might have been fourteen centuries gained to the science.

We look in vain for anything like local value in the system of the Egyptians, or any other nation of antiquity who are known with *certainty* to have very ancient records. That of the Jews was similar to the one just described, so far as it went, and the use of some letters common to both (P. 406) in the numeral system, but not so in the *alphabets* of the two, proves that the notation of both had a common source. [NUMERALS.]

To the same article we must also refer for the Roman system, which extended itself throughout Europe during the first twelve centuries. It is much more rude than the Greek, and is a sufficient proof of the well known inaptitude of the former people for scientific invention.

The Chinese had several systems of numeration, all containing complicated symbols, and somewhat resembling that of the Greeks in principle, but with this important difference, that the symbol for 30, for example, has direct analogy with that for 3, being made by the juxtaposition of a symbol for ten; so that the improvement upon the Greek scale which we have been obliged to make in order to explain it, renders our imitation of the Greek a better resemblance of the Chinese. But they have no written method of expressing local value; though their *Schwan-pan* [ABACUS] is a practical use of the principle.

Before we proceed to the history of our own scale, we must extend our remark, that the 'decimal notation' and 'system of local value' are distinct things. When we agree that 10 shall stand for ten, we merely express that a number in the second column from the right shall stand for ten times as much as the same in the first column. But we are at liberty to suppose that a number in the second column shall mean nine, eight, or any other number of times what it does in the first. Thus, if we choose a *quinary* scale, in which 10 stands for 5, we reject the symbols 5, 6, 7, 8, and 9, and our numerical scale runs thus:—

1	2	3	4	10	11	12	13	14	20	21	22	&c.
one	two	three	four	five	six	seven	eight	nine	ten	eleven	twelve	&c.

Thus 20 is *ten*, because 2 in the second column counts five times 2. But if we choose a higher scale than the decimal, we shall have to invent instead of rejecting symbols; if, for instance, we take a *duodenary* scale in which 10 means twelve, we are left without symbols for *ten* and *eleven*. Let *t* and *e* stand for these; then our scale of number, beginning from ten, is as follows:—

t	*e*	10	11	12	13	14	15	16	17	18	19	1*t*	1*e*	20	&c.
ten	eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty	twenty-one	twenty-two	twenty-three	twenty-four	&c.

But the scale which best exemplifies the principle is the binary, in which 10 stands for 2, and in which there are consequently no symbols except 1 and 0. The system of numbers in this scale (from one to ten) is as follows:—

1 10 11 100 101 110 111 1000 1001 1010.

A Jesuit at Pekin (P. 392) communicated to Leibnitz the following Chinese symbol, called by them the Cova, or *lineation*, and attributed to Fohi, the founder of the empire. It is suspended in their temples, and considered as a mystery:—

If the long line be interpreted to mean *one*, and the broken line *nothing*, these symbols, each being read from the bottom to the top, give a system of binary arithmetic from 0 to 7 (both inclusive). And Leibnitz asserts that there is a larger *Cova*, which goes up to 63. But as no additional information has been obtained upon the subject, which, for anything certainly known to the contrary, may be a hoax, we can only say that there is some presumption that the Chinese long ago possessed the complete principle of the 'local value.'

We trace our own knowledge of the decimal system direct to the Hindoos, who themselves ascribe it to the divinity. As to the manner of its introduction, there are some differences of opinion on that subject. One and the old account is, that Gerbert, after Pope Sylvester II., found it in Spain among the Moors (P. 415) in the latter part of the 10th century. But upon this there are strong reasons for hesitating [SYLVESTER II., BIOG. DIV.] Another and more probable account is, that Leonard of Pisa [BONACCI, BIOG. DIV.; ALGEBRA] introduced it, in 1202, in a work entitled 'Liber Abbaci,' &c.; and some have supposed that the 'Alonsine (or Alphonsine) Tables,' being constructed principally by Moors at the court of Alonso, must have been the first in which the system appears (P. 413). It is certain that this system had been before the 12th century, and most probably as early as the 9th, in the hands of the Persians and Arabs, who ascribe it to the Hindoos, and call it by a name which signifies 'Hindoo science.' It is also certain that the Hindoos themselves have long used it [see VIJA GANITA and LILIWATI, names of Hindoo works], and that it is easy to trace the manner in which our numeral symbols have been derived from those of the Sanscrit. In this latter language there are distinct names for *units, tens*, &c., up to what we should call *hundreds of thousands of millions of millions*. But whether we are to look to a Hindoo for the invention is a question on which no surmise can be made till some probable account of the origin of Hindoo literature can be given.

The steps by which the new notation made its way through Europe are not capable of being very clearly traced. Montfaucon (P. 417) found them in an Italian manuscript which was finished in 1317; and many manuscripts of the works of authors a century older contain them, but it is well known that it was usual to substitute the new figures for the old in recopying. In the library of Corpus Christi College, Cambridge (P. 418), is a catalogue of eclipses from 1300 to 1348, to which they are subjoined. Graven dates on inscriptions have been given by Wallis and others as old as 1330; but, upon examination, reason has been found to suspect that 5 has been mistaken for 3. There does not seem to be evidence of any general use of the Arabic numerals before the invention of printing, and even the works of Caxton do not contain them, except in a woodcut. Merchants continued their accounts in Roman figures up to the 16th century. On the whole, we think that the general use of these numerals in scientific works did not much precede, if at all, the diffusion of algebra.

There has been much argument in favour of the assertion that the principle of local value is of older date in Europe than is commonly supposed, and was known even to the Romans. We suspend our opinion on this unfinished discussion, and refer the reader to the writings of M. Chasles.

The only material addition which has been made to this groundwork of arithmetic is the invention of decimal fractions. This is an extension of the principal of local value, of so simple a character, that it is surprising the Hindoos never adopted it. They write fractions as we do, omitting only the line which separates the numerator and denominator, and they make great use of decimal fractions in approximating to the square roots of numbers, but without any peculiarity of notation.

The first fractional notation which we find among the Greeks consisted in writing the denominator where we now write the *exponent*. Thus, retaining our imitation, $\frac{207}{365}$ would be written $2''7^{3''6'5}$. This system is principally used by Diophantus; and in Eutocius we also find a peculiar symbol, something like κ, for *one half*. Ptolemy made a further step, in the application of the method of dividing the circle to all units whatsoever, known by the name of the *sexagesimal* notation. The degree of the circle is divided into sixty minutes, the minute into sixty seconds, that again into sixty thirds, and so on: Ptolemy divides every unit in the same manner. We have still retained in our division of the circle the ′, ″, ‴, &c., used by him. In the notation alluded to (which is that of Ptolemy in the particular point referred to)

$$27\ 33'\ 21''\ 3'''$$

would denote

$$27 \text{ units}, \frac{33}{60}, \frac{21}{3600}, \text{ and } \frac{3}{216,000}.$$

This sexagesimal notation retained its ground until the introduction of the Arabic numerals, and with the aid of tables of reduction, was of material use.

Stifelius and Stevinus (P. 440) used circumflexed digits instead of ′, ″, &c., in the *sexagesimal* system, and an application of the same principle to the *decimal* system was first made by Albert Girard in or about 1590. This consisted in expressing fractions by tenths, hundredths, &c., in the following way—

$$16\ \frac{3}{10}\ \frac{4}{100} \text{ would be written } 1\ \overset{(0)}{6}\ \overset{(1)}{3}\ \overset{(2)}{4},$$

the number in parentheses over a digit being the exponent of the power of ten, which must be used with that digit as a denominator. Here the application of the principle of local value practically begins; and it is clear, from the examples cited by Mr. Peacock, that the *cipher* was made use of to denote a vacant column. One of those examples is

$$94\overset{(0)}{1}\ \overset{(1)}{3}\ \overset{(2)}{0}\ \overset{(3)}{4}$$

Decimal fractions were slowly introduced into England in the first half of the 17th century, by Wright, Napier, Wingate, Johnson, Oughtred, &c., From that time the modern form of the Indian arithmetic must be considered as established. The invention of LOGARITHMS (which see) is the principal aid to calculation which has been engrafted upon the system.

We subjoin a list of names, which the reader may consult on various points connected with the history of arithmetic, either in this work or elsewhere. The figures refer to the century before or after Christ in which the individual is supposed or known to have lived; and the works cited are in quotation marks.

B.C. 6—Pythagoras. 4—Euclid, Aristotle, Plato. 3—Archimedes, Apollonius. 1—Vitruvius.

A.C. 2—Ptolemy, Diophantus. 3—Nichomachus. 4—Pappus, Theon. 5—Proclus, Eutocius. 6—Boethius. 9—Mahommed Ben Musa. 11—Gerbert. 12—Jordanus, Leonardo Bonacci. 13—Sacrobosco, Planudes. 15—Lucas di Borgo. 16—Scheubelius, Stifelius, Recorde, Albert Girard. 17—Briggs, Napier, Oughtred, Stevinus, Wright, Bouillaud, Mersenne, Wallis, 'Algebra;' Bachet de Meziriac. 18—Weidler, 'Historia Astronomiæ;' Kæstner, 'Geschichte der Mathematik;' Montucla, 'Hist. des Mathématiques;' Delambre, 'Hist. de l'Astronomie Ancienne;' Hutton, 'Tracts,' 'History of Algebra;' Colebrooke, Preface to 'Bija Ganita;' Chasles, various writings; Libri, 'History of Mathematics in Italy.'

We need not of course refer to the work of Dr. Peacock, which we have so often cited.

ARITHMETIC, POLITICAL. [STATISTICS, INTEREST, ANNUITIES, POPULATION, MORTALITY, &c.]

ARITHMETIC OF SINES. [TRIGONOMETRY.]

ARITHMETIC, SPECIOUS. [VIETA.]

ARITHMETICAL COMPLEMENT is that which a number wants of the next highest decimal denomination. Thus what 7 wants of 10, or 3; 32 of 100, or 68; 159 of 1000, or 841; ·017 of 1, or ·983: are the arithmetical complements of these numbers. The best way to find them is to begin from the left, subtract every figure from 9, and the last significant figure from 10, as in the following examples, which include all the cases:—

No.	17634	19·0018	1734000
Ar. Co.	82366	80·9982	8266000

ARITHMETICAL MEAN. By *the* arithmetical mean is meant, that number or fraction which lies between two others, and is equally distant from both. Thus the arithmetical mean between 6 and 14 is 10. To find this arithmetical mean, take the *half sum* of the two numbers. Thus, that of 4 and 17 is $10\frac{1}{2}$. But any numbers are also said to be arithmetical means between two others, when all together form a series of equally increasing or decreasing numbers. Thus, 8, 10, 12, are three arithmetical means between 6 and 14. To interpose any number of arithmetical means between two numbers, divide the difference of those two numbers by one more than the number of means required, which gives the difference between the means. Thus, to interpose four arithmetical means between 27 and 102, divide 75 (102—27) by 5 (4+1) which gives 15. The means are, therefore, 27+15 or 42, 42+15 or 57, 57+15 or 72, and 72+15 or 87. If the means are fractional, the same process is employed. [AVERAGE.]

ARITHMETICAL PROGRESSION is a name given somewhat improperly to a series of numbers which increase or decrease by equal steps, such as 1, 2, 3, &c.; 2, 4, 6, &c.; $1\frac{1}{2}$, 2, $2\frac{1}{2}$, &c. The difference between any two successive terms, being *common* to all, is called the common difference. The *data* which distinguish one arithmetical progression from another, are the *first term*, the *common difference*, and the *number of terms*: from these it is easy to find the last term and the sum of all the terms. To find the last term, multiply the common difference by one less than the number of terms, and add the first term to the product. To find the sum of all the terms; take

the number of terms,
the sum of the first and last,

and multiply the half of either (whichever is most convenient) by the other, or take half the product of the two. Thus, for 100 terms of either of the series

3	6	9	12 . . . . &c.	(A)
1	$1\frac{1}{2}$	2	$2\frac{1}{2}$ . . . &c.	(B)

To find the last, or 100th, term of (A), multiply 3, the common difference by 99 (100—1) and add 3, the first term, which gives 300. Similarly to find the last, or 100th, term of (B), multiply $\frac{1}{2}$ by 99 and add 1, which gives $50\frac{1}{2}$. For the sums we have

	(A)	(B)
No. of terms	100	100
Sum of first and last	303	$51\frac{1}{2}$

Multiply half of 100 by 303, and by $51\frac{1}{2}$, which gives 15150 for the sum of (A), and 2575 for that of (B).

Algebraically, let a be the first term, x the common difference, and n the number of terms. Let z be the last term, and S the sum. Then

$$z = a + (n-1)\,x$$

$$S = \tfrac{1}{2}\,n\ \ (a + z) = na + n\frac{n-1}{2}x$$

from which any three of the letters being given, the other two can be found.

For the theory of which this article is a part, see SERIES, DIFFERENCES, INTEGRATION.

ARITHMETICAL PROPORTION, the relation which exists between four numbers, of which the first and second have the same difference as the third and fourth. Thus:—

1	2	81	82
7	3	16	12
$2\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{3}{4}$	$2\frac{1}{2}$

are severally in arithmetical proportion, and in every such proportion the sum of the extremes is equal to that of the means. Thus:—

$$12 + 7 = 3 + 16.$$

ARK, a chest or coffer. This term is frequently used by our earliest English and Scottish poets.

In 1347, in the brewhouse of the priory of Lindisfarne, was an ark for meal (see Raine's 'North Durham,' p. 92); and among other articles of furniture occurring in an inventory of the household goods belonging to Sherborn hospital, taken in 1636, in the boulting-house, is, '1 boulting ark.' (Hutch. 'Hist. Durh.' ii. p. 599.) The same word is still in use, in the north of England, for the chest which is employed in containing meal.

Noah's ark was so named from its supposed resemblance to an ark or chest; by which name it occurs both in the Gothic and Anglo-Saxon versions of the passage in Luke, xvii. 27. Wiclif, in this passage, instead of ark, reads ship. The same term ark is used in our translation of the Old Testament, for the basket or cradle in which the infant Moses was laid when he was put into the Nile. (See Boucher's 'Glossary,' by Stevenson.)

The ark of the tabernacle is of the same derivation. While travelling in the Wilderness the Israelites bore it in the form of a shrine, though it is said to have been fifty-five feet long, eighteen broad, and eighteen high. When the temple was built, the form was preserved, an oblong square. Into this none but priests were admitted, the people being assembled; and the sacrifices performed, in a court in front, while the sacred apartment was in the innermost recess.

ARMA'DA. This term, which is derived from the Latin word *armata*, 'armed,' and consequently comes from the same root as the French *armée* and our *army*, is used in Spain to denote exclusively a naval armed force, or fleet of war. *Flota* is used in the same language for a fleet of merchant-men. Armado, which occurs in Shakspere's

'King John,' act iii. sc. 4, Sandys's 'Travels,' p. 51, &c. is a corrupted term; so Fairfax, in the translation of 'Tasso,' i. 79.

"Spread was the huge *armado* wide and broad."

Ben Jonson, however, writes it correctly, Armada.

Nares, in his 'Glossary,' thinks that this word was not known in England before the Spanish projected invasion in 1588; and it is now rarely used but in speaking of that particular fleet. An account of it will be found under ELIZABETH, in the BIOGRAPHICAL DIVISION.

ARMATOLI, were originally the mountaineers of Thessaly or northern Greece. On the subjugation of the country by the Turks, they preserved their independence by retreating to the mountains, where they lived practising robbery in the plains, and were known as Klephts. They inhabited the fastnesses of the ranges of Olympus, Pelion, and Pindus. As their marauding was so far from being considered a disgrace that they formed favourite subjects for the national poets (see the 'Chants populaire de la Grèce moderne,' collected by C. Fauriel), it will not sound strange that they were mostly Christians. The sultans, finding great difficulty in reducing them to submission, were constrained to come to terms of pacification with them, and, on the payment of a trifling tribute, they were allowed to retain their arms, and to form themselves into a military community, occupying their native districts, and governed by their own laws. They were charged with the suppression of brigandage in the mountain passes, for which they received a species of tribute. The chiefs were styled Capitani, Polemarchs, or Protatos; the jurisdiction of a chief was called an armatolic, and he resided generally in the principal village of his canton. The office was hereditary, descending to the eldest son, who obtained a diploma from the pacha of his district, to whose authority he submitted. The band was composed of and commanded by Greeks exclusively; and, according to Fauriel, the number of cantons, immediately prior to the revolution, amounted to seventeen. The members who, in point of number, were unrestricted, were called palikari: their costume was that generally known as the Albanian; their arms consisted of a yatagan, sabre, musket, and pistols; they were brave and temperate, and inured to hardship and fatigue.

About the middle of the last century, however, the Porte appointed a Dervenji Bashi, in whose hands the care of all the passes was placed: this was a measure designed for the subversion of the armatoli. Ali, pasha of Joannina, having been also appointed Dervenji Bashi, made strenuous efforts to destroy their independence; but his cruelties drove the greater part to rebellion, and they fled to their native fastnesses, and re-incorporated themselves with the Klephts, being recognised indifferently by either name. Here, and also in the Morea, they maintained a sort of turbulent independence, and, at the first cry of the revolution, which commencing at Patras in 1821 was only ended in 1829 by the establishment of Greece as an independent kingdom, they issued forth to assist in the liberation of their country. After Greece became a kingdom, the Armatoli were chiefly incorporated into the regular army, and though no longer recognised as a class, the old Klephtic spirit is not yet extinct in the Thessalian hills.

ARMILLA, a bracelet, or large ring, for the wrist or arm. The wearing of the Armilla, or bracelet, as an ornament, is of very high antiquity. It occurs in Genesis, chap. xxiv. 22, 23, where Abraham sends his servant to seek a wife for Isaac. The Amalekite who slew Saul (2 Sam. i. 10) "took the crown that was upon his head, and the *bracelet* that was on his arm," and brought them to David.

The Armilla, or bracelet, as a decoration for both sexes, was perhaps the most universal of all ornaments—common to almost every nation, and far more general than the *torques*, or collar for the neck. It was sometimes worn upon the wrist, sometimes near the shoulder, and occasionally upon the ancles. Bartholinus, in his treatise 'de Armillis Veterum,' asserts, that it was of such general use as to be worn even by slaves, when they could obtain permission from their masters. This accounts for the great number of armillæ which have been found, of a slender shape and mean form, in bronze, in different countries once possessed by the Romans. By the Greeks the use of the bracelet seems to have been confined to the female sex; and even in Rome it was looked upon as an effeminacy for men to wear bracelets in ordinary life.

As an ornament of dress, the Armilla is frequently spoken of as massive. Livy (l. i. c. 11) says the golden bracelets of the Sabines were of great weight. Petronius Arbiter (c. 67) speaks of the Roman women as wearing bracelets of six pounds and a half, and even of ten pounds' weight, though the fact seems incredible.

It is not, however, as a mere ornament of dress that we are to consider the armilla; its most important use was as a gift of reward. Ælian ('Hist.' lib. i. c. 22) says the Persian kings rewarded all ambassadors, whether from Greece or other nations, with presents of armillæ. Plutarch, Xenophon ('Anabasis,' i. 2, 27), and Herodian, all allude to them as military or royal gifts.

Livy, in his account of the Samnite war (l. x. c. 44), says that at Aquilonia, Papirius, who had been engaged in various service, in the field, the camp, and the city, gave *armillæ* and coronets of gold to Spurius Nautius, to Spurius Papirius his own nephew, to four centurions, and to a whole band of the hastati. To the horsemen also, as a reward of valour, he gave armillæ and little horns of silver.

The gift of the *golden* armilla, however, was reserved peculiarly for the Roman citizen. Pliny says, to auxiliaries and strangers they give gold torques; to their own citizens only silver. But, exclusive of these, the Roman citizens have armillæ given them, which foreigners have not. ('Hist. Nat. l. xxxiii. c. 10.)

Aulus Gellius, in the eleventh chapter of his second book, describing the exploits of Dentatus, says he was called the Roman Achilles; that he had been in more than a hundred and twenty actions; that he had never received a wound in the back, but that he had five and forty wounds in front; and that among his rewards he had achieved eight golden crowns, one obsidional, and three mural crowns; that he had received eighty-three torques, and more than a hundred and sixty armillæ. ('Noct. Att.' l. ii. c. 11.)

Gruter (Inscript. MXCVI. 4) has preserved a monumental inscription in memory of Lucius Lepidius, who had served in different legions, and received various armillæ, torques, and other ornaments, as rewards, from the Emperor Vespasian. Smetius (fol. lxxiii. b.) gives another, for a soldier upon whom both torques and armillæ had been bestowed by Trajan. Numerous other such inscriptions will be found in the different collections. Brissonius has given the formula of one of these donations: '*Imperator te Argenteis Armillis donat.*'

The draconarii, or standard-bearers, wore armillæ. See Ammianus Marcellinus (l. xx. c. 4), where the soldiers crown Julian with one of them.

There was another use to which the armilla or bracelet was applied from the very remotest ages of the world. It was used as an offering. In the Book of Exodus bracelets are included among the free gifts for the tabernacle.

Offerings of serpentine armillæ, or torques, were also made to Æsculapius.

Gifts of armillæ, however, were not confined to the warriors of Greece and Rome. The practice was as prevalent in the remoter regions of the north. The fragments which remain of the compositions of the Scaldic bards are full of allusions to the gift of bracelets. Snorro Sturleson's History affords ample proof of this. Hrolf Krake, King of Norway, whose reign is ascribed to the 5th century, is mentioned as bestowing them by Saxo Grammaticus. ('Hist. Dan.' ii. p. 29.) In the 'Saxon Chronicle,' under the year 975, the English Edgar is expressly called be oꞃnabeah-ᵹyꞅa the *bestower of bracelets*, the rewarder of heroes; a term, indeed, usual as an epithet for a great chieftain in most of the Saxon poems. It occurs no where more frequently than in the song of the Traveller, and in the well-known poem of Beowulf.

Nor were armillæ gifts of reward made in person only; we find them frequently mentioned as legacies in the Saxon wills. In the will of Brihtric and his wife Ælfswytha (he was one of the Thanes of Archbishop Ælfric), preserved in the Textus Roffensis, among the articles which formed a legacy to the king, we have a bracelet of gold of the weight of eight mancuses; and to the queen a bracelet of thirty. In the will of Wulfer, which follows the will of Brihtric in Dr. Hickes's 'Thesaurus,' we find a legacy of a bracelet of sixty mancuses. ('Dissert. Epist.' p. 51.) William of Malmesbury informs us, that when Earl Godwin made his peace with Hardiknut, in the year 1040, he sealed it by a magnificent present—a ship, whose stern was richly ornamented with gold; and within it, eighty soldiers, each clothed in the most sumptuous habiliments of war, with armillæ of pure gold on both arms, each weighing sixteen ounces. (W. Malmsb. edit. Francof. 1601, l. ii. p. 77.) The same writer (p. 102), describing the manners and customs of the English in 1066, upon the conqueror's arrival, says their arms were laden with golden bracelets; "*Armillis aureis* brachiis onerati."

Arngrim Ionas, in his work on Iceland, speaking of the pagan rites which were used in the chief temple of southern Iceland, in the isle of Kialarnes, describes an armilla of twenty ounces weight, which was kept upon the altar, and which, being sprinkled with the blood of victims, was touched by those who took any solemn oath. He says it was either of silver, or silver and brass mixed. ('Crymog. Rer. Island.' l. i. p. 63.) He adds, that for this purpose it was worn upon the judge's arm during trials. (*Ibid.* p. 76.)

There is a passage in the Saxon Chronicle, under the year 876, which refers to a ceremony not altogether unlike the practice in Iceland. It says, that when the Danes made their peace with the English Alfred, at Wareham in Wessex, they gave him the noblest among them as hostages, and swore oaths to him upon the holy bracelet.

Armillæ, as we learn from Bartholinus, were sometimes marriage presents. Virgins, it appears, did not usually wear them. ('De Armill. Vet.' p. 79.) From different passages in the Roman classics, we learn that they were sometimes given as birth-day presents. Placed among treasures, there was a superstition that an armilla would augment them. Lovers thought them efficacious; and ivory armillæ were used in the cure of epilepsy. See other superstitions in Pliny. ('Hist. Nat.' ed. Harduini, tom. ii. 451, 11; 472, 10; 531, 22.)

Among the articles which from time to time have been turned up in the bogs of Ireland, armillæ of gold have not been the least numerous. Some years ago a very large bracelet of gold was found in Cheshire; and several in the same metal, of different sizes, have been found under Beachy Head in Sussex, amongst the chalk which the tide had undermined. Two or three of these are still preserved in Mr. Payne Knight's collection of bronzes.

The Hamilton, Townley, and Knight collections of antiquities, in the

British Museum, contain armillæ in great quantities, and of almost every variety of form, in gold, in silver, and in bronze. See the Hamilton Room, Case 68; Mr. Knight's collection, Case 8; and the Hamilton and other gems.

In vol. xii. of the 'Archæologia,' pl. li., a bronze armilla is engraved, found upon the wrist of a full-sized skeleton at Westwang Field in the East Riding of Yorkshire. See in the same work (vol. xxii. p. 285) some observations upon an ancient bracelet of bronze, found on the sand-hills of Altyre on the coast of Murrayshire; and also vol. xxvii. p. 400.

In the 'Journal' of the British Archæological Association, vol. ii., are accounts of bracelets in bronze and mixed metal found at Castlethorpe in Buckinghamshire, and at Colchester, Essex; and in subsequent proceedings of the Archæological Association and Institute, will be found other notices of similar discoveries in various parts of the country. In the National Museum at Copenhagen, are some bronze armlets found in Denmark, which appear to have been intended to cover the whole arm, and which M. Worsaae ('Antiquities of Denmark,' trans. by Thoms, p. 34) says belong exclusively to the bronze period. He suggests that they were intended as a protection to the arm against the blow of a sword.

ARMILLARY SPHERE. The Latin word *armilla* signifies a bracelet, and the armillary sphere is one in which the principal circles of the heavens are constructed of some solid material, and put together into their relative positions; thus presenting the appearance of a hollow sphere, of which all the surface has been cut away except the equator, ecliptic, colures, &c. This instrument is now little more than a toy, the complete sphere being generally preferred for the purposes of instruction; but in the ancient astronomy, and even so late as the time of Tycho Brahé, an instrument, the simple description of which is, that it was the whole or part of an armillary sphere, was extensively used in astronomical observation. On this point we refer the reader to ASTROLABE.

ARMINIANS are the followers of James Arminius, or those who are considered to entertain his sentiments. A full account of his doctrines will be found in the notice of ARMINIUS in the BIOGRAPHICAL DIVISION.

ARMOUR is a term generally applicable to any defensive habit, used to protect the person of the wearer from the attack of an enemy. The English word for it in the aggregate, in the fifteenth and sixteenth centuries, was *harness*.

Among the more civilised ancient nations, brass, iron, and other metals, were preferred for its fabrication; and in the time of Asiatic magnificence, even gold was not spared. Herodotus (vii. 71) says that the Libyans who assisted Xerxes in the great army wore leather armour, or probably skins only is meant; of which material, he adds (b. i. 71), the armour of the ancient Persians also was composed.

But for the earliest memorials of armour we must look to the sacred writings, where we find the shield, the helmet, and the breast-plate used by the Israelites. Goliath of Gath (1 Sam. xvii. 6) wore greaves to defend the legs, which were also worn by the warriors of other Asiatic nations; and, at the siege of Troy, by the Grecians in general. Homer's epithet of ἐϋκνημῖδες Ἀχαιοί (the well-greaved Achæi) is familiar to every classical reader. His description of the thorax or breast-plate of Agamemnon, at the beginning of the eleventh book of the 'Iliad,' shows that decorated armour was used at this early period. The same conclusion follows as a matter of course from the description of the shield of Achilles, and it proves that occasionally great pains and skill were employed in decorating armour. The golden armour of Glaucus ('Iliad,' vi. 236) is stated to be worth a hundred oxen. Among the Egyptians, armour of metal was confined to kings and nobles; the helmet of Psammetichus was of brass; the common soldiery wore quilted linen for helmets, and carried large wooden shields. (Xenophon, 'Anab.' i. 8.) The breast-plate which Amasis sent to Athenæa (Minerva) at Lindos was made of linen, on which figures of animals were woven; the ornamental parts were of cotton-thread and gold. (Herod. iii. 47.) As to Greek armour, several specimens of the helmet and cuirass occur upon the frieze of the Elgin marbles; in one instance (slab 51) we have a scaled cuirass richly ornamented. In the bronzes of Siris, purchased from M. Bröndsted for the British Museum, the warriors have helmets and shields only. One has a round, the other an oval shield: their bodies are unclothed. [ALEXANDER, in BIOGRAPHICAL DIVISION, where a representation is given.]

The complete Roman armour consisted of the helmet, shield, lorica, and greaves. The lorica was originally of leather, as we learn from Varro; in the time of Servius Tullius, according to Livy, the whole of the Roman body armour was of brass. The laminated lorica was heavy. Tacitus ('Hist.' lib i.) informs us that its weight was made a subject of complaint by some of the soldiers in the time of Galba; and the emperor himself, in his old age, found the weight of his cuirass too much for his feeble frame. ('Hist.' lib. i. c. 35.) The Roman lorica was frequently enriched on the abdomen with embossed figures, on the breast with a Gorgon's head by way of amulet, on the shoulder-plates with scrolls of thunderbolts, and on the leather border which covered the tops of the lambrequins (or pendent flaps) with lions' heads; and these were formed of the precious metals. Each Roman legion had its own device marked upon its shields. In the time of Trajan, as is exemplified in the armour represented upon his column, the lorica was shortened, being cut straight round above the hips. A bronze breast and back plate of this kind are preserved in the British Museum, upon the front of the former of which one of the paps of the breast still remains, like a high button, to which the shoulder-plates were fastened, which held the back and breast together.

From these facts a general notion will be gathered of the kind of body-armour used among the ancient nations. But as to the minute varieties of it, which are to be found in statues, or upon gems, coins, vases, and other representations, exhibiting the differences and peculiarities which existed, according to the time, the country, or the progress of improvement among the people, the details would be endless. Some of the most important facts will be mentioned under the proper heads, such as SHIELD, HELMET, &c.

Upon the history of defensive armour, as it was worn in England, we shall be more minute. The early Britons are believed to have used none except the shield. Sir Samuel Meyrick, on the authority of Aneurin, the British bard, says, that the Anglo-Saxons under Hengist and others, wore many of them loricæ of leather and four-cornered helmets. This armour, he thinks, was probably acquired through the alliance of their fathers with the Romans, under Carausius and his successors. Aneurin says that Hengist wore scale-armour. A very early illuminated manuscript in the Harleian Collection, No. 603, represents a warrior exactly answering this description. Drawings of the 8th century represent the Anglo-Saxon soldier without any other defensive armour than the shield and helmet, which latter, Sir Samuel Meyrick remarks, seems, in general, to have been nothing more than leather, and is often omitted even in representations of battles. His offensive arms are the sword and the spear. The form of the shield at this period is always oval; it is usually surrounded by a broad rim on the outside, and has a sharp boss projecting from the middle, both of metal; the materials were wood, covered with leather. One of the laws of Æthelstan prohibits the making of shields of sheep's-skin, under the penalty of 30s. The helmet, as it is commonly represented in drawings of this æra, appears to have been either a cap of leather, with the fur turned outwards, sometimes strengthened by a metal rim, or of felt, the *fellen hæt* being often mentioned by Saxon writers, but personages of rank had one of a conical form made of metal and gilt.

When the tunic supplanted the lorica, Sir Samuel Meyrick observes, the Roman pectoral was still retained, and called halſ-beaꞃh or beoꞃᵹ, "neck-guard;" bꞃeoꞅꞇ-beðen, "defence for the breast;" and bꞃeoꞅꞇ-ꞃocc, "breast-plate." It may be seen on a warrior in an illumination in a manuscript of the Cottonian Library, marked Tiberius, B. v., in which the resemblance to the Roman pectoral is quite manifest. The Saxon authors, he continues ('Crit. Inquiry into Ant. Armour.' Introd. p. lxiii.), are by no means explicit with respect to the form or materials of the breast-guards, but the epithet applied to such as were of metal is "rigid." Others are mentioned which are said to have been "rough or shaggy," so that we may suppose them to have been formed of wool or hair, or perhaps of undressed hides.

Notwithstanding these remarks, the word lorica frequently occurs in the writings of the most eminent Saxon authors, and sometimes is mentioned in terms which might imply that it was made of metal. Aldhelm, who lived in the latter part of the 7th century, in some ænigmatical lines ('Poet. nonnulla,' 12mo. Mogunt. 1601, p. 51, 'De Lorica,'), speaks of a warrior's vesture which feared not darts drawn from the long quivers:—

> "—— En! vestis vulgi sermone vocabor:
> Spicula non vereor longis exempta pharetris."

Whether this was the scaled-armour, such as worn by Hengist, or that made of flat rings in the Phrygian style (as designated in Hope's 'Costume'), is not quite clear. In an illumination, however, of the 8th century, a king habited in a tunic covered with flat rings occurs; and in another manuscript of that period similar armour occurs. (See the Cottonian MSS., Claud. B. iv., and Cleopatra, C. viii.) The Saxon authors call this ᵹiehꞃynᵹeð byꞃn, or "ringed byrne." Some illuminations seem to show that the rings were worn edgewise (compare the MS. Cleopatra, C. viii.), and in either case the name is equally applicable. Poems of the 10th century mention the "shining iron rings," but it is probable that it was not in general use till the invasions of the heavier-armed Danes compelled its adoption.

Towards the close of the 9th century, the corium, or corietum, was the armour generally used, and appears frequently in the drawings of that period. It was formed of hides cut into the resemblance of leaves, and covering one another; sometimes all of one colour, as blue, &c., and sometimes of two, as brown and orange; the upper part being of the one, while that which covers the thighs is of the other. It should be observed, that the Saxon byꞃne, originally in shape like a tunic, became in form afterwards a complete cuirass, sitting close to the body, and generally terminating with it. Alcuin ('De Offic. Divin.') speaks of the Anglo-Saxon military tunics of linen in the following terms: "The soldiers are accustomed to wear linen tunics, so well fitted to their limbs as to enable them, with the utmost expedition, to direct the dart, poise the shield, wield the sword," &c. The weight of the ringed byrne seems to have been found a great impediment to activity. Hence, when Harold, in 1063, obtained immediate and decisive success over the Welsh, it was owing to the change of armour among his soldiers. He had observed that these mountaineers could not be pursued to their fastnesses by his troops when clad in ringed tunics, and he therefore commanded them to use their ancient leather suits, which would not impede their activity. (Ingulfus, fol. 68. Joh. Sarisb. 'De Nugis Curialium,' lib. vi. c. vi. p. 185.)

The Saxon artists, it appears, made no distinction between the cynehealm, or royal helmet, and the crown. The monarch is depicted by them, in his court and in the field of battle, with the same kind of head-covering, even when every other part of his dress is marked with decisive variation; but upon the figure of Edward the Confessor, in his great seal, the diadem is evidently put on a helmet. The casque of the nobility is usually pointed in the form of a cone, and made of brass or some other metal. In the two succeeding centuries its shape is the same; but it is ornamented with gold and precious stones, and is improved by the addition of a small piece to protect the nose, called a nasal. (See an illumination in the Cottonian MS., Tiberius, B. v.)

Leg-guards are decidedly mentioned by the early Saxon writers; but they uniformly appear to have been made of twisted pieces of woollen cloth, coming from within the shoe, and wound round the legs to the top of the calves, in imitation of the hay-bands used by their rude ancestors.

The shield still continued oval, and indeed until the Norman conquest; but it differed from time to time greatly in dimensions, especially in the 10th and 11th centuries, in the drawings of which times it appears of various sizes, from a magnitude sufficient to cover the head and body, to a diameter not greater than a foot and a half. This variation is further supported by historical testimony, for we find mention made of "little shields," and "smaller shields." In the will of Æthelstan, dated 1015, the shoulder-shield is included among the legacies, and it is distinguished from the target. It was probably of the larger sort, and received its appellation from being usually slung upon the shoulder.

When the Danes made their first appearance in England, Sir Samuel Meyrick says, they seem to have had no other armour than a broad collar which encircled their chest and the lower part of their neck, or a small thorax of flat rings, with greaves, or rather shin-pieces, of stout leather. About Canute's time, the Anglo-Danes adopted a new species of armour, which, he thinks, they probably derived from their kinsmen, the Normans. This consisted of a tunic, with a hood for the head and long sleeves, and what were afterwards called chausses, that is, pantaloons, covering also the feet, all of which were coated with perforated lozenges of steel, called, from their resemblance to the meshes of a net, macles, or mascles. They wore, too, a helmet, or skullcap, in the shape of a curvilinear cone, having on its apex a round knob, under which were painted the rays of a star. This helmet had a large broad nasal to protect the nose, and the hood was drawn up over the mouth, and attached to it, so that the only exposed parts were the eyes. The authority for these observations is the manuscript in the British Museum commonly called Canute's Prayer-book. Spears, swords, and battle-axes, or bipennes, were the offensive arms. The shields were either circular or lunated; a law of Hacon, who died in 963, directs that the shield should be of two boards in thickness, and painted red.

Such had been the state of armour in Britain when William led his army of Normans and Flemings to the victory at Hastings.

From this period, the great seals of our kings, those of the greater barons, and monumental effigies, give the outline of the changes which took place in the fashions of armour. The great seal of William the Conqueror represents him on one side seated on a throne, upon the other he is in a hauberk apparently of rings set edgewise, which kind of armour had been used by the Anglo-Saxons. The Norman body-armour represented in the Bayeux tapestry is of two kinds; one of rings or mascles, sewn flat on the vesture; the other of leather. The helmets are conical, and have the nasal. The ring-armour of the Bayeux tapestry is a tunic descending below the knee, but divided before and behind for the convenience of riding, so that the sides hang down so as to resemble short trousers: "This," says Sir Samuel Meyrick, "I take to be the haubergeon, as there are some few specimens of the tunic or hauberk, and both being mentioned in the 'Roman de Rou.' This opinion," he adds, "is further strengthened by a specimen of this curiously shaped armour existing on a monument in Ireland as late as the time of Edward III. It appears to have been put on by first drawing it on the thighs, where it sits wide, and then putting the arms into the sleeves, which hang loosely, reaching not much below the elbow, as was the case with the Saxon flat-ringed tunic: the hood (Mr. Planché prefers the term cowl, in order to distinguish the capuchon or cowl from the hood or chaperon) attached to it was then brought up over the head, and the opening on the chest covered by a square piece, through which were passed straps, that fastened behind, hanging down with tasselled terminations, as did also the strap which drew the hood, or capuchon, as it was called, tight round the forehead. This is evident in several figures in the Bayeux tapestry; but the manner in which the armour was put on and fastened is best shown where William is arming Harold. The Duke of Normandy is there represented as placing the helmet on the head of the Saxon earl with his left hand, while his right is busied making tight a strap, which is drawn through the rings on the breast of the latter. No examples of such shaped armour in England occur previously or in any subsequent reign; but it appears to have been introduced into Ireland, and worn in that country, as has been above observed, as late as the time of Edward III.; nor does any distinguishing name seem to have been applied to it: hence I conclude that it is what Wace calls the haubergeon, in his description of the appearance at the battle of Hastings of Bishop Odo, the conqueror's half-brother." The legs of the figures in the tapestry are, generally speaking, bound with bands of different colours, rising out of the shoe in the ancient Saxon manner; but in some instances, and where the hauberk is worn, they appear covered with mail to the ankles. Such, however, is the case only with the most distinguished characters, as William, Odo, Eustace, &c. This covering for the legs, according to William of Malmesbury, was called *heuse* or *hose;* whence Robert of Normandy being rather short-legged, we are told by Ordericus Vitalis, his contemporary, was often called by his father Curt-hose. The shield, as depicted in the tapestry, and introduced by the Normans, was of a very peculiar form. It has been called heater-shield and kite-shield by modern antiquaries, from its supposed resemblance to those familiar objects; but by the Normans themselves it was merely termed *escu*, from the Latin, *scutum*. While in the tapestry most of the Saxon shields are represented round or oval, with a central boss, as in the illuminations of that people, there is no instance of a Norman with any other than the long kite-shaped shield. These shields were hung on the arm by an inner strap, which left the hand free, and gave them a great advantage over the Saxons by whom the shield was grasped by the hand and held straight forward; so that to wield the heavy double-handed battle-axe, they were forced to relinquish the shield.

The armour of the reign of William Rufus remained precisely the same as in that of the Conqueror; and we have no new specimen of any part, except the *chapelle de fer*. This appears on the seal of Rufus, and resembles a Tartar cap, being a cone which projects beyond the head.

The great seal of Henry I. represents that king in flat-ringed armour. Other specimens of his time occur in the enamelled copper of Geoffrey Plantagenet, engraved by Stothard, and described by John of Marmoustier, and in a representation of similar date, engraved by Strutt, in his 'Dresses and Habits of the People of England,' from a manuscript in the possession of the late Francis Douce, Esq.

In the reign of Stephen, what is called tegulated armour appears to have prevailed, which consisted of several little plates, covering each other in the manner of tiles, and sown upon a hauberk, without sleeves or hood. The seal of Richard Fitzhugh, Earl of Chester, engraved in the 'Vetusta Monumenta,' of the Society of Antiquaries, affords a fine specimen of this kind of hauberk. The nasal of the helmet appears to have been disused toward the close of this reign; though, upon his great seal, Stephen is represented with it.

Henry II. is represented upon his great seal in a flat-ringed hauberk, wearing a conical helmet without a nasal. The flat rings, however, gave way soon after the commencement of his reign, and the hauberk with rings set edgewise came into general fashion. The shape of the shield became somewhat shortened, and often more angular on each side at the top.

Richard I., in his first seal, appears in a hauberk of rings set edgewise, from under which falls the drapery of his tunic; in the second seal he has the same without drapery; in both he is represented with chausses; in the first, wearing a conical helmet, but with its apex somewhat rounded; in the second with a cylindrical one, surmounted by the *planta-genista* (or broom-plant) in reference to his name, and having an aventaille or plate to protect the face.

The great seal of John affords the first example of an English king wearing a surcoat; it is put over a hauberk of rings set edgewise. Surcoats are supposed to have originated with the crusaders, for the purpose of distinguishing the many different nations serving under the banner of the cross, and to throw a veil over the iron armour, so apt to heat excessively when exposed to the direct rays of the sun. Besides the surcoat the haqueton and the gambeson were military garments in great esteem during this reign. They were both padded, the latter stuffed with wool in buckskin, the first in leather, stuffed with cotton. Thus, in a wardrobe account dated in 1212, we find a pound of cotton was expended in stuffing an aketon belonging to King John, which cost twelve pence, and the quilting of the same was charged at twelve pence more. John is represented with a cylindrical helmet, but without any covering over his face. The monument in the Temple church ascribed to Geoffrey de Magnaville, or Mandeville, which appears to be about this period, has one very similar, but with a nasal and cheek-pieces. A helmet of this time, "of a very cumbrous and inelegant form, and which was only worn in actual combat, when it was placed over the coif-de-mailles and chapel-de-fer (*Angl.*, mail hood and iron skull-cap), and rested on the shoulders," was found a few years ago in digging among the ruins of Eynsford Castle, Kent, and is now in the collection of the Earl of Warwick. (Planché.)

Henry III.'s great seals afford us the earliest specimen of the *ouvrages de pourpointerie*, which came more into fashion towards the latter part of his reign. His hauberk and chausses are of this padded work, stitched. On his first seal his helmet is represented as with the visor or aperture for sight, not in the aventaille, but in the helmet itself, while the latter has merely perforations for the breath, and is therefore fixed at the lower part. His second seal exhibits him in a cylindrical helmet of a more perfect form, the aventaille, which contains both the before-mentioned conveniences, being apparently made to open and shut by means of hinges and a clasp. This seal of Henry III. also represents him in a surcoat. A remarkable monumental effigy of a knight in this reign, in the armour of rings set edgewise, occurs in the church of Malvern in Worcestershire. The monumental figure of Richard Longespée, Earl of Salisbury, who died in 1224, is another specimen. "The horse soldiers, at this time," says Sir S. Meyrick, "consisted of the heavy cavalry, who were the knights, and completely covered with mail, or, as Matthew Paris expresses it, *ad unguem armatos*, the face and left hand excepted." In a manuscript, entitled 'The Lives of the Offas,' written by Matthew Paris (MS. Cotton. Nero, D. i.), and of the time of Henry III., the knights appear generally in gamboised armour (padded work, stitched), with surcoats, and wearing shin-pieces or greaves of steel. One, however, is in a hauberk, with hood and chausses of flat contiguous rings, and probably this is the latest example of such armour being worn. Some appear with visors, consisting of a convex plate of steel, on which is a cross, with perforations for the sight, and punctures for the breath, tied upon the hood. Others have a nasal skullcap, though not the latest representation of this defence; and others the cylindrical helmet common to this period. The helmets of the kings are distinguished from the rest by a crown at top. They have all, too, those coverings for the knees called poleyns. This word is often erroneously confounded with poulaines, which were the long points at the toes of shoes, worn in Richard II.'s time, as well as anterior; but we learn from the following passage from Carolus Blessensis, in Lobineau's 'Hist. Bretagne,' vol. ii. p. 566, that they were for the knees: "Fecit sibi per Oliverium auferri à genibus polenas, et antebrachia à brachiis:" He caused Oliver to take the poleyns from his knees, and the vambraces from his arms. Pourpointing, or elaborate stitching, it appears, became at this time a trade, and there were several pourpointers in Paris and London. The use of the pourpoint seems greatly to have gained ground, and the military in the delineations of this and the next reign are almost constantly depicted in it. Sir Samuel Meyrick says, "it has been observed, that in the illuminations of this period, the archers are represented wearing leathern vests over their hauberks of edge-ringed mail. These appear to have been the jack in its primary form, which originated with the English, and which afterwards assumed a shape so cumbersome. From the 'Chronicle' of Bertrand du Gueschin, composed about the time of Richard II., we learn that it continued to be worn over the hauberk, for he says, "S'avoit chascun un jacque par dessus son haubert,'—each had a jack above his hauberk. The small vest was called jacket, and in the Latin of the time *jaquetanus*, as was the *jacque*, *jacquemardus* and *jacobus*. The monument of Eudo de Arsic, who died about the latter part of this reign, seems to represent him in the jacque. He is clad in mail, and wears this garment, which is made with sleeves, sits close to the body, is buttoned down the front, and has a puckered skirt reaching to the knees. In later times it was generally of leather, for Coquillart, an old French writer, 'sur les Droits nouveaux,' describes it as of chamois, extending to the knees, and stuffed with flocks, so as to be a kind of pourpoint. During the latter part of this reign, the shape of the helmet underwent a partial change, taking the form of a truncated cone on the top of a cylinder: the apertures for the sight were horizontal, and pierced in the transverse part of a cross that ornamented the front, covering the whole head and resting on the shoulders. The crusade in this reign, says Sir Samuel Meyrick, seems to have introduced a new and most ingenious species of armour, probably of Asiatic discovery, and still worn by those nations at the present day. This was the interlaced rings, which, as dependent on each other, did not require to be sewn to an under garment. The earliest specimen he considers to be the monumental effigy of De l'Isle, in Rampton church, Cambridgeshire, which exhibits him in the flat coif worn during the greater part of this reign, but made, as well as his hauberk and chausses, of interlaced chain. The shape of his shield, however, is that of the close of Henry III.'s reign, and, with his surcoat, is ornamented with his armorial bearings. The shields, however, had generally become flatter, the top was straight, and the custom of emblazoning them was coming rapidly into use. The *chapelle de fer* continued to be used in this reign. The chanfron, or armour for the horse's head and face, first occurs in the clause-roll of the fifty-fourth Henry III.

Considerable improvements were made in armour during the reigns of the first three Edwards. Ailettes, or shoulder-pieces, appear to have been introduced in that of Edward I. In Edward II.'s time, armour appears to have assumed a mixed character, being neither altogether mail nor wholly plate. *Armures de fer*, towards the close of this reign, became the distinctive term, among the French writers, for plate-armour. The Florentine annals, says Sir Samuel Meyrick, consider the year 1315 as remarkable for a new regulation in armour, by which every horseman who went to battle was to have his helmet, breastplate, gauntlets, cuisses, and jambes all of iron, a precaution which was taken on account of the disadvantages their cavalry had suffered from wearing light armour at the battle of Catino; but this usage did not find its way into general practice in Europe for at least ten years after. The seal of Edward Prince of Wales, afterwards King Edward III., represents him with ailettes on which are his arms, in the same manner as Edmund Crouchback is exhibited in Westminster Abbey, and in a missal belonging to the late Francis Douce, Esq. What is curious in this is the early representation of the mamelieres, or pieces put on the breast, from which depended chains, one of which was attached to the sword-hilt, and the other to the scabbard. The armour at the close of this reign may be seen in an initial letter of a grant from King Edward II., constituting his brother, Thomas de Brotherton, Marshal of England. (See the MS. in the Cottonian Library, Nero, D. vi.) In the chancel of Ash church, in Kent, is the monumental effigy of a knight which exhibits still further the progress toward plate-armour. The helmet was still conical and frequently surmounted by a crest. The shield had become triangular or pear-shaped.

The helmet on the seal of Edward II. is of a cylindrical form, with a grated or pierced aventaille and visor attached: a clasp which fastens this on the right side is very visible, and it is probable that on the other it was retained by hinges. It was very much the custom during this reign to wear over the armour the cointisse, or surcoat, ornamented with the warrior's arms: this was sometimes shorter before than behind, as is shown in a brass in Minter church in the Isle of Sheppey.

The monumental effigy of John of Eltham, who died in 1329, exhibits the fashion in which armour was worn at the commencement of the reign of Edward III.; similar to which is the figure on the monument of a knight in Ifield church, in Sussex. The splendid manner, it is observed, in which some of the knights of this period chose to have their armour made proved sometimes fatal to them. Froissart tells us, that "Raymond, nephew to Pope Clement, was taken prisoner, but was afterwards put to death for his beautiful armour." The monument of Sir Oliver Ingham, at Ingham church, in Norfolk, who died in 1343, shows the further gradual progress of mixed armour. His monument also affords us one of the earliest specimens of the justing helmet of this time, surmounted by its crest—an owl with wings expanded. The equestrian statue of Bernabo Visconti, at Milan, engraved in the 'Archæologia,' vol. xviii. pl. xii. xiii. xiv. with its details, affords a magnificent specimen of the mixed armour used at this time upon the continent. Moveable visors attached to the bacinets (or skull-caps in the form of a bason) appear to have come in about the middle of the reign of Edward III. The Black Prince's monument at Canterbury, who died in 1360, is another specimen of the period. The monument of Humphrey de Bohun, Earl of Hereford, in 1367, Sir Samuel Meyrick observes, is the earliest specimen of plate-armour with taces, or overlapping plates to envelope the abdomen, at the bottom of the breastplate, without any surcoat. It was not till the reign of Henry V. that this practice became general. The surcoat about this time began to give place to the jupon, which was richly ornamented with heraldic bearings. Humphrey de Bohun wears plate over the insteps, but the rest of his feet is covered with chain. The leathern gauntlets were furnished at the knuckles with knobs or spikes of iron, called *gadlings*, which were often used to good purpose on an adversary, and seem to be the precursor of the barbarous modern American *knuckle-duster*. The gauntlets of Edward the Black Prince, thus armed, are hung above his tomb in Canterbury Cathedral.

The reigns of Richard II. and Henry IV. were still more distinguished by the increased ornament of armour. The armourers of Italy were much employed at this time by the English nobility. When Henry, Earl of Derby, proposed to combat with the Duke of Norfolk at Coventry, he sent to Galeazzo, Duke of Milan, for armour, who gave the knight who bore Henry's message not only the choice of all his armour, but sent with him to England four of the best armourers of Milan to give personal attendance upon Henry for his equipment. Chaucer, noticing a tournament at this period, says,

> "Ther mayst thou see devising of harneis
> So uncouth and so riche, and wrought so well
> Of goldsmithry, of browdying, and of stele;
> The sheldes brighte, testeres, and trappures;
> Gold-beten helmes, hauberkes, and cote-armures."—v. 2498.

Soon after the year 1400, chain-mail seems to have been entirely disused; and the complete armour of plate adopted. Henry V. is so represented on his great seal, as well as in one of the illuminations of the celebrated Bedford Missal; in the latter he is represented being armed by one of his esquires. Black armour was at this period often used for mourning. Henry IV. is constantly represented in black armour in the illuminations to the celebrated manuscript on 'The Deposition of Richard II.,' preserved in the Harleian Collection. The vizor of the basionet assumed fanciful shapes, and was sometimes formed so as to resemble the beak of a bird. In the time of Richard II., and under Henry V. the panache or plume of feathers was placed upon the helmet as an ornament.

A more splendid specimen of armour of the reign of Henry VI., than that represented on the effigy of Richard Beauchamp, Earl of Warwick, in the Beauchamp Chapel at Warwick, will not be found anywhere; he died in 1439. Armour was becoming lighter by degrees. The jazerine, a jacket composed of small overlapping plates of iron covered with velvet, frequently supplied the place of the breast and back-plates.

The fashion of armour prevalent through the reign of Edward IV. may be judged of from that monarch's great seal, and from the monumental effigy of Sir John Crosby, in the church of St. Helen, without

Bishopsgate, in London. The latter died in 1475. Soon after this time, numerous specimens of armour occur with immense elbow-plates; these continued till the time of Henry VIII.

The perfection of plate armour is supposed to have been attained in the reign of Richard III. The effigy of Sir Thomas Peyton, in Isleham church, Cambridgeshire, furnishes an excellent specimen. The head was defended by the casque, and the shield had become nearly pentangular.

Fluted armour was sometimes used in the reign of Henry VII.; this fashion is supposed to have come from Germany. The helmet assumes the form of the head, but presents a salient angle in front. The breast-plate is globular; and *lambays*, or steel plates to protect the thighs when on horseback, have been adopted.

Drawings of various military figures of the middle of King Henry VIII.'s reign, made at the time, occur in the Cottonian manuscript in the British Museum marked Augustus II., and amongst them Henry himself in armour. A great deal of the armour of this period had devices, arms, &c. stamped or engraved upon it; and some was *damasquinée*, or inlayed with gold. The alterations were chiefly those of ornament.

In the reign of Edward VI. a slight change took place in the form of the breast-plate, which was again a little changed in the reign of Mary. During Elizabeth's reign, no great alteration took place. "But armour *cap-à-pie*," says Sir Samuel Meyrick, "began to fall into disrepute soon after the accession of King James I., and in the latter part of his reign, the jambs or steel coverings for the legs were almost wholly laid aside."

King Charles I. is continually represented in armour; and he took great pains to bring about a uniformity in the fashion of armour among his officers and soldiers. But the troubles of his reign, and the success of the levellers of that period, caused a material alteration, so that soon after the establishment of the Protectorate we find the helmet and cuirass only worn; the latter consisting of a breast and back plate. The wearing of armour to the knees continued only to the time of Cromwell. The cuirass and a kind of helmet, however, are still retained amongst us for the royal regiments of Life Guards; and have, likewise, been resumed in the armies both of the French and Germans.

The reader who wishes for further information may consult Sir Samuel Meyrick's 'Engraved Illustrations of Ancient Armour from the Collection at Goodrich Court,' 2 vols. fol. Oxford, 1830, where (pl. iv. to x.) a series of tournament armour of successive dates, from 1458 to 1586, is exhibited.

Bordeaux steel is frequently mentioned by Froissart as excellent for armour. Felippo Negroli, of Milan, was the eminent armourer who worked for Francis I. of France, and the Emperor Charles V.

Some remarks on the ancient mode of putting on armour, communicated to the Society of Antiquaries by Sir Samuel Meyrick in 1821 (Archæologia,' vol. xx.), unravel, by the help of an ancient document, what was previously an enigma. The knight began with his feet and clothed upwards, namely; 1, his sabatynes, or steel clogs; 2, the greaves, or shin-pieces; 3, the cuisses, or thigh-pieces; 4, the breech of mail; 5, the tuillettes, or overlapping pieces below the waist; 6, the breast-plate, or cuirass; 7, the vambraces, or covers for the arms; 8, the rere-braces, or arrière-bras, the covering for the remaining part of the arm to the shoulder; 9, the gauntlets; 10, then the dagger was hung; 11, the short sword; 12, the cloak or coat, which was worn over the armour; 13, the bacinet; 14, the long sword; 15, the pennoncel, held in the left hand; 16, the shield.

For this account of armour, various works have been consulted—Grose's 'Treatise;' Gough's 'Sepulchral Monuments,' &c; but the chief outline has been taken from Sir Samuel Meyrick's 'Critical Inquiry into Ancient Armour as it existed in Europe, but particularly in England, from the Norman Conquest to the Reign of Charles II.' The collection of ancient armour possessed by that gentleman's son at Goodrich Court, in Herefordshire, and his own extensive researches, have supplied more information upon the subject than it is probable could have been given by any other writer.

(Planché's *History of British Costume.*)

ARMS, from the Latin *arma*, in a general sense, includes all kinds of weapons, whether of offence or defence, about the earliest of which we have any mention being the bow and arrow. Isaac told Esau to take his quiver and his bow and go out to the field and take some venison (about 1760 B.C.). It enabled man to kill wild animals for food before its use was required as a weapon of war. As a military weapon, it was probably succeeded by the sling. Lucretius says,—

"Arma antiqua, manus, ungues, dentesque fuere," &c.

* * * * * *

Man's earliest arms were fingers, teeth, and nails,
And stones, and fragments from the branching woods,
Then fires and flames they joined, detected soon;
Then copper next; and last, as latest traced,
The tyrant iron, than the copper vein
Less freely found, and sturdier to subdue.

Homer and Hesiod tell us, that in the early ages, the arms and instruments of the heroes were composed entirely of χαλκός (*copper*), perhaps hardened with tin. The word is commonly translated *brass*, but is more properly speaking bronze. Defensive arms have been already treated of under ARMOUR. The present article is confined chiefly to weapons of offence.

The Jews appear to have had swords, daggers, spears, javelins, bows, arrows, and slings: axes or maces were also used by them as weapons of war. According to Josephus, the use of iron arms was first taught by Joseph, who armed the troops of Pharaoh with casque and buckler.

Herodotus (vii. 61-80) gives a minute description of the weapons used by most of the different nations which formed the great army of Xerxes. Amongst these, the Medes and Persians had short spears, bows, arrows made of reeds, and daggers; the Assyrians, besides spears and daggers, had wooden clubs knotted with iron; the Bactrians and Parthians, bows made of reeds, and short spears; the Arabians had bows, large, flexible, and curved at the ends; the Æthiopians, bows made from the spathe (σπαθη) of the palm, four cubits, or six feet, long; their arrows were short, and pointed with sharp stones instead of iron; they had spears headed with the sharpened horns of the *dorcas* [ANTELOPE, in NATURAL HISTORY DIVISION], and knotted clubs. The Libyans had their spears hardened at the end by fire. The Paphlagonians, Phrygians, and Thracians, had spears, javelins, and daggers. In the Persian army at the battle of Cunaxa, we find chariots armed with scythes mentioned. (Xenophon, 'Anab.' i. 8.)

The Grecian armies were composed of various sorts of soldiery. In the earliest ages, as we see from Homer, the chief personages often fought in chariots; but this practice seems not to have existed in the historical ages. The cavalry of Thessaly and that of Macedonia obtained the highest reputation among the Greeks. It was with this cavalry that Alexander mainly defeated both the troops of the Persian king and those of the rulers of the Punj-ab. With the age of Alexander elephants were brought into use, and they were employed both by Pyrrhus the Greek King of Epirus, and by Hannibal, in their invasions of Italy. The Greek foot soldiers were distinguished by the terms ὁπλῖται (*hoplitai*), those who wore armour, and carried broad shields and long spears; and ψιλοί (*psiloi*), the light troops, who, with no other protection than a helmet, were armed with darts, bows and arrows, or slings. The πέλτασται (*peltastai*), who carried the peltæ, or narrow-pointed shields, and spears, were a species of light troops, and considered as an intermediate kind. The heavy-armed foot were the chief strength of the Grecian armies.

The Greek spears were generally of ash, with a leaf-shaped head of metal, and furnished with a pointed ferule at the butt, with which they were stuck into the ground. Pausanias saw a spear in the temple of Minerva at Phaselis, said, according to the legend, to have belonged to Achilles, the blade and ferule of which were of copper. The same diligent and credulous observer saw a knife at Nicomedia, made wholly of copper, reputed to have once belonged to Memnon. The Macedonians had a particularly long spear called σάρισσα (*sarissa*), which was fourteen or sixteen cubits in length. (See Polybius for this extraordinary length, and the notes to the 'Onomasticon' of Julius Pollux, v. σάρισσα.)

Swords, spears, javelins, bows, and slings, were the offensive arms of the Romans, whose infantry soldiers were divided into *hastati*, who fought with spears; *principes*, who led the van; *triarii*, the third line; *velites*, the light troops; *funditores*, the slingers; and *sagittarii*, the archers. Their cavalry used the javelin on horseback. The arrows of the saggittarii had not only their pikes barbed, but were furnished with little hooks just above, which easily entered the flesh, but tore it when an attempt was made to draw them out. What greatly contributed to render the Romans masters of the world, was, that as they successively fought against all nations, they renounced their own arms and methods of fighting, introducing any improvements they met with. Romulus, after the war with the Sabines, is said by Plutarch (Romulus, 21) to have adopted the broad buckler of that nation, instead of the Argolic buckler (*aspis Argolica*), which the Romans had used till that time: a story of little historical value, but confirmatory of the opinion that the Romans improved their military art by adopting the best things from other nations, and that they traced this policy to the supposed origin of their national existence.

The early Saxons, previous to their arrival in Britain, besides the buckler and dagger, used a sword bent forwards like a scythe; but their descendants soon changed it for one that was long, broad, straight, double-edged and pointed. The ordinary weapons of the Saxons, after their arrival in our island, for the infantry, were spears, axes, bows and arrows, clubs, and swords. Few of the infantry had any other defensive armour than small round shields with spikes in the centre. The cavalry were more uniformly armed with long spears which they carried in their right hands, and swords which hung by a belt on their left sides.

The arms of the Normans differed but little from those of the Saxons; their spears or lances were usually made of some light strong wood, with a well-tempered steel point: to these, with the sword and dirk, they added the cross-bow, as has been already shown in the article ARCHERY. The Normans also appear to have introduced a kind of field-artillery, consisting of machines from which darts and stones were thrown to a considerable distance: some of the arrows were also headed with combustible matter for firing towns and shipping.

Our military weapons were probably but little altered till the time of Edward I. when the English long-bow seems to have been adopted, or rather perfected and confined to the use of infantry.

Gunpowder was invented in the 13th, and the larger sort of fire-arms in the 14th century: these will be separately treated of under the head of ARTILLERY.

Portable or hand fire-arms, to which we shall confine ourselves at present, were not invented till a century later. Sir Samuel Meyrick in a Memoir in the 'Archæologia' of the Society of Antiquaries, has collected most of the scattered notices to be found in military writers relating to their introduction. He has indeed given the very year of their invention, upon the authority of an eye-witness. "It was in 1430," says Bilius, "that they were contrived by the Lucquese when besieged by the Florentines." Villaret, however, states that John, Duke of Burgundy, had 4000 hand cannons, as they were called, in his army in 1411 (Villaret, t. xiii. p. 176, 310). The French and Italians appear to have made the principal improvements.

A French translation of Quintus Curtius, written in 1468, preserved among the Burney manuscripts in the British Museum, exhibits two warriors in one of its illuminations, who bear the earliest representations of hand fire-arms with which we are acquainted: they appear to be hand-guns.

The following is the enumeration of the different pieces of portable fire-arms and their accompaniments, almost all of which have been engraved by Skelton, in his 'Specimens of Arms and Armour.' Hand-cannon, hand-gun, arquebus, arquebus à croc, haquebut, demi-haque, musket, wheel-lock, currier, snaphaunce, caliver, carabine, esclopette, fusil, musquetoon, fowling-piece, petronel, blunderbus, dragon, hand-mortar, dag, pistol, tricker-lock, fire-lock, self-loading gun, fancy-gun, musket-arrows, match-box, powder-horn and flask, touch-box, bandeleers, cartridges, patron, sweynes-feathers, and bayonet. The recollection of the fact, that *phialæ* (small pots) had been sometimes used for casting the Greek fire, was likely to lead to some more dexterous invention. The emperor Leo, in his 'Tactics,' ch. xix. § 6, *περὶ ναυμαχίας, on sea fight*, describing the use made of artificial fires in vessels employed in pursuit after a naval battle, says, "on the prows of such vessels were placed *σίφωνες* (*siphones*), large tubes; they were of copper, through which these fires were blown into the enemies' ships." Anna Comnena ('Alex.' l. xiii.) says, "that soldiers were supplied with copper tubes, and blew artificial fire in the same way upon their enemies in battles on land." Here we have, undoubtedly, the origin of fire-arms.

The *hand-cannon* was a simple tube fixed on a straight stock of wood, about three feet in length. It was furnished with touch-hole, trunnions, and cascable, like a large cannon. The touch-hole was, in the first instance, at top; but the liability of the priming to be blown away led to the improvement of placing a small pan under the right side to hold the powder. This pan was the first step to the invention of the gun-lock.

The *hand-gun* was an improvement on the hand-cannon. It was cast in brass, and, as a tube, was of greater length; a flat piece of brass, made to turn upon a pin, covered the pan which contained the powder; it had also the addition of a piece of brass fixed on the breech, and perforated to insure the aim. The hand-gun appears to have been in use in England at least as early as 1446. The Greeks made use of it to great advantage in their last defence of Constantinople in 1453.

As soon as the hand-gun had received a contrivance suggested by the trigger of the cross-bow, to convey with certainty and instantaneous motion the burning match to the pan, it acquired the appellation of *arquebus*, corrupted into harquebus. Previous to this invention, the match had been held in the hand in using the hand-gun as well as the hand-cannon. The arquebus is first mentioned by Philip de Comines, in his Account of the Battle of Morat in 1476. In England, on the first formation of the Yeoman of the Guard in 1485, one-half were armed with bows and arrows, the other with arquebuses. At the battle of Fournoe, in 1495, we read of mounted arquebusiers. A large party of arquebusiers are seen in the picture at Hampton Court which represents King Henry VIII.'s procession to meet Francis I., between Guisnes and Ardres. The arquebus, like the hand-cannon and hand-gun, being fired from the chest, while its butt remained straight, the eye could with difficulty only be brought sufficiently near to the barrel to afford a perfect aim. By giving to the butt a hooked form, the barrel was elevated, while the horizontal position would be retained. This idea, originating with the Germans, gave name to the fire-arms thus constructed, and was thence by the English termed a *haquebut*, hakebut, hagbut, or hagbush. The invention as well as the name was known in England as early as the reign of Richard III. We find numerous haquebutters in the English army in the time of Henry VIII.

The *demihaque* was a kind of long pistol, the butt-end of which was made to curve so as almost to become a semicircle. The demihaques were smaller, and probably about half the weight of the haquebuts, the diameter of the barrel being much less. In the 'Gesta Grayorum,' printed in 1594, we are told they carried bullets, and sometimes half-shots.

The *musquet* is sometimes stated to have been a Spanish invention. We find, however, that that arm was seen for the first time in 1432, in Tuscany. (Muratori, Dissert. 26, p. 457.) And, in 1449, the Milanese are said to have armed their militia with 20,000 muskets, which Sismondi (t. ix. p. 341) states, required a quarter of an hour to load and fire. Hallam, however ('Middle Ages,' vol. i. p. 342), doubts the fact of so many muskets having been collected. It was used at the battle of Pavia, and is said to have contributed in an especial manner to decide the fortune of the day. Its use, however, seems for a while to have been confined. It appears not to have been generally adopted till the Duke of Alba took upon himself the government of the Netherlands, in 1567. M. de Strozzi, Colonel-General of the French infantry under Charles IX., introduced it into France. The first Spanish musquets had straight stocks; the French, curved ones. Their form was that of the haquebut, but so long and heavy, that something of support was required; and hence originated the *rest*, a staff the height of a man's shoulder, with a kind of fork of iron at the top to receive the musquet, and a ferule at bottom to steady it in the ground. On a march, when the piece was shouldered, the rest was at first carried in the right hand, and subsequently hung upon the wrist by means of a loop tied under its head. A similar rest had been first used by the mounted arquebusiers. In the time of Elizabeth, and long after, the English musqueteer was a most encumbered soldier. He had, besides the unwieldy weapon itself, his coarse powder for loading, in a flask; his fine powder for priming, in a touch-box; his bullets in a leathern bag, the strings of which he had to draw to get at them; while in his hand was his burning match and his musquet rest; and when he had discharged his piece, he had to draw his sword in order to defend himself. Hence it became a question for a long time, even among military men, whether the bow did not deserve a preference over the musquet.

An ingenious contrivance to supplant the match-lock appeared in the reign of Henry VIII. This was the *wheel-lock*, invented in Italy. M. de Bellai informs us, that one of the first occasions on which it was used was in 1521, when Pope Leo X. and the Emperor Charles V. confederated against France, and their troops laid siege to Parma, which was defended by the Marquis de Foix. It was a small machine for exciting sparks of fire by the friction of a furrowed wheel of steel against a piece of sulphuret of iron, which, from such application, acquired the name of pyrites or fire-stone. The spring which turned this wheel was attached to it by a chain, formed like those in watches, and was wound upon the axle, or, as the term was, 'spanned' with a small lever called a spanner. This instrument, having at one end a hole made square to fit on the projecting axle of the wheel, was used like a key to wind a clock; and, being turned, made the wheel revolve, and a little slider that covered the pan retire from over it. The spanner was then removed, and the wheel was held by a catch connected with the trigger. The cock, like that in modern firelocks, except having its position reversed, containing the pyrites, was brought down upon the wheel, which, on the trigger being pulled, revolved rapidly, and grating against the pyrites elicited the fire. Wheel-locks were for a long time chiefly manufactured in Germany. They were certainly brought to England in the time of Henry VIII., in whose reign we find them mentioned in inventories under the name of 'fierlocke.' Benvenuto Cellini ('Memoirs,' vol. i. p. 182, Roscoe's transl.) mentions his mounting a brown Turkish horse, and placing a wheel lock arquebus at the pummel of the saddle, in the year 1530.

The *Currier*, or *currier of war*, is another species of fire-arm, first noticed in a letter from Lord Wentworth to Queen Mary (see the 'Hardwick State Papers'), while writing respecting the siege of Calais. It is again noticed in the Earl of Essex's operations in Ireland in the time of Queen Elizabeth. (Birch's 'Memoirs.') The earliest account of it is given in a work entitled 'The Knowledge and Conduct of Warres,' printed in 1578. Sir John Smith, in his 'Animadversions on the Writings of Captain Barwick,' describes it as of the same calibre and strength as the arquebus, but with a longer barrel.

Grose observes, that the *Snaphaunce* derived its name from the troops who made use of it. These were a set of marauders whom the Dutch termed *snaphans*, or 'poultry-stealers.' The use of the match-lock exposed them to this inconvenience, that the light from the burning match pointed out their position, and they were unable to purchase the wheel-lock from its expense. In this dilemma they formed the snaphaunce from a study of the wheel-lock. A flat piece of steel, furrowed in imitation of the wheel, was placed on a steel post, which, being screwed beyond the pan, was made moveable. Then the furrowed piece being brought to stand over it, on pulling the trigger, the flint, which they substituted for the pyrites in the cock, struck against it, and the spark was produced. This was an invention of the time of Elizabeth, and its comparative cheapness rendered it fashionable in France, Holland, and England. The snaphaunce was a near approach to the fire-lock.

The *Caliver* differed from the musquet in being lighter and shorter. It was a fire-arm of a regulated standard as to the diameter of its bore, which was larger than that of the arquebus. It was made to fire with a match-lock. A match-lock caliver is preserved at Brancepeth Castle, Durham, which bears the date of 1611.

Of the *Carabine* Sir Samuel Meyrick says, "In the extraordinaries for the war in Picardie, in 1559, we first meet with the troops called carabins, who were light cavalry in the service of Henry II., King of France." M. de Montgommeri informs us that "they wore a cuirass sloped off the right shoulder, that they might the more readily couch their cheeks to take aim; that they had a cabasset on their heads, and their bridle-arms protected by an elbow gauntlet. Their offensive weapons were a carabine three feet and a half in length, so named from themselves and a pistol. Their manner of fighting was, to form a little column deeper than wide, to discharge their pieces rank after rank, each rank, after firing their pieces, wheeling off, and forming immediately in the rear of the rest, and there preparing for a second discharge." Now, although the origin of the word is involved in much obscurity, it is more consistent with analogy to suppose that the carabineers were so named from the gun, rather than that from them. The French derived this species of troops from the Spaniards; and Duetal tells us that the Calabrians, who used the carbine, gave it this appellation. If so, it was probably at first used by them at sea in the vessels termed carabs. M. Bellon, in 'Les Principes de l'Art Militaire,' tells us, that "the carabines were armed with a large wheel-lock arquebus, three feet or more in length, a sword, and a short pistol, in the time of Louis XIII.; but being suppressed by his successor in 1665, we know that that king formed from them his carabineers."

The *Esclopette.* "The peculiar characteristics of this fire-arm," says Sir Samuel Meyrick, "I have not been able to discover. It was called in Latin *sclopeta*, a diminutive of *sclopus;* and occurs in the 'Chronicon Estense,' under the year 1534, as well as in the decree of the Council of Tarragona in 1591, who forbade the clergy to make use of it. Probably it was only the foreign name of the demihaque."

"The name of the *Fusil* as a fire-arm in England," says the same authority, "does not appear to be older than the time of Charles II., though invented in France in the year 1630." There are in the British service three regiments of fusileers or fuzileers: the Scots, now the 21st Foot, raised in 1678; the English, now the 7th Foot, levied in 1685; and the Welsh, now the 23rd, formed in 1688 or 1689. The Sieur de Gaya, in 1688 ('Traité des Armes'), describes it as of the same proportions as the "mousquet," and furnished with a fire-lock; adding, that "although by couching the cheek you can take better aim, yet it often misses fire from the use of the flint." It seems to have been of the same length and calibre, but lighter than the musket. In modern times its size has been diminished.

The *Mousquetoon*, or musketoon, was also of French origin. The same author describes it, in 1688, as not so long as the fusil, nor capable of carrying a ball so far by one-third; its barrel not rifled, but differing from the carabine in being furnished with a fire-lock instead of a wheel-lock, and from the carabine *a l'extraordinaire* not only in this, but in its fluted bore.

The *Fowling-piece*, though properly speaking a fabrication for the sole purpose of killing game, is entitled to a place in the history of military weapons, from the circumstance of the Earl of Albemarle noticing it for the soldiers' use, in his 'Observations,' compiled about the year 1646, and published in 1671. He says, "It is very fit, likewise, that you have in each company six good fowling-pieces, of such a length as a soldier may well be able to take aim, and to shoot off at ease: twelve of them being placed in a day of battel, when you bring a division of foot to skirmish with an enemy, on the flanks of a division of foot, and six on the other flank, as you shall see them placed in these three battels following. Those soldiers that carry the fowling-pieces ought to have command when they come within distance of shot of that division of the enemy that they are to encounter with, that they shoot not at any but at the officers of that division." We have here plainly the origin of riflemen.

The President Fauchet, who lived in the time of Francis I., and that of his successors till the time of Henry IV., introduces to our notice a piece called a *Petronel* or *poitrinal*, because it was rested on the poitrine or chest, after the old manner, and thence fired. It was the medium between the arquebus and the pistol, and differed from the long dag merely in having its butt made broader, so as to rest in its position with proper firmness. Fauchet says, it was believed 'that this arm was the invention of the bandouliers of the Pyrenean mountains.' Mention is made of it in 1592, at the siege of Rouen by Henry IV., and in the Hengrave Inventory of 1603 we have, "Item, iij pethernels." Nicot, in his dictionary, asserts that "it was of large calibre, and, on account of its weight, carried in a broad baudrick over the shoulder."

The *Blunderbus.* This is a fire-arm shorter than the carbine, but with a wide barrel. Sir James Turner, in his 'Pallas armatá,' p. 137, thus describes it: "The carabineers carry their carabines in bandileers of leather about their neck, a far easier way than long ago, when they hung them at their saddles: some, instead of carabines, carry blunderbusses, which are short hand-guns of a great bore, wherein they may put several pistol or carabine balls, or small slugs of iron. I do believe the word is corrupted, for I guess it is a German term, and should be donderbucks, and that is, thundering guns, donder signifying thunder, and bucks a gun." Sir Samuel Meyrick remarks, that Sir James Turner is right in his etymology, except that "bus" and not "bucks" is the term for a gun, a name that became general after its introduction in the word arquebus: the modern German word is büchse. Blunderbus being called in the Dutch language *donderbus*, in all probability it was from Holland that the English derived it: it does not appear to have been much known before the time of Charles II.

The *Dragon.* The troops called dragoons have been most absurdly said to have been so denominated from the Draconarii of the Romans. They were raised about the year 1600 by the Mareschal de Brisac, in order to be superior to the German Reiters, who used the pistol to so much advantage. On this account they had a more formidable weapon, like a small blunderbus, the muzzle of which being ornamented with the head of a dragon, gave it its denomination, and from this weapon those who used it were called dragoneers and dragoons. Other, but less satisfactory, explanations of the term dragoon (with no reference to the fire-arm called a dragon) will be found in Sir James Turner's 'Pallas armatá,' in Pere Daniel's 'Milice Française,' and in Count Bismark. The dragon will be found among Skelton's engraved 'Illustrations.'

The *Hand-mortar* was used for throwing small shells and grenades; though grenades which are said to have been first used in 1594, were also thrown by the hand, and thence gave origin at a later date to the troops denominated grenadiers. Like the dragon it appears to have been fired from the shoulder.

The *Dag.* In pursuing the inquiry into the origin of this term, says Sir Samuel Meyrick, nothing could be more perplexing than to find, that while dag implied a kind of pistol, pistolese, in the Italian language, signified a great dagger, or wood-knife. The weapon appears to have been suggested by the demihaque, and differs from the pistol solely in the form of the butt end, that being invariably terminated by a straight oblique line instead of a knob. In this respect it greatly resembled a petronel, and that it gave the distinction is clear, from what is wrongly called a Highland pistol being by the Highlanders themselves termed a tack, and its having its butt made flat and terminated slant-wise. The dag was of various sizes, and hence in inventories of arms we meet with long, short, and pocket dags, and dags with different kinds of locks. It appears to have been almost coeval with the pistol, which is known to have been invented in the reign of Henry VIII.; for in the inventory, taken in 1547, of stores in the different arsenals in England, "one dag with two pieces in one stock" occurs, with "a white tacke with fier locke graver, and all the stocke white bone; two tackes, after the fashion of a dagger, with fier lockes vernished with redde stockes, shethes covered with blacke vellet garnished with silver and guilt, with purses, flaskes, and touch boxes of black vellet garnished with iron guilt; two tackes hafted like a kniff with fier lockes and double lockes," &c. The snaphaunce dag seems to be alluded to in the play of Jack Drum's entertainment

> "He would show one how to hold the *dag*,
> To draw the cock, to charge and set the flint."

The *Pistol*, according to Sir James Turner, was invented at Pistoia, in Tuscany, by Camillo Vitelli, and in the reign of Henry VIII. M. de la Noue says, "the reiters first brought pistols into general use, which are very dangerous when properly managed." These reiters, or more properly ritters, were the German cavalry, who gave such ascendancy to the pistol as to occasion in France, and subsequently in England, the disuse of lances. We learn this interesting fact from Davila, who, speaking of the battle of Ivry, in 1590, takes occasion to extol the use of lances, and express his regret that the French cavalry, composed of gentlemen volunteers, had, in the revolutions of the civil wars, ceased to use them. He tells us, that in consequence of their having adopted pistols as more ready, in imitation of the German reiters, the king was obliged to oppose the lances of the enemy's cavalry by dividing his own into small bodies, that they might offer less resistance to the charge, and more easily get out of the way. Père Daniel informs us, that the horsemen who were armed with pistols, in the time of Henry II., were thence called pistoliers, a term subsequently introduced into England. John Bingham, in his 'Notes on the Tactics of Ælian,' published in 1616, gives us an engraving of the arms and armour of this species of troops at that time, from which a correct knowledge may be obtained of their form. The first ordonnance of Henry II., king of France, respecting the pistol, is directed to the men at arms, and dated 1549; the regulations of Mary, Queen of England, were of a similar character; both implying that the adoption of the pistol, in the first instance, was by permission. The manual exercise of this weapon is detailed and exhibited in several plates in Captain Cruso's 'Military Instructions for Cavalry,' published in 1632. Sir James Turner, in his 'Pallas armata,' published in 1670, says, the French then used locks with half-bends (snaphaunces), as well as for the most part the English and Scots; the Germans, rose or wheel-locks; the Hollanders used both.

The *Trickerlock*. "A match tricker-lock compleat" occurs in a schedule of the year 1629. This was the adoption of what is now termed a hair-trigger, which was added to the former one, and gives a more instantaneous discharge. A tricker wheel-lock of the reign of Charles I., a tricker match-lock of that of Charles II., and a tricker fire-lock of that of James II., upon this principle, are preserved in Colonel Meyrick's collection of arms and armour at Goodrich Court, in Herefordshire.

The *Fire-lock*. Colonel Meyrick is in possession of a portrait of a republican officer, said to be that of Colonel Joyce, which proves that the modern firelock is an invention as early as the middle of the 17th century, for he has a firelock pistol in his hand. This is important evidence, for it has been shown that the name had been equally applied to the wheel-lock. The firelock was evidently suggested by the snaphaunce. It originated with the French about the year 1635. The steel post on which the furrowed piece had been placed was got rid of, and the furrowed piece set upright and fixed on the cover of the pan. The cock was moved sufficiently near to permit its opening the pan, by the sudden impulse on striking this furrowed piece; performing this operation, and giving fire at the same time. Such a firelock of the time of Cromwell will be found among Skelton's engravings. The term firelock was no longer applied to the fire-arm with the wheel, which was now termed "the rose or wheel-lock."

The *Self-loading Gun* originated in Italy about the close of the English Protectorate. The butt was made to answer the purpose of a flask, and a small touch-box was attached to the pan. At the breach was a cylinder, with a hole to receive the bullet. To the axle of this cylinder was affixed a lever, on turning which the bullet was conveyed to its proper place: sufficient portions of charge and priming were cut off, and the piece cocked at the same time. This, therefore, rendered the firelock just described as expeditious as the long-bow; but the contrivance was attended with great danger, and occasioned the subsequent inventions of a moveable or revolving breach composed of several cylinders, each containing a charge; or a small barrel to be brought to the breach when requisite to load, &c. Though none of these contrivances were ever adopted by infantry regiments, yet some of them were extremely ingenious, being a very close approach to our modern revolver pistols.

In 1712, a brass fire-arm called the *Fancy gun* was invented. It was in the shape of a walking-cane, and might be used as a gun or pistol; but it was never used for military or even general purposes.

Musket-Arrows, sometimes called fire-arrows, are at least as old as the time of Queen Elizabeth. They occur in the inventories of the royal arsenals. Sir Richard Hawkins, in the account of his voyage to the South Sea in the year 1591, speaks of using them with great success. In Elizabeth's time, these arrows, which carried combustibles, were of wood; at a subsequent period they were made of iron. Arrows of this latter kind were used in the Civil Wars, at the siege of Lyme. Lord Bacon says the arrows shot by muskets were called sprights.

The *Match-box*. One great inconvenience, says Sir Samuel Meyrick, of the burning match was, that it discovered the soldier on guard, and counteracted the necessary secrecy for enterprises by night. To remedy this defect, small tubes of tin or copper, pierced full of holes, were invented by a Prince of Orange, apparently Prince Maurice. They are thus described by Walhuysen, a captain of the town of Danzig, in his 'Art Militaire pour l'Infanterie,' printed in 1615: "It is necessary that every musqueteer should know how to carry his match dry in moist or rainy weather, that is, in his pocket or in his hat, by putting the lighted match between his head and hat, or by some other means to guard it from the weather. The musqueteer should also have a little tin tube, of about a foot long, big enough to admit a match, and pierced full of little holes, that he may not be discovered by his match, when he stands sentinel, or goes on any expedition." This was the origin of the match-box, till lately worn by our grenadiers on one of the cross belts in front of their chests.

The *Powder-horn* and *Flask*. The convenient form of the horn to hold gunpowder, one end being broad, into which it might be conveyed with ease, and the other with a small aperture by which it might be discharged into the barrels of fire-arms, naturally suggested it as best adapted for the purpose. But it was not long before the narrow end was entirely closed, and the broader one furnished with a tube that might contain just sufficient power for one charge. In this state it appears suspended in front from the necks of the arquebusiers in the triumph of Maximilian I. This modification of the powder-horn suggested the more capacious flask, which, with its name, in reference to its resemblance to a bottle, is of German origin. The flask was known in England as early as the reign of Henry VIII., and appears on a hackbutter of that date in one of Strutt's engravings, taken from an original drawing in the British Museum, suspended like the horn, but at the hip, instead of on the breast. So in the inventory, taken 1 Edward VI., we have "One horne for gonne-powder, garnished with silver. Three grete flaskes covered with vellet, and three lytle touch boxes." And in that at Hengrave, "xxiiij flaskes, and as many tootche boxes." M. Montgommeri Corbosson, in his 'Treatise on the French Army' in the time of Henry IV., informs us that "the captain of a company, mounting guard, ought to carry an arquebuse and a powder-flask, and wear on his head a great plume of feathers." Varieties of powder-horns and flasks will be found in Skelton's engravings.

The *Touche-box*. Gunpowder was at first not corned; when, however, it had been manufactured into granules, such as were considered proper for the charge, it was discovered that the finer these were made the quicker would they ignite. This was the origin of priming or serpentine powder, and consequently of a small case to hold it, which is in reality a flask on a smaller scale, to which the name given was touche-box.

Bandoliers. To enable the soldier to load his piece with greater rapidity, small cylindrical boxes, each containing one charge of powder, either of wood or tin, and covered with leather, were suspended to a belt or band, put either over the shoulder or fastened round the waist. They seem to have been first introduced in the reign of Henry III. of France. The earliest instance which Sir Samuel Meyrick met with of the bandolier was in Montfauçon's 'Monarchie Françoise,' pl. ccxciv.; Davis, in his 'Art of War,' he says, would induce the belief that the English received them from the Walloons in the neighbourhood of Liege. Sometimes six were placed before, and six behind the person, when slung over the shoulders; sometimes more. Nine are suspended to a waist-belt in Col. Meyrick's collection. Immense numbers still remain at Hampton Court. Sir James Turner, who published his work in 1670, says they were first laid aside about thirty years before by the Germans. Soldiers who were without cloaks could not keep them from snow and rain, which soon spoiled them and made the powder useless; and in surprisals, the noise which they made betrayed those who carried them.

The *Cartridge*. Sir James Turner, speaking of the pistol, says, "all horsemen should always have the charges of their pistols ready in patrons, the powder made up compactly in paper, and the ball tied to it with a piece of packthread." In this description we have evidently the cartridge, though not expressed by name. It is a curious fact that these were first confined to the cavalry, and that the general adoption of the cartridge was not earlier than the common use of the modern firelock. Lord Orrery, in his 'Treatise on the Art of War,' says, "I am, on long experience, an enemy to the use of bandeleers, but a great approver of boxes of cartridges, for then, by biting off the bottom of the cartridge, you charge your musket for service with one ramming. I would have these cartridge-boxes of tin, as the carabiners use them, because they are not so apt to break as the wooden ones are, and do not in wet weather, or lying in the tents, relax. Besides, I have often seen much prejudice in the use of bandoleers, which, being worn in the belts for them above the soldiers' coats, are often apt to take fire, especially if the matchlock musket be used; and when they take fire, they commonly wound and kill him that wears them, and those near him; for likely, if one bandoleer take fire, all the rest do in that column; they often tangle those which use them on service, when they have fired, and are falling off by the flanks of the files of the intervals to get into the rear to charge again."

The *Patron* was an upright semi-cylindrical box of steel, with a cover moving on a hinge, filled with a block of wood with five perforations to hold as many pistol-cartridges. Skelton has engraved some of Elizabeth's time, and in the 'Diversarum Gentium Armatura Equestris,' printed in 1617, the German cavalry are represented with a brace of pistols in the same holster at the saddle-bow, and patrons at their hips.

The *Sweynes-feather*, and *Musket-rest*. To remedy the inconvenience of a musketeer's being compelled to draw his sword, and to defend himself after the discharge of his piece, and to render him more competent to act against the pikemen, a long thin rapier blade, fixed into a handle, and carried in a sheath called a sweynes-feather, that is, hog's bristle, the invention of which is by its other name attributed to the Swedes, was given him instead. This, after a discharge, he drew out of its scabbard, and fixed into the muzzle of his gun, which gave him a weapon of great length; but as the soldier had then more to carry in his hand than previously, an attempt was made to unite the sweynes-feather with the rest. This latter, instead of having a wooden shaft simply, was made of a thin tube of iron, covered with leather, which held within it the feather. Thus it was preserved from rain, and when wanted, it could be ejected by a jerk. The sweynes-feather was invented in the reign of James I. During the civil wars, its name was sometimes corrupted into swan's feather. One of the musket-rests, armed with a projecting pike from one of the prongs of its fork, is represented in Grose's 'Treatise on Ancient Armour,' pl. xl. fig. 5. The Duke of Albemarle, in his 'Observations upon Military and Political Affairs,' written in 1646, and printed in 1675, recommends arming musketeers and dragoons with muskets and sweynes-feathers, with the heads of rests fastened to them. The rests themselves were apparently disused about the middle, or toward the latter end of the civil wars, the weight and incumbrance of the musket and its apparatus being probably found too great for the active service inseparable from campaigns carried on by small detachments.

The *Bayonet*. Sir Samuel Meyrick observes, that as the sweynes-feather was laid aside when the rest which contained it was relinquished, the musketeers were reduced to the same inconvenience as they experienced before it had been invented. To resume the simple sweynes-feather was not deemed expedient, as from its length it was extremely awkward to manage, and pikemen were a species of troops that had become disused. This induced such soldiers as were armed with daggers to stick them into the muzzles of their pieces after having fired. In this practice we have the origin of the bayonet, which was so termed from having been first made at Bayonne. The French called them bayonet à marche, and first introduced them into their army in 1671. These were formed with plain handles, formed to fit tight into the muzzles, rather enlarging towards the blade to prevent their entering too far into the piece. Subsequently a ring was added, by which it was placed on the muzzle, in which way the French used it in the reign of William III., to the astonishment of the 25th regiment of foot, on whom they poured a volley, halting in their charge.

The arms at present used will be described under their respective heads MUSKET; RIFLE; &c., and the arming of the various branches of the service under INFANTRY; CAVALRY; &c.

Besides the authorities quoted in this article, Grose's 'Military History;' Strutt's 'Manners and Customs,' and the various authors quoted by them, may be referred to.

ARMS, COATS OF. [HERALDRY.]

ARMS, STAND OF, means the complete set of arms for one man, namely, musket and bayonet, belts, cartridge-box, &c.

ARMY, THE ENGLISH. The word *army* is derived from the French *armée*, from which language many of our military terms are taken. It is applied to an armed, and more or less disciplined, body of men. An army is defined by Locke to be a collection of armed men obliged to obey one man. There are, however, various definitions given by writers on the Law of Nations.

The word army is not used to designate a single regiment or battalion, or any small body of armed men. An army is a large body of troops of all arms, accompanied by their trains of stores and materiel, divided for the purposes of organisation into divisions, brigades, and regiments, each under its own special commander, and having officers of various descriptions to attend to all that is necessary to make the troops effective when in action; the whole body being under the direction of some one commander, and moving according to his orders. This officer is called the commander-in-chief, the general, and sometimes, as when two or more allied armies are under the chief direction of one of the generals, the generalissimo.

We may briefly explain why we limit this article to a sketch of the origin of the English army, without including, as is sometimes done in similar works, an historical sketch of the armies of ancient nations. The armies of Greece, Rome, and the ancient Oriental nations, were, owing to various causes, different from those of modern Europe, and the consideration of their true character belongs to the history of those nations. From the impossibility of saying anything satisfactory within reasonable limits, and also from a desire to avoid the errors which we observe in all short sketches of this description, we have, under such heads as GREEKS, ROMANS, EGYPTIANS, &c., noticed their military system, so far as it possesses a distinct character.

The history of the armies of continental Europe, as, for instance, that of Prussia, is inseparably connected with the political history of each state, and has been treated under those heads in the GEOG. DIV. of ENG. CYCL. For other particulars connected with the formation of an army, see ENLISTMENT, RECRUITING, SOLDIER, and also MILITIA.

The whole military force of a nation, comprising its regular or standing army, militia, and volunteers, is sometimes called its army, though generally this term is confined to its standing army. In another sense, an army is a detachment from the whole collected force; a number of regiments sent forth on a particular expedition under the command of some one person who is the general for that especial purpose. Instances of this latter sense of the word occur in the expressions 'Army of Italy,' 'the Army of Spain,' &c., as formed by Napoleon. Such a detachment may be a large or a small army; and should it return with its ranks greatly thinned and without many of its officers, it would still be an army, if the distribution into divisions and regiments remained, though actually consisting of not more than a single regiment with its full complement of men and officers. In this state it is sometimes not inaptly called the skeleton of an army.

An army is the great instrument supported by a nation and placed in the hands of its government, by which in the last extremity it maintains the constitution at home by enforcing obedience to its laws, and supports the honour of the country abroad, by defending its rights against any powers which may show a disposition to encroach on them. When the efforts of the ministers of peace and justice are inadequate to enforce submission to the laws; when the correspondence of cabinets and the conferences of ambassadors fail in composing disputes which arise among nations, the army is that hand of power which is then legitimately put forth. This powerful engine has, however, but too often been used for baser purposes; not only for aggression and unprovoked attacks against the liberties of other countries, but, when in the hands of unprincipled men, for the subversion of the constitution and liberties of their own countries. Thus was it in Rome in ancient, and France in modern, times; and thus will it always be, when the ranks, from which its officers are recruited, have no stake in the country, and being dependent solely on their profession, become a separate caste without community of interest with the rest of the nation.

The legitimate purposes for which an army is maintained are manifestly so important to the well-being of a state, that attention must have been directed to this subject in the very beginning of political society. But to have an army always appointed and always ready for the field can only be effected in a comparatively high state of civilisation, when the whole machinery of state is well organised, by maintaining a regular or standing army as distinguished from a militia which is capable of being called out merely for a temporary exigency. No better proof can be afforded of the high civilisation of Egypt and other countries in early times than the well-appointed and powerful armies which they were able to bring into the field. This was effected in Egypt by having a particular caste or class of soldiers, corresponding pretty nearly to the Kshatriyas of India. (See Herod. ii. 164, &c.) The army raised by Sesostris seventeen centuries before our era, which is the earliest military establishment of which we have any record, is stated by Diodorus Siculus, to have been composed of 600,000 infantry, 24,000 cavalry, and 27 war chariots, though this is probably an exaggerated estimate, if one may judge from the size and population of the country. The armies of the Greeks, especially in the post-Alexandrine period, those of Carthage under the command of Hannibal, and the armies of Rome in the best days of the Republic and the Empire, were not inferior to any of modern times in numbers, appointments, discipline, or the military skill of their commanders, and were essentially standing armies. It is not, however, to them that we are to trace the origin or the history of our modern armies.

An army, meaning by that term a body of men distinct from the rest of the nation, constantly armed and disciplined, was unknown to the remote fathers of the English and the other modern European nations. The whole male population was the army; that is, every person learned the use of arms, was ready to defend himself, his family, and his possessions; and in time of common danger, to go out to more lasting warfare under the command of some one chief chosen from amongst the heads of the tribes. Such was the nature of the vast armies which presented themselves from time to time on the Roman frontier, or contended against Cæsar when he made his conquest of Gaul; and such was the power which, on so short a warning, was arrayed against him on the British coast under the command of Cassibelaunus, when he made that descent from which neither honour accrued to the Roman arms, nor benefit to the Roman state. In all these nations the warlike spirit was kept up by the sense of danger, not so much from foreign invaders, as from neighbouring and kindred tribes.

In the writings of Cæsar and of Tacitus, the two authors from whom we derive our best acquaintance with the manners and habits of the Germanic and the western nations of Europe, we see the warlike character of those nations, and the principles on which their military affairs were conducted. A whole male population trained to arms; confederating in time of common danger under some one chief; with little defensive armour, and none offensive but darts, spears, and arrows; throwing up occasionally earth-works to strengthen a position —this is the outline of their military proceedings. (Tacit. 'Annal.' ii. 14.) There is little peculiar in the military system of the ancient Britons; yet it must have been by long practice and perseverance that the warriors attained that skill which attracted the attention of Cæsar. His description of one of their chariots, driven by a charioteer whose attention was solely directed to the management of the chariot, while in it stood the painted warrior dealing his darts around him, or running along the beam while the chariot was in its swiftest motion, presents an object at once picturesque and terrible.

When Britain was reduced to the form of a Roman province, a regular army was introduced and permanently settled in the island, for the purpose of enforcing submission, and of defence against foreign invaders. Almost all the remains of Roman authority in Britain, as roads, walls, encampments, and inscriptions, are military. In that curious relic of Roman time, the 'Notitia,' which is referred to the age of the Roman emperors, Arcadius and Honorius, we have a detailed account of the distribution of the whole Roman army, and we see, in particular, how Britain was then divided for military purposes, and what were the fixed stations of the various portions of the Roman legions.

It was the policy of Rome to recruit her legions from among the barbarous nations, but to employ such soldiers in countries to which they were foreign. Thus, in the inscriptions relating to military affairs which have been found in England, many tribes of Gaul, of Spain, and Portugal, are named as those to which particular soldiers or particular bodies of troops belonged. And so in foreign inscriptions the names of British tribes are sometimes found. The grounds of this policy are apparent. The military portion of these nations was thus drawn away. There remained only the quiet and the peaceable, or the females, the young, the infirm, and the aged. As long as the Roman army was sufficient for their protection, it was well. But when that army was withdrawn, we see, as in the case of Britain, that a people so weakened easily fell a prey to nations which had never been subdued by the Roman arms, and we see also what was probably the true reason of the difference between the spirited resistance which was made to Cæsar on his two landings in Britain, and the clamorous complaint and feeble resistance with which the people of Britain met the Picts and the Saxons.

From this time we lose sight of any entire British population of the part of the island called England. The conquests made by the Saxons appear to have been complete, and their maxims of policy and war became the principles of English polity. They seem to have been at first in that state of society in which every man is a soldier; and the different sovereignties which they established were the occasion of innumerable contests. We have, however, but little information on this subject; and even the supposed policy of Alfred in the separation of a portion of the people for military affairs, in the form of a national militia, is a part of his history on which we have not any very satisfactory information.

We find, however, that the Saxon sovereigns had powerful armies at their command; and the most probable account of the mode in which they were got together seems to be this:—the male population were exercised in military duties under the inspection of the earls, and their deputies the sheriffs or vicecomites, in the manner of the arrays and musters of later times; being drawn out occasionally for the purpose, and being thus ready to form, at any time when their services were required, an efficient and powerful force.

In the year 1017 Canute became king of England, and established the first regular army of which we have any record in the middle ages. Hallam states ('Middle Ages,' vol. i. ch. 2, part 2) that he is unaware of any instance of what may be called a regular army (unless we consider the Antrustions of the Merovingian kings as such), more ancient than the body guards, or huscarles of Canute the Great. These select troops amounted to six thousand men, on whom he probably relied to ensure the subjection of England. A code of martial law, compiled for their regulation, is extant in substance; and they seem to have displayed a spirit of military union of which their master stood in awe. A singular story is told, which, if false, still illustrates their traditionary character. Canute having killed one of their body in a fit of anger, it was debated whether the king should incur the legal penalty of death; and this was only compromised by his kneeling on a cushion before the assembly, and awaiting their permission to rise. (Hallam's 'Middle Ages,' note, vol. i. ch. 2, part 2.)

The next remarkable instance of a mercenary army is that of William the Conqueror; and we see from that curious remain of those times, a piece of needlework representing the wars and death of Harold, that the Saxon soldiers were not those half-clothed and painted figures which had presented themselves on the shores of Britain when the Roman armies made their first descent. We see them clothed from head to foot in a close-fitting dress of mail. They have cavalry but no chariots. The archers are all infantry. Both infantry and cavalry are armed with spears, to some of which little pennons are attached. Some have swords, and others carry bills or battle-axes. They have shields, the bosses on which are surrounded with flourishes and other ornaments; and there are sometimes other devices, but nothing which can be regarded as more than the very rudiments of those heraldic devices which were afterwards formed into a kind of system by the heralds who attended the armies, and by which the chiefs were distinguished from each other, when their faces were concealed by their vizors. The piece of needlework representing the wars of Harold is supposed to be the work of Matilda, the queen of William the Conqueror, and the ladies of her court. It is preserved in the cathedral of Bayeux, whence it is commonly called the Bayeux tapestry. [Bayeux Tapestry.]

In the 9th century a great change took place in the military policy of Europe. Feudal military tenures succeeded that earlier system of public defence which called upon every man, and especially every landholder, to protect his country. The hordes of barbarians, who, issuing from Germany, had spread over Europe and overthrown the Western Empire, had divided the greater portion of the conquered lands among themselves. And each allotment was given as a reward for, and was held on condition of, military service under the chief or lord of whom the land was immediately held. To him fealty was sworn, and whenever called upon the holder was obliged to follow him to the field. Hence arose the feudal system. An aggregation of petty sovereignties; the lords with trains of vassals constantly making war on one another and owing but little obedience to their sovereign, to whom they in their turn had sworn fealty, unless he happened to be powerful enough to enforce it.

At the conquest this feudal system was introduced into England with this remarkable difference: "By the leading principle of feuds, an oath of fealty was due from the vassal to the lord of whom he immediately held his land, and to no other. But William received at Salisbury, in 1085, the fealty of all landholders in England, both those who held in chief and their tenants." (Hallam, vol. ii. ch. 8, part 2.) Thus placing the army far more under his own control. William, reserving certain tracts as his own demesne, distributed the greater portion of England among his followers, to hold by military service; that is, for every knight's fee, as it was called, the tenant was bound to find the king one soldier ready for the field, to serve him for forty days in each year. The extent of the knight's fee varied with the varying qualities and value of the soil. In the reign of Edward I. the annual value in money was 20*l*. The number of knights' fees is said by old writers to have been 60,060. The king had thus provision made for an army of 60,000 men, whom he could call at short notice into the field, subject them when there to all the regulations of military discipline, and keep them for forty days without pay, which was usually as long as their service would be required in the warfare in which the king was likely to be engaged. When their services were required for any longer time, they might continue on receiving pay.

Writs of military summons are found in great abundance in what are called the 'Close Rolls,' which contain copies of such letters as the king issues under seal. But this system, it is evident, had many inconveniences; and the kings of England had a better security for the protection of the realm against invasion and for the maintenance of internal tranquillity, in that which seems to be a relic of Saxon polity. We allude to the liability of all persons to be called upon for military service within the realm; to the power which the constitution gave to the sheriff to call them out to exercise, in order that they might be in a condition to perform the duty when called upon; and to the obligation which a statute of Edward I. imposed on all persons to provide themselves with certain pieces of armour, which were changed for others by a statute of James I. We see in this system at once the practice of our remoter ancestors, and the beginning of that drafting of men to form the county militia which is a part of the military polity of the country at present.

The sheriffs were the persons to whom the care of these affairs was committed; but it was the practice of the early kings to send down into the several shires, or to select from the gentry residing in them, persons whose duty it was to attend the musters or arrays, which were a species of review of these domestic troops, and who were intended, as it seems, to be a check upon the sheriffs in the discharge of this part of their duty. The persons thus employed were usually men experienced in military affairs; and when the practice became more general, there was a permanent officer appointed in each county, who had the superintendence of these operations, and was called the lieutenant: this is the origin of the present lord-lieutenant of counties, an officer who cannot be traced to a period earlier than the reign of Henry VIII.

Foreigners were also sometimes engaged to serve the king in his wars; but these were purely mercenary troops, and were paid out of the king's own revenues.

We see then that the early kings of England of the Norman and Plantagenet races had three distinct means to which they could have recourse when it was necessary to arm for the general defence of the realm: the quota of men which the holders of the knight's fees were bound to furnish; the posse-comitatûs, or whole population, from sixteen to sixty, of each shire, under the guidance of the sheriffs; and such hired troops as they might think proper to engage. But as the posse-comitatûs could not be compelled to leave the kingdom, and only in particular cases the shire to which they belonged, the king had only his feudal and mercenary troops at command when he carried an army to the Continent, or when he had to wage war against even the Scotch or Welsh. We are not to suppose that troops so levied, especially when there were but contracted pecuniary resources for the hiring of disciplined troops of other nations, would have been sufficient to make head against the power of such a sovereign as the king of France, and once to gain possession of that throne. And this leads us to the next great innovation, marking the third period in the military history of England; for about the 13th century mercenary troops were substituted for the feudal militia.

The mutual inconveniences attendant on the nature of the military services due from those who held the feudal tenures of the crown naturally disposed both parties to consent to frequent commutations. Money was rendered instead of service, and thus the crown acquired a revenue which was applicable to military purposes, and which was expended in the hire of native-born subjects to perform service in the king's armies in particular places and for particular terms. The king covenanted by indenture with various persons, chiefly those of most importance in the country, to serve him on certain money-terms with a certain number of followers, and in certain determinate expeditions. There appears little essential difference between this and the modern practice of recruiting armies. It was chiefly by troops thus collected that the victories of Creci, Poictiers, and Agincourt were gained.

In the office of the Clerk of the Pells in the Exchequer, Dugdale perused numerous indentures of this kind, and has made great use of them in the history which he published of the Baronage of England. A few extracts from that work will show something of the nature of these engagements.

Michael Poynings, who was at the battle of Creci, entered into a contract with King Edward III. to serve him with 15 men-at-arms, 4 knights, 10 esquires, and 12 archers, having an allowance of 21 sacks of the king's wool for his and their wages. Three years after the battle of Creci, King Edward engaged Sir Thomas Ughtred to serve him in his wars beyond sea, with 20 men-at-arms and 20 archers on horseback, taking after the rate of 200*l*. per annum for his wages during the continuance of the war. In the second year of King Henry IV., Sir William Willoughby was retained to attend the king in his expedition into Scotland, with 3 knights, besides himself, 27 men at arms, and 169 archers, and to continue with him from June 20th to the 13th of

September. When Henry V. had determined to lead an army into France, John Holland was retained to serve the king in his 'voyage royal' into France for one whole year, with 40 men at arms and 100 archers, whereof the third part were to be footmen, and to take shipping at Southampton on the 10th of May next following. At the commencement of the 15th century, we find mentioned in Rymer a contract of the Earl of Salisbury, to supply a body of troops for the war in France, consisting of 600 men at arms, including 6 bannerets, 34 bachelors, and 1700 archers. The pay was, for the earl, 6*s.* 8*d.* a-day; banneret, 4*s.*; bachelor, 2*s.*; every man at arms, 1*s.*; and every archer, 6*d.* Artillerymen were paid higher than men at arms. This is equal to about fifteen times the sum at our present value of money. They were however bound to furnish their own equipment and horses. In the 12th of Henry VII., John Grey was retained to serve the king in his wars in Scotland, under the command of Giles, Lord Daubeney, captain-general of the king's army for that expedition, with 1 lance, 4 demi-lances, and 50 bows and bills, for 290 miles; with 1 lance, 4 demi-lances, and 50 bows and bills, for 266 miles; and with 2 lances, 8 demi-lances, and 200 bows and bills, for 200 miles. These were nearly half what is now the usual complement of a regiment.

Troops thus levied, together with foreign mercenaries, are a near approach to, though they can hardly be considered as, a regular or standing army in the modern acceptation of the word. The king might, to the extent of his revenue, form an army of this description; but as to the other means of military defence or offence put into his hands, the persons engaged were only called into military service on temporary occasions, and soon fell back again into the condition of the citizen or agriculturist. But the king's power was necessarily limited by his revenue, and the maintenance of a permanent force appears to have been little regarded by our early sovereigns, since, before the reign of King Henry VII. it does not appear that the kings had even a body-guard, much less any considerable number of troops always prepared for service. About the year 1450, Charles VII. of France established his companies of ordonnance; they consisted of about 9000 soldiers, all cavalry, of whom 1500 were heavy armed: a force not very considerable, but yet stated by Hallam to be the first, except mere body-guards, which had been raised in any part of Europe as a national standing army. From this we may date the fourth period in the military history of Europe, and of England also. Chivalry began to decline; and in the 16th century the importance of infantry was fully established by the Milanese wars of Louis XII. and Francis I., and caused the general employment of pikemen and musketeers.

The policy of standing armies was gradually imitated by the other European states, and has now become a matter of necessity and of self-defence. In England, probably in a great degree owing to her insular situation, this took place later than in most Continental countries. Still, the example of the Continental states, a sense of the great convenience of having always a body of troops at command, and the change in the mode of warfare effected by the introduction of artillery, which brought military operations within the range of science, and made them more than before matters which required much time and study in those who had to undertake the direction of any large body of men, disposed the king and the nation generally to adopt the practice of having a permanent army, varying in numbers with the dangers and necessities of the time.

The few troops who formed the royal guard were the only permanent soldiers in England before the civil wars. The dispute between Charles I. and his parliament was about the command of the militia. Charles II. kept up about 5000 regular troops as guards, and to serve in the garrisons which then were established in England. These were paid out of the king's own revenue. James II. increased them to 30,000; but the measure was looked on with great jealousy, and the object was supposed to be the destruction of the public liberties of Englishmen. In the Bill of Rights (1689) it was declared that the raising or keeping a standing army within the kingdom, in time of peace, unless it be with consent of Parliament, is against law; and this continues to be the preamble of the Mutiny Acts to the present day. An army varying in its numbers has ever since been maintained, and is now looked on without apprehension. It is raised by the authority of the queen, and paid by her; but there is an important constitutional check on this part of the royal prerogative in the necessity for Acts of Parliament to be passed yearly, in order to provide the pay and to maintain the discipline.

The present regular army of England is maintained by voluntary enlistment, and is composed of cavalry, infantry, artillery and engineers, and a military train. Attached to the army are the following departments:—the Commissariat and Medical (including Purveyors and Veterinary departments), Field Train, Military Store, and Barrack departments.

By the English constitution, the sovereign is the supreme head of the army, from whom alone it receives all orders, and by whom all promotions are made and all honours and rewards conferred, all commissions being under her sign manual. This authority is in part delegated to the commander-in-chief, who has the general superintendence of the organisation and discipline of the army, whilst the general superintendence of the War department is under the secretary of state for war, who is answerable to Parliament, and is responsible for the finances, &c.

Of the English army, besides that which is distributed in the various colonies, a large portion is employed in India, and whilst there is paid out of the finances of that country; in addition to which, the Indian army, consisting of cavalry, infantry, artillery, engineers, &c., formerly raised and paid by the East India Company, is now transferred to the queen, and is called 'The Queen's Army for Service in India.'

The following tabular view of the military force of the various civilised nations is from the 'Almanach de Gotha' for 1859, with some few corrections:

MILITARY ESTABLISHMENTS ON FOOT AND IN RESERVE. 1857, 1858.

	Estimated Population.	Army.	Reserve Militia and National Guard.
America, United States of, 1857	27,797,403	15,764	2,125,358
Austria, pop. 1854, army 1858, peace establishment of, being raised from the reserve to between 700,000 and 800,000	39,411,309	400,000	
Baden, pop. 1852	1,356,943	7,691	6,976
Bavaria, pop. 1855, army 1858	4,541,556	88,227	157,924
Belgium, pop. 1856	4,529,461	74,318	27,131
Brazil, pop. 1856	7,677,800	22,586	26,000
Denmark, pop. 1858	2,650,000	45,138	
Egypt, pop. 1857	2,895,550	21,000	
France, pop. 1856, army 1859	36,039,364	320,000	
,, Foreign possessions	3,506,218	93,000	
,, Rome		9,000	
Great Britain, pop. 1857, army 1858	28,416,056	222,874	
,, E. Indies, native troops (1857)	187,515,148	263,949	
Greece, pop. 1855	1,045,232	9,686	
Hanover, pop. 1855	1,819,777	26,938	
Netherlands, pop. 1858	3,523,823	58,495	
,, Foreign possessions	16,536,761		
Papal States, pop. 1857, army 1858	3,126,263	15,255	
Portugal, pop. 1854, army 1858	3,499,121	25,194	4,996
,, Foreign possessions	2,756,379	8,528	*9,572
Prussia, pop. 1855, army 1857	17,202,631	261,000	50,731
Russia, pop. 1851, army 1858	65,237,437	577,859	243,862
Sardinia, pop. 1857, army 1858	5,167,542	47,915	
Saxony, pop. 1855, army 1858	2,039,075	25,396	
Sicilies, Two, pop. 1856	9,117,050	92,586	
Spain, pop. 1857, army 1858	16,301,851	200,401	
,, Foreign possessions	4,528,633		
Sweden and Norway, 1855	5,131,647	15,313	129,330
Switzerland, 1850	4,392,740	72,000	36,000
Tuscany, 1858	1,793,967	17,206	
Turkey, pop. 1844, army, ending 1855	32,250,000	105,325	103,827
Würtemberg, 1856	1,788,720	9,893	12,136

The following table is added to show the numbers of the standing armies of the principal European States relatively to their respective populations:—

Bavaria	1	in every	54	inhabitants.
Denmark	1	,,	58	,,
Netherlands	1	,,	60	,,
Belgium	1	,,	61	,,
Switzerland	1	,,	61	,,
Prussia	1	,,	66	,,
Hanover	1	,,	68	,,
Saxony	1	,,	80	,,
Spain	1	,,	81	,,
Austria	1	,,	98	,,
Sicilies	1	,,	98	,,
Tuscany	1	,,	104	,,
Greece	1	,,	107	,,
Sardinia	1	,,	109	,,
France	1	,,	112	,,
Russia	1	,,	112	,,
Great Britain	1	,,	127	,,
Egypt	1	,,	138	,,
Portugal	1	,,	139	,,
Baden	1	,,	176	,,
Würtemberg	1	,,	181	,,
Papal States	1	,,	205	,,
Turkey	1	,,	306	,,
Sweden and Norway	1	,,	335	,,
Brazil	1	,,	340	,,
United States of America	1	,,	1761	,,

ARNICIN. The non-azotised, bitter principle of arnica flowers, *Arnica montana.* It has not been investigated.

ARNOTTO (*Annatto*). A pasty colouring matter obtained from the seed-pulp of the *Bixa Orellana*, a plant found in the West Indies. The colouring matter is prepared by kneading the pulpy seeds in warm water; the liquid is then passed through fine sieves, evaporated to the consistence of a stiff paste, and lastly dried in the shade. It is afterwards made into small cheese-shaped cakes, which soon become yellow outside, but retain a red-brown colour within. According to John, it contains 28 per cent. of coloured resin, 20 of coloured extractive matter, 26 of gum, and 20 of vegetable fibre, together with free acid, and an aromatic substance to which the peculiar odour of arnotto is due. Chevreul describes two colouring matters in arnotto; one yellow, soluble in water and alcohol; and another red, soluble in alcohol, and slightly so in water. Caustic alkaline solutions are tinged of a dark orange colour by arnotto. Alum and protosulphate of iron give orange yellow precipitates in decoction of arnotto, whilst protochloride of tin gives a lemon-yellow precipitate.

Arnotto imparts an orange colour to wool, cotton, and silk; but its use is now chiefly confined to silk-dyeing. The colour is brilliant, but fugitive. It is also employed to colour cheese and butter, and to impart an orange-yellow colour to varnishes, oils, tinctures, &c.

The Arnotto of commerce is brought to us from South America. It is moderately hard, brown on the outside, and of a dull red within. It comes in cakes of about two or three pounds weight each, and is generally enveloped in large flag-leaves previous to being packed in casks. It this state it receives the name of "flag arnotto," to distinguish it from another preparation which is a harder and more concentrated extract from the fruit-pods of the same plant, and which contains a larger proportion of colouring matter than flag arnotto. This superior description, of which but little is imported, is known as "roll arnotto.' The liquid sold under the name of Nankin dye—now, by the fluctuations of fashion, little used in England—is a solution of arnotto in potass and water. A solution is also sometimes made in alcohol, which is used for lacquering and by varnishers.

It is believed that the method employed for making this extract in the country of its production, which is by the application of a high degree of heat in combination with a process of fermentation, is injurious to its colouring properties: an opinion which is confirmed by the fact of the superiority of the colouring matter when procured from the fresh pods. There is reason to suppose that means might be used for precipitating the colouring matter without subjecting it to so great a risk of carbonisation by heat as it is usually made to undergo, and without having recourse to the process of fermentation. Some experiments made with this view by Vauquelin seem to confirm this supposition.

AROMATICS are agents obtained from the vegetable kingdom, exercising a peculiar influence over the digestive powers, and possessed of more or less odour or fragrance. Of this odour, by which they can at all times be recognised, the most usual vehicle is an essential or volatile oil, as stated in the article AROMA, in NAT. HIST. DIV. Indeed volatile oil exists in all aromatic plants, and in every part except the cotyledons, save in the nutmeg and a very few other seeds; but this aromatic oil does not reside in the same part in every kind of plant. In umbelliferous plants we find it mostly in the fruits (and chiefly in the *vittæ* of them), yet in angelica, celery, and parsley it is diffused through the whole structure. Labiate plants, such as mint, balm, rosemary, and lavender, have it in the leaves and stem; cinnamon in the bark; all terebinthinate plants in their young branches. The *Iris florentina* (orris) and others have it chiefly in the root; the *Scitamineæ* equally in the root (ginger) and the seeds (cardamoms); the rose and chamomile have it in the petals; yet it is not equal in all the petals of the chamomile, being greatest in the yellow florets of the disk: hence, doubling the flowers of the chamomile, by which the yellow florets of the disk are diminished, and the white florets of the ray increased, lessens the virtues of the flowers.

The power of medicines is frequently judged of by their sensible qualities; that is, by the impression which they make on the organs of smell and taste; aromatics affect both of these senses in a very perceptible and sometimes extraordinary manner. Scarcely any one is insensible to the odour of particular flowers, and some are affected by them to an extraordinary degree. The approach to Ceylon can be determined by the fragrance of the air, at the distance of many miles; the *Magnolia glauca* (beaver-tree or swamp magnolia) diffuses an odour by which it can be recognised at the distance of three miles among the swampy districts and consequently moist atmosphere in which it grows. This powerfully affects many persons while travelling or hunting; and the *Magnolia tripetala* causes sickness, headache, and an aggravation of fevers or rheumatism, among those near it who are labouring under these complaints. The odour of the jonquils and other fragrant plants raised in Holland is so great when brought into a room or close apartment as to be quite overpowering. In such countries or places as have a very humid atmosphere, the odour of plants is most readily diffused as well as most potent; of this we may satisfy ourselves by calling to mind the greater fragrance of flowers early in the morning, in the evening, or after a shower. This accounts for the violent action of the plants in the countries just mentioned; but even many plants of Britain affect some individuals, endowed with a peculiar and excessive sensibility, to an extreme degree. The sweet-scented violet has such an effect on certain persons as to occasion headache, convulsions, and apoplexy. (See Triller, 'Dissertatio de Morte Subita ex nimio Violarum Odore.')

Aromatics are seldom applied to the organ of smell for the purpose of influencing the system in a remedial manner, except in the form of aromatic vinegar, in threatened or actual fainting; we shall therefore proceed to consider their action upon the palate and stomach. As all aromatics contain volatile oil, their action is generally referred to this principle; but there cannot be a doubt that the more fixed principles which they contain contribute greatly to their effect. Volatile oils, when separated, act chiefly on the nervous system; but aromatics influence more particularly the digestive organs, the function of assimilation, and the generation of animal heat. They are themselves digested, but previous to this process commencing, or going any length, they produce, by direct contact with the internal surfaces, a peculiar effect, which we perceive beginning at the lips and palate, and accompanying them in their progress to the stomach. They scarcely excite any general action of the system, but expend their power chiefly upon the stomach, and, in a less degree, upon the intestinal canal, increasing the vital force of the former, and quickening the muscular action of the latter. They also communicate to the stomach a greater power of resistance to unpleasant sensations, as under their influence many articles can be borne by it which would otherwise be rejected; and this happens equally with regard to food and medicines.

The mixture of aromatics renders them more agreeable than when given singly; and this is exemplified both in their medical and culinary employment, as no good cook will use only one spice if she can procure more. The *aromatic powder* and *aromatic confection* are compounded on this principle for medical use, and Dr. Kitchener's Zest for culinary purposes.

The necessity for the employment of aromatics is greater in warm climates and warm weather than in cold; and we find the plants which furnish them grow in the greatest abundance in hot countries. The pepper tribe (*Piperaceæ*), for example, is confined to the hottest parts of the world, such as tropical America and the Indian Archipelago; forty species of pepper are met with in the island of Java alone. Throughout the East Indies the natives restore the powers of the stomach by chewing betel, which consists of slices of the areca nut, sprinkled with fresh lime, wrapped up along with some other aromatic in a leaf of the *piper betel*. The Indians of South America use the *Erythroxylum Peruvianum* (called *cocca*) along with the leaves of the *Chenopodium Quinoa*, mixed with quick-lime, to stimulate the impaired powers of the stomach during their long and toilsome journeys over the heights of the Andes. (See Humboldt, 'Tableau Physique de la Nouvelle Espagne.') On the same principle, the Europeans who visit tropical countries use curry and other hot dishes. But in every quarter of the globe we find condiments used along with all articles difficult of digestion, especially vegetables, fish, and young meats, such as veal. Aromatics are therefore employed both to prevent and cure diseased states of the stomach, and to assist the action of other remedies.

In simple loss of appetite, without any other obvious disease, or in slow digestion, they may be employed in the form of the warmer pickles during dinner, or preserved ginger after dinner.

In many cases of fever in warm climates, the stomach is so powerless that it cannot extract from cinchona bark, or other febrifuge medicines, the principles fitted to cure the disease, unless aided by aromatics. Hence, Cayenne pepper is added to them; and indeed Cayenne pepper will often cure the fever without any bark. Lately, piperin (the active principle of pepper) has been recommended as a means of curing fevers in Europe; and certain it is that some lingering fevers of the intermittent character, occurring in old or feeble persons, cannot be cured without the assistance of aromatics. [AGUE.] It may be stated however that piperin, when pure, has no aromatic property.

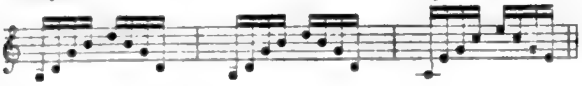
The preparation of iron (carbonate) which is found to be so useful in curing tic-douloureux, can rarely be borne by the stomach for such a length of time, or in such large doses, as are necessary, without adding aromatics to it. They are also very beneficially added to aloëtic purgatives, for the treatment of indigestion and constipation, occurring in literary and sedentary persons. Aromatics are frequently used to disguise the unpleasant taste of many medicines. The disagreeable taste of aloes is concealed by adding the aromatic or compound spirit of lavender, and the intensely bitter taste of the sulphate of quinia is nearly covered by mixing one part of it with ten or fifteen parts of powdered valerian, fennel, aniseed, or orange-peel.

Aromatics are most suited to persons of a phlegmatic constitution, or those advanced in life; less so to the young, or those of very irritable constitutions. They are to be altogether prohibited in certain states of the stomach or system generally. When there exists any inflammatory condition of the stomach they would be very improper; and it is necessary to observe, that in all degrees and stages of inflammation of the stomach, debility more or less is felt by the patient, which might seem to indicate their use; but under such circumstances they are extremely hurtful. The same observations apply to the aromatic teas, such as balm and sage, in common use among the people.

In certain affections of the brain, such as when there is a tendency to apoplexy, they are improper. Cullen mentions the case of a gentleman, who having taken by mistake two drachms of powdered nutmeg, in about an hour became drowsy, and fell from his chair. Being laid in bed, he dropped asleep, but awoke from time to time, and was quite delirious. He thus continued alternately sleeping and delirious for several hours. Even the following day he still complained of headache and drowsiness. In the East such cases are of frequent occurrence. Persons predisposed to affections of the brain should abstain from such articles, especially mulled wine at bed-time.

ARPEGGIO, in music (Ital. to play on the harp), is, when applied to keyed instruments, the striking the notes of a chord in rapid succession, as in the manner of touching the harp, instead of playing them simultaneously, the notes, when struck, being held out the full remainder of the time. Example—

On the violin, flute, &c., where the notes cannot be held out, the arpeggio is commonly executed thus:



ARQUEBUS. [Arms.]

ARRAC. [Arack.]

ARRAIGNMENT. This word is derived by Sir Matthew Hale from *arraisoner*, *ad rationem ponere*, to call to account or answer, which, in ancient law French, would be *ad-resoner*, or, abbreviated, *a-resner*. Conformably to this etymology, arraignment means nothing more than calling a person accused to the bar of a court of criminal judicature to answer formally to a charge made against him. The whole proceeding at present consists in calling upon the prisoner by his name, reading over to him the indictment upon which he is charged, and demanding of him whether he is guilty or not guilty. Until very lately, if the person accused pleaded that he was not guilty, he was asked how he would be tried; to which question the usual answer was, "By God and my country." This useless form was abolished by Stat. 7 & 8 Geo. IV., c. 28, s. 1, which enacts, that "if any person, not having privilege of peerage, being arraigned upon an indictment for treason, felony, or piracy, shall plead 'Not guilty,' he shall, without any further form, be deemed to have put himself upon the country for trial, and the court shall in the usual manner, order a jury for the trial of such person accordingly."

The arraignment of a prisoner is founded upon the plain principle of justice, that an accused person should be called upon for his answer to a charge before he is tried or punished for it. That this was a necessary form in English criminal law at a very early period appears from the reversal in parliament of the judgment given against the Mortimers in the reign of Edward II., which Sir Matthew Hale calls "an excellent record." One of the errors assigned in that judgment, and upon which its reversal was founded, was as follows: "that if in this realm any subject of the king hath offended against the king or any other person, by reason of which offence he may lose life or limb, and be thereupon brought before the justices for judgment, he ought to be called to account (*poni rationi*), and his answers to the charge to be heard before proceeding to judgment against him; whereas in this record and proceedings it is contained that the prisoners were adjudged to be drawn and hanged, without having been arraigned (*arrenati*) thereupon, or having an opportunity of answering to the charges made against them, contrary to the law and custom of this realm." (Hale's *Pleas of the Crown*, book ii. c. 28.

The ceremony of the prisoner holding up his hand upon arraignment is merely adopted for the purpose of pointing out to the court the person who is called upon to plead. As it is usual to place several prisoners at the bar at the same time, it is obviously a convenient mode of directing the eyes of the court to the individual who is addressed by the officer. In the case of Lord Stafford, who was tried for high treason in 1680, on the charge of being concerned in the Popish plot, the prisoner objected, in arrest of judgment, that he had not been called on to hold up his hand on his arraignment; but the judges declared the omission of this form to be no objection to the validity of the trial. (Howell's *State Trials*, vol. vii. p. 1555.)

ARREOY, a remarkable institution, which formerly subsisted in Otaheite and the other islands of the Society group. The first notice of the existence of this institution was brought to Europe by Cook, on his return from his first voyage in 1771. The account given in the narrative of the voyage published the following year was, however, generally supposed to have received a colouring from the florid pen of Hawkesworth, by whom the book was written. In the narrative of his second voyage, which he wrote himself, Cook appears inclined to soften down certain of the features of the former representation. Subsequent statements were given by Dr. Forster and others, for the most part differing from each other in important particulars. The fullest account, we believe, that has appeared, and at the same time the latest, is that given in Ellis's 'Polynesian Researches,' vol. i. pp. 311-344.

Amidst many contradictory statements, it seems to be admitted that the institution was distinguished by great profligacy of manners, and that infanticide was common with its members. One of the happy consequences of the introduction of Christianity into the island of Otaheite has been the entire abolition of those associations, as well as of the practice of infanticide generally. What effect this change may have upon the progress of population, remains in great part still to be ascertained. Mr. Ellis states, that when the missionaries arrived at the islands, the natural proportion of the sexes had been so deranged, that there were four or five men to one woman. Mr. Malthus has given it as his opinion, that the Arreoy was in all probability originally instituted with the view of preventing the inconvenient increase of population; and he seems to think that, from the unsparing rigour with which the fundamental law of the association appears to have been observed, it probably had that effect. But this opinion is in opposition to the general fact, which, as he notices, had been before remarked by Mr. Hume, that the existence in any country of a law permitting infanticide, had usually, from its tendency to promote marriages by diminishing the fear of their consequences, been attended with the opposite result.

ARREST is the apprehending or restraining a man's person by authority of law.

In criminal matters the object of an arrest is to secure the person of one who has, or is supposed to have, committed an offence, in order that he may be brought before a magistrate; and then, if there appears sufficient ground of suspicion against the party to justify his being put upon his trial, the magistrate takes measures for securing his presence before the proper court, either by committing him to prison, or by taking bail for his appearance.

An arrest may be made either by virtue of a warrant, or, where the law authorises it, without warrant. A warrant may be granted in extraordinary cases by the privy council, the secretaries of state, and some other public officers; but the only warrants which occur in the ordinary administration of the law are such as are issued by justices of the peace, whose duties in that respect are regulated by the statute 11 & 12 Vict. c. 42.

When a charge is made before a magistrate, it is his duty to examine the witnesses upon oath (unless it be intended to issue a summons, and not a warrant, in the first instance), and to take down their statement in writing; and then, if he see any probable ground of suspicion against the party charged, he may issue a warrant for his apprehension. The person to whom the warrant is directed—generally some constable or other peace-officer—is bound to execute it as far as the magistrate's jurisdiction and his own extends; but if the party to be arrested escapes into another county, the warrant cannot be executed without being *backed*, that is, signed by a justice of the peace for that county. [Warrant.]

But in many cases an arrest may be made without a warrant, particularly by officers connected with the administration of justice. A constable, for instance, may arrest in case of felony, if there is reasonable ground of suspicion, and for any breach of the peace actually committed in his view; so persons loitering at night, and suspected of having committed or being about to commit a felony, under the Act (9 & 10 Vict. c. 25) relating to injuries by explosive substances, may be arrested by any constable or peace-officer without a warrant.

An officer may, upon a criminal charge, break open doors, if, upon demand of admittance, it cannot be otherwise obtained; he may likewise, in apprehending a person charged with felony, use any degree of force that may be necessary; and if the person charged attempt to save himself by flight or resistance, and is killed by the officer (there being no other means of preventing an escape), the homicide is justifiable; but if he kill the officer with the intent to oppose him in the execution of his duty, it is murder.

Private persons, also, are not only authorised, but required, to apprehend any person who commits a felony in their presence; and in pursuing such felon, they will be justified in breaking open doors and in using force, as much as an officer. A private person may likewise arrest upon reasonable suspicion of felony; but inasmuch as this is not a duty enjoined by the law, he is not armed with the same privileges as where he saw the offence committed: he cannot justify breaking open doors, or using the same degree of force; if he kill the supposed offender, he will be guilty of manslaughter; and if he be killed, the offence will be the same, and not murder: besides this, he acts at his own peril, and is liable to an action unless he can show that a felony had been actually committed, and that there was reasonable ground to suspect the person whom he arrested.

There are also several cases where private persons have the power of arresting given them by Act of Parliament. Any person whatsoever is authorised to apprehend for any offence against the Vagrant Act, 4 & 5 Geo. IV. c. 83. And where persons are found committing any offence against the Larceny Act, or the Malicious Injuries Act, 7 & 8 Geo. IV. c. 29 and 30, they may be apprehended, without warrant, by any peace-officer, or by the owner of the property, or by his servant, or any person authorised by him. So any one may apprehend persons found committing offences under the Prevention of Offences Act, 14 & 15 Vict. c. 19, or persons found committing *any* indictable offence in the night.

When an officer has arrested any one, he ought to take him before a magistrate to be examined as soon as possible. Where a private person has made the arrest, he will in general be justified either in taking the party arrested before a justice of the peace, or delivering him over to a constable of the place, and this alternative is expressly given him by the Vagrant Act; but the Larceny Act and the Malicious Injuries Act require that the person arrested should be forthwith taken before a justice of the peace. But if a person be apprehended in an attempt to commit a felony at night, he may lawfully be detained, even by a private person, till he can be carried before a magistrate.

There is likewise another mode of arrest for felony, and that is upon *hue and cry* raised; but though this was once in ordinary practice, it has now fallen into disuse. [Hue and Cry.] Hale's 'Pleas of the Crown,' vol. i. p. 575, vol. ii. pp. 72-120; Stephen's 'Summary of the Criminal Law,' pp. 239-244.

Arrest in civil cases is of two kinds: 1, that which takes place before trial, and is called arrest on mesne process; 2, that which takes place after trial and judgment, and is called arrest on final process, or arrest in execution. [Process.]

The primary object of arrest on mesne process is to secure the defendant's appearance in court, so as to enable the plaintiff to proceed with his action against him. This compulsory mode of proceeding, being penal in its nature, was originally allowed by our law in such injuries only as are accompanied by force: its use, however, was gradually extended, partly by Acts of Parliament, partly by the fictitious proceedings of the courts, to almost every species of complaint; but by later regulations it has nearly been confined to cases of debt.

When it was intended to proceed by arrest, the plaintiff, after making an affidavit that the cause of action amounted to 20*l.*, which by stat. 7 & 8 Geo. IV. c. 71, was the lowest sum for which a party could be held to bail, commenced his action by suing out a writ, called a *capias*, directed to the sheriff, who, on its being delivered to him, granted a warrant to his inferior officers or bailiffs to execute it on the defendant.

With regard to arrest on mesne process, the law was materially altered by the statute 1 & 2 Vict. c. 110. Since that statute all personal actions must be commenced by writ of summons, and no defendant can be arrested before a judgment has been obtained against him, unless it be shown by the affidavit of the plaintiff, or of some other person, to the satisfaction of a judge of one of the superior courts, that such plaintiff has a cause of action against the defendant to the amount of 20*l.* or upwards, or has sustained damage to that amount, and that there is probable cause for believing that the defendant is about to quit England unless he be forthwith apprehended. The judge is then authorised to issue a writ of capias against such defendant; the proceedings upon such writ are the same as they were under the writ of capias, which formerly was used as the commencement of all personal actions which were commenced in the superior courts of common law, when the object was to arrest a person or hold him to bail. [Capias.]

This application to the judge may be made and the defendant arrested at any time after the commencement of the action, and before final judgment shall have been obtained therein. Upon making the arrest, the officer is required forthwith to deliver to the defendant a copy of the writ, and is not allowed to take him to gaol within twenty-four hours, unless, upon request made, he refuses to go to any place of safe custody. He is in general taken to the house of the officer (vulgarly called a 'spunging-house'), where (if not sooner lawfully discharged) he may be confined until the expiration of the eight days limited for the putting in of special bail.

When arrested, the defendant is in custody of the sheriff: but by stat. 43 Geo. III. c. 46, s. 2, he may obtain his discharge by depositing with the sheriff or his officer the sum for which he was ordered to be held to bail, together with 10*l.* to answer for the costs, or by giving bail for his appearance to defend the action: this being what most commonly occurs, the process upon which an arrest is founded is called *bailable* process. For further information on this subject, see Bail.

The Commissioners of the district Courts of Bankruptcy and the Judges of the County Courts have now power, by the Absconding Debtors' Arrest Act, 1851, to grant a warrant for the arrest of absconding debtors, and for their detention for seven days, until a writ of *capias* can be procured from one of the superior courts of law. By this means debtors absconding from the seaports at a distance from London may be arrested on the spot, and detained until they pay the debt or give bail to the action, or deposit the money in the hands of the sheriff.

Arrest on final process, or arrest in execution, is one of the means by which a party who has succeeded in an action may compel performance of the judgment.

Arrest in execution may in general be resorted to in any case where, before trial, bailable process might issue; when execution has been taken out against the property, and there is not enough to satisfy the judgment, execution against the person may afterwards be resorted to; but if the person has once been taken in execution, no process can in his lifetime issue afterwards against the property. [Execution.]

The statute 7 & 8 Vict. c. 96 has, however, effected a very important alteration in arrest on final process or in execution. The 57th section enacts that no person shall be taken or charged in execution upon any judgment obtained in any of Her Majesty's superior courts, or in any county court, court of requests, or other inferior court, in any action for the recovery of any debt wherein the sum recovered shall not exceed the sum of 20*l.* exclusive of the costs recovered by such judgment.

An arrest is made by seizing or touching the defendant's person. The officer is not justified in breaking open the defendant's house in order to arrest him; but, when once the arrest is made, he may break into any house in pursuit of him.

Certain personages were from the earliest times privileged from arrest or civil process, either entirely so, or temporarily. A list of them is given in Blackstone's 'Comm.,' Mr. Kerr's edit., vol. iii. p. 298, &c.

In France, imprisonment seems to have existed from the earliest ages as a means of execution to compel the payment of a debt, though its application was originally restricted to cases where the property of the debtor had been previously seized and found insufficient. In the reign of Louis XIV. a principle was introduced, which at the present day constitutes one of the characteristics of French jurisprudence; debts of a commercial nature being distinguished from debts purely civil, and arrest being allowed as of course in the former, but, in the latter, only in a few specified cases.

An arrest, by the law of France, cannot take place without being authorised by the sentence of a court. The cases in which this authority is exercised in matters not of a criminal nature may be classed under four heads:

I. In all cases of commercial debt to the amount of 200 francs (8*l.* sterling), arrest forms part of the sentence as a matter of course. The object of imprisonment is to compel the debtor to give up any property which he may be supposed to have concealed; after a certain length of confinement, it may be presumed that, if he has given nothing up, it was because he had nothing to give; and thus the reason for detaining him ceases to operate. The debtor is, therefore, in all cases discharged from prison, after a certain length of time, varying according to the amount of the debt. In commercial cases, the length of imprisonment varies from one year to five.

II. In actions of a purely civil nature, arrest takes place only in those cases which are specified by the laws. The civil code (Arts. 2059, 2060) contains an enumeration of the cases in which it is pronounced as a matter of course. They are chiefly such as imply either gross fraud, or a breach of official duty. The length of imprisonment varies from one year to ten.

There are other cases in which the court have a discretionary power to pronounce sentence of imprisonment if they think fit; the length of confinement varies in this instance from one year to five. In all civil cases, 300 francs, or 12*l.* sterling, is the lowest sum for which a person can be arrested.

III. All public servants are liable to arrest in respect of any sum of money to the amount of 300 francs, 12*l.* sterling, due, by virtue of their office to the state, or any public establishment. The duration of imprisonment varies from one year to ten.

IV. With respect to foreigners not domiciled in France the law is peculiarly severe. As their property is presumed to be in their own country, the confinement of their persons is considered to be the only means by which they can be compelled to satisfy their creditors; they are, therefore, liable to arrest for all debts, whether civil or commercial, provided the sum amounts to 150 francs, or 6*l.* sterling. And for this sum a foreigner may be arrested, not only after final judgment, but as soon as the cause of action has arisen. In the latter case, however, he may obtain his discharge by finding sureties, or by proving that he is possessed of sufficient property in France to pay the debt: when arrested on final judgment, the duration of his imprisonment varies from two years to ten.

A debtor who has entered his 70th year cannot be arrested on final process, except in the case *stellionat*, the *stellionatus* of the Roman law, a fraud committed by a party in falsely representing property as being his own or as being free from incumbrance. And with the same exception, a debtor who is in prison is, on entering his 70th year, entitled to be discharged. The debtor likewise obtains his discharge in the following cases:—1. If the creditor give his consent thereto; or 2. If he neglect to advance the sum which the law requires him to pay for the support of the debtor. This sum is now fixed at 25 francs, 1*l.* sterling per month, except in Paris, where it is 30 francs; 3. By payment of the debt, costs and expenses; or, in cases not commercial, by payment of one-third thereof, and finding sureties for the remainder; or 4. By being allowed the benefit of cession, answering to a discharge under the Insolvent Act in English Law. [Cessio Bonorum.]

(See *Code Civile*, Arts. 2059-2070; *Code de Procédure Civile*, Arts. 780-805; law of 17th of April, 1832; Fœlix, *Commentaire sur la Contrainte par Corps.*)

ARREST OF JUDGMENT. After an action at law has been carried through all the stages previous to the judgment, and the plaintiff has up to this point been successful, the defendant may still move in arrest of judgment: that is, he may pray the court to withhold or arrest the judgment to which the plaintiff is apparently entitled, on the ground that there is some error appearing on the face of the record, which vitiates the proceedings. In consequence of such error, on whatever part of the record it may arise, the court is bound to arrest the judgment, but the error must be such as is apparent on the record, and generally speaking, it must not be an error in a mere point of form. This was formerly otherwise [Amendment]; but at the present day judgment cannot be arrested for any merely formal objection.

For further information on this matter, see Blackstone's *Comm.*, Mr. Kerr's ed., vol. iii. ch. 24; Comyn's *Dig.*, tit. "Pleader," § 48.

ARRESTMENT in the law of Scotland is a process by which a creditor may attach money or moveable property which a third party holds for behoof of his debtor. It bears a general resemblance to the custom of foreign attachment in the Mayor's Court of the City of

London. [Attachment, Foreign.] The person who uses it is called the arrestor; he in whose hands it is used is called the arrestee, and the debtor is called the common debtor. It is of two kinds, arrestment in execution and arrestment in security. The former can proceed only on the decree of a court, on a deed which contains a clause of registration for execution, or on one of those documents, such as bills of exchange and promissory notes, which by the practice of Scotland are placed in the same position as deeds having a clause of registration. Arrestment in security is generally an incidental procedure in an action for the constitution of a debt; but it may be obtained on cause shown, as a method of constituting a security for a debt not yet due. This latter class of arrestments is under the equitable control of the judge who issues it; and it is a general principle that it cannot be obtained unless the claimant show that circumstances have occurred which have a tendency to make his chance of payment less than it was at the time when he entered into the engagement with his debtor. An arrestment may be recalled on it being shown that it should not have been issued, and an arrestment in security may be "loosed" on the debtor finding security for the payment of his debt. An arrestment in execution expires on the lapse of three years from the date of its execution, and an arrestment in security, on the lapse of three years from the day when the debt becomes due. In the meantime, the person in whose hands the process is used, is liable in damages if he part with the property arrested, but it cannot be attached after he has parted with it, in the hands of a *bonâ fide* holder. The arrestment is made effectual for the payment of the debt by an action of Forthcoming, in which the common debtor is cited. It concludes for payment of the money if the arrestment be laid on money, or for their sale for behoof of the creditor, if it be laid on other moveable goods. The arrestee may plead against the arrestor whatever defence he might have had against the common debtor.

There is another species of arrestment, called arrestment *jurisdictionis fundandæ causâ*, the object of which is, by attaching the moveable property of a defendant who is not in Scotland, to give jurisdiction to the Court of Session to proceed against him. This arrestment may be loosed, as in other cases, on security being given by the arrestee to abide the judgment of the court. (London and N. W. Rail. Co. *v.* Lindsay, 3 Macqueen's Reports, p. 99.)

ARRIS, in French *Areste* and *Arête*, is a term employed in building. It may be defined as the intersection or line in which the two straight or curved surfaces of a body, forming an exterior angle, meet each other. The term arris, synonymous with edge, is constantly employed by workmen engaged in buildings, especially in the formation of mouldings, whether of stone, wood, or plaster. In parallelopipedal bodies, on which the length and thickness may be measured, as in planks, bond timbers, shutters, &c., the term edge only is used. In Gothic architecture, owing to the numerous lines and angles, the arris is of frequent occurrence; for example, in the mullions and transoms of windows, where there are many mouldings, every edge is an arris, whether formed by square mouldings or by the intersection of curves. In Grecian architecture, the raised edge between two flutes of a Doric column, and in both Grecian and Roman architecture, the lines bounding every flat moulding are so many examples of the arris.

ARRIS FILLET, a small triangular piece of wood, used to raise the slates of a roof against the shaft of a chimney or a wall, to throw off the rain more effectually; it is used for the same purpose also in forming gutters round skylights, which have the same inclination as the roof, and are slightly raised above it.

ARROW-HEADED CHARACTERS. [Cuneiform Inscriptions.]

ARROW-ROOT. An article of commerce, which is imported in considerable quantities from both the West and East Indies. It is a farinaceous substance, prepared from the roots of certain plants. That which is brought from America is made from the root of the *Maranta Arundinacea;* the arrow-root imported from Asia is extracted from the tubers of the *Curcuma Angustifolia.* [For the botanical descriptions of these plants, see Maranta and Curcuma, in Nat. Hist. Div.]

The English name of this preparation is derived from the use to which the Indians of South America were accustomed to apply the juice extracted from another species of *Maranta*—the *Maranta galanga,* which was employed as an antidote to the poison in which the arrows of hostile tribes were dipped.

The method of preparing the arrow-root of commerce is the same from whichever of the two plants it is extracted. The root, or tuber, as the case may be, must first be carefully washed, in order to remove the adhering particles of earth, and then it is either grated or beaten to a pulpy consistence in a mortar, which should be formed of wood. The pulp is next intimately mixed with a considerable quantity of pure water, by which operation the fibrous portion is separated from the farina, which remains mechanically suspended in the water. This fibrous portion is then removed, the larger parts by the hand and the minuter parts by straining through a hair sieve. The remaining milk-like fluid is then left for subsidence, after which the water is drawn off. A second and sometimes a third washing in fresh water and straining through finer sieves of the pulpy residuum, are then employed; after which the starchy matter is collected in a state of purity, and its moisture thoroughly evaporated by exposure to the sun and air. When perfectly dry it is packed in casks or boxes, and will retain its nourishing property unimpaired for many years.

Arrow-root may be used with advantage as the food of young children or of persons in delicate health, since its nutritive property is great, and it is of very easy digestion. It is used either mixed with hot water or boiling milk, or in the form of puddings. The powder is frequently adulterated by the admixture of common starch or the farina of potatoes, and it is therefore advisable to purchase it in the package in which it is imported, or from some dealer of respectability. That which is the most esteemed for purity is imported from the Bermudas and New Providence; but within the last few years the arrow-root of Ceylon has acquired some celebrity: this is made from the American plant the *Maranta Arundinacea,* which was conveyed from the West Indies to Ceylon. The cultivation has lately been introduced with considerable success into the island of St. Vincent; machinery of skilful construction is employed to prepare the arrow-root from the plant; and the packing for shipment is carefully conducted.

ARSENAL, from the Italian *Arsenale,* a magazine of warlike stores, or government establishment, where naval and military arms, ammunition, and equipments, are manufactured and stored. Portsmouth, Plymouth, Woolwich, Deptford, Sheerness, and Pembroke, are the principal English naval arsenals: Brest, Toulon, L'Orient, and Cherbourg, the principal French ones. Paris, Vincennes, Vernon, and Metz, are some of the French military arsenals, whilst, besides the Tower, which is principally a store, Woolwich is the only English military arsenal.

Woolwich arsenal contains a brass-gun foundry, where all the brass guns and fitments used in the British service are cast, to which latterly an iron foundry has been added, where a few iron guns, shot, and shell are cast, principally to act as a check on the private foundries which supply most of them. Besides these Woolwich arsenal contains the following departments: boring department, both for brass and iron guns; carriage department, for the manufacture of gun-carriages, limbers, waggons, and the various carriages and equipments of an army; laboratory, containing percussion-cap factory, rocket manufactory (both Congreve and signal), workshops for the manufacture and filling of shells and fuzees, the compression of lead bullets, and the making-up and packing of all descriptions of ammunition; proof department, for proving brass and iron guns, shot, and shell; and lastly, a store department for warehousing all descriptions of military equipment. The greater portion of the gunpowder used in the British army is made at the government powder-mills at Waltham Abbey. A manufactory for small arms has also, within the last few years, been established at Enfield, from which the rifle now used in the army takes its name. These are afterwards proved at the Tower.

At the naval arsenals men-of-war are, when put in commission, fitted out and equipped for sea, and when paid off, stripped and laid up in ordinary. [Dockyard.]

ARSENIATES. [Arsenic.]

ARSENIC. (As). The term Arsenic is derived from the Greek *ἀρσενικὸν*, which is found first in the works of Dioscorides, and of some other authors who wrote about the beginning of the Christian æra. It denotes, in their works, the substance called *σανδαράκη* by Aristotle, and *αρσενικόν* by Theophrastus (although Pliny, lib. xxxiv. 18, seems to make a distinction between *σανδαράκη* and *ἀρσενικὸν*), and is said to be the *auri pigmentum,* the well-known paint, orpiment.

Arsenic is a peculiar metal, which, though long known, was first examined with tolerable precision by Brandt, in 1733. It is very frequently met with in nature; sometimes in its pure metallic state, but more commonly combined with other metals, as nickel, cobalt, and iron, or with sulphur, and sometimes united with oxygen. It may be artificially obtained from its natural compounds in a mode which will be presently pointed out.

Arsenic has a steel gray colour and considerable brilliancy; its density is 5·700 according to Berzelius, and 5·884 by Turner's experiments; when sublimed, Dr. Thomson states that its density is only 5·235; the native metal is granular, and the artificial crystalline; it is extremely brittle, and consequently easily powdered. When arsenic is exposed to the air it soon loses its lustre, and becomes black on the surface; the artificially obtained metal not only suffers these changes, but falls to powder by the action of the air: in this state it is known on the continent by the name of *fly-powder,* and is supposed by Berzelius to be a peculiar oxide of arsenic; most chemists, however, regard it as a mere mixture of arsenious acid and the metal. When kept under water, arsenic is gradually converted into arsenious acid; if heated to 356° Fahrenheit, it is volatilised, without previous fusion; the vapour has a strong smell, resembling that of garlic, and this, to a certain extent, is relied upon as proof of its presence; the vapour readily condenses in small brilliant crystals of metallic arsenic, the form of which is an acute truncated rhombohedron. According to Berzelius, arsenic exists in two allotropic conditions; one is of a dark gray colour, and soon falls to powder in the air; the other is nearly white, with a strong metallic lustre, and is permanent in the air.

Arsenic and oxygen combine in two proportions, and both compounds possess acid properties.

Arsenious acid (AsO_3). As a natural product, arsenious acid is extremely rare; it may be artificially prepared by heating the metal in atmospheric air, when, being very combustible, it burns and combines with oxygen; the white vapour of arsenious acid formed, speedily condenses, and frequently in the form of the regular octahedron; this acid may also be procured by heating the metal in very dilute nitric acid, which being decomposed yields oxygen. These processes are, however, needless, for arsenious acid is met with abundantly, and very pure, as an article of commerce; being formed and volatilised during the roasting of cobalt ores, it is first condensed in an impure state, and purified by a second sublimation in an iron vessel. Arsenious acid (oxide of arsenic, the white arsenic of the shops, and of the 'London Pharmacopœia'), has the following properties: it occurs in compact masses of various sizes, which are externally colourless and opaque, but internally, when recently broken, frequently yellowish and transparent, and of a glassy appearance and fracture; by exposure to the air the transparency is lost; the density of the opaque kind is 3·706, and that of the glassy 3·699. Arsenious acid is volatilised at 380° Fahrenheit; the vapour has not the garlic smell, like that of metallic arsenic. According to Dr. Christison, arsenious acid has little or no taste. It is well known as a most virulent poison. Arsenious acid is soluble in water; at about 60° Fahrenheit it dissolves about 1-50th of its weight, and when boiling, nearly 1-13th; on cooling to 60°, a considerable portion is deposited in octahedral crystals, so that only about 3-8ths of that taken up remains dissolved; the solution reddens litmus paper but slightly, and though it acts feebly as an acid in this respect, and does not decompose the alkaline carbonates when cold, yet it expels their carbonic acid when they are heated together in solution. The nature of the saline compounds will be presently mentioned.

In order to avoid the danger of accidentally poisoning by arsenic, or any colourless preparation of arsenic, and to render its use more difficult for intentional poisoning, an Act was passed regulating the sale of such substances, in the session of parliament 1851. By this Act it is required that, except when sold for agricultural or other purposes in quantities of not less than ten pounds, or to be used in medicine by a qualified practitioner, all arsenious acid is to be mixed and coloured with soot or indigo; that all persons selling arsenic are to keep a book in which the name, place of abode, condition or occupation of the purchaser, the quantity sold, and the purpose for which it is required, shall be entered, certified by the signatures of the seller and the purchaser, or the referee of the purchaser, whenever he is not personally known to the seller. Any infraction of these provisions subjects the offender to penalties not exceeding 20*l.* for each offence, to be levied by two justices on summary conviction.

Arsenic acid (AsO_5) exists in nature much more commonly than the arsenious acid; sometimes it is found combined with lime, and frequently with various metallic oxides, as those of copper, iron, and lead; the arseniates of copper constitute, indeed, a most beautiful and extensive variety of the ores of that metal.

Arsenic acid may be formed artificially by heating either the metal or arsenious acid in nitric acid, or, which is preferred, in a mixture of nitric and hydrochloric acid; the mixture is to be distilled in a glass retort until it has acquired the consistence of a syrup; afterwards it is to be heated nearly to redness in a platina crucible, until all the nitric acid is expelled. Arsenic acid thus prepared is of a milk-white colour; it contains no water, but when exposed to the air attracts moisture until a solution of specific gravity 1·935 is obtained; when water is added to the anhydrous acid it dissolves only a part of it for a long time, leaving a white powder, which is, however, eventually taken up; by evaporation a syrupy liquid of specific gravity 2·55 is obtained, which, when concentrated till the temperature rises to 248°, begins to deposit solid matter. The anhydrous acid has not a very strong taste, but the aqueous solution is extremely sour, acts strongly as an acid on litmus paper, and decomposes alkaline carbonates when cold. It is extremely poisonous. Its salts, termed arseniates, will be mentioned hereafter.

Arsenuretted hydrogen (AsH_3)—Arsenic is one of the few metals which form permanent compounds with hydrogen. Arsenuretted hydrogen may be prepared by fusing equal weights of arsenic and zinc, and dissolving the alloy in hydrochloric acid; the gas may be received in air jars filled with and inverted in water, in which it is insoluble. This compound is gaseous at the usual temperature of the air,: but when subjected to intense cold, it is condensed into a limpid liquid resembling ether. The gas has an extremely fetid smell; its specific gravity is 2·695; it is fatal to animals when it forms only 1-10th of the air which they breathe. When exposed to atmospheric air, it is decomposed; metallic arsenic, mixed with some arsenious acid, is deposited, and water is formed. It is composed of 6 volumes of hydrogen gas, and 1 of the vapour of arsenic, condensed into 4 volumes.

There is also a solid compound of arsenic and hydrogen; it is obtained by employing arsenic as the negative electrode, when water is decomposed by electricity; the hydrogen of the water, instead of being evolved, combines with the arsenic, and the compound is detached from the metal in brown-coloured flocks. Its composition has not been clearly ascertained.

Terchloride of arsenic ($AsCl_3$).—When arsenic in powder is thrown into chlorine gas, it burns, owing to the heat attending the combination; when also a mixture of 1 part of arsenic and 6 parts of perchloride of mercury is distilled, a fuming colourless liquid condenses in the receiver; the product in both cases is terchloride of arsenic. It is very volatile, and does not become solid at a low temperature. If water and chloride of arsenic are mixed, both are decomposed, and arsenious and hydrochloric acids are formed. When heated, chloride of arsenic dissolves sulphur and phosphorus, but they separate on cooling.

Another method of preparing chloride of arsenic is, to put 1 part of arsenious acid and 12 parts of sulphuric acid into a retort, heat the mixture nearly to 212°, and then gradually add small fragments of fused common salt; pure chloride of arsenic, which is to be condensed by artificial cold, passes over into the receiver. A little water frequently comes over with the chloride towards the end of the operation, and this hydrated chloride does not mix with, but floats on, the anhydrous chloride first distilled.

Arsenic does not appear to unite with carbon; it combines with bromine, iodine, fluorine, selenium, and phosphorus; but the resulting compounds are not important.

Compounds of sulphur and arsenic.—Arsenic and sulphur may be made to combine in several different proportions; two of these sulphurets, and the more important, exist in nature, and these only will be described at any length. The first is the red sulphuret of arsenic, commonly called *realger* (AsS_2); this is found native in several parts of Europe, and sometimes crystallised. It is of a deep-red colour, brittle, easily reduced to powder, inodorous, tasteless, and insoluble in water: its specific gravity is about 3·338. It may be artificially formed by melting a mixture of arsenic and sulphur in a covered crucible, or the arsenious or arsenic acid may be used. In the latter cases, sulphurous acid is formed and evolved, owing to the oxygen of the acid combining with a portion of the sulphur. In close vessels, it sublimes unchanged. It appears to be poisonous, but less so than arsenious acid. It is used as a pigment.

The second is the yellow sulphuret of arsenic (*Sulpharsenious acid*, AsS_3) usually called *orpiment*. This sulphuret is also a natural product, occurring rarely crystallised: it is commonly composed of thin plates, which are of a very fine yellow colour, and flexible to a considerable degree: its specific gravity is 3·452. It is insoluble in water, and inodorous. Acids do not dissolve it, but nitric acid and chlorine decompose it. When heated in close vessels, it melts, and then sublimes; when heated in the air, it burns with a pale blue flame, and gives a white vapour, and an odour of sulphurous acid. It may be formed artificially by passing a current of sulphuretted hydrogen gas into an acid solution of arsenious acid. It is used as a pigment, and is the colouring ingredient of *king's yellow.*

The other sulphurets of arsenic are unimportant.

Arsenic and metals in general combine with great facility: those which are malleable it renders brittle, and those which are difficult to melt, it renders fusible.

The combination of arsenic with potassium and sodium is attended with the disengagement of much heat. The resulting arseniurets are decomposed by water, the potassium and sodium are oxidised, while the hydrogen of the water converts the arsenic partly into gaseous arsenuretted hydrogen, and partly into the brown arseniuret of hydrogen already noticed.

The metallic arseniurets are not of sufficient importance to require a more minute description.

We have now to notice the salts that contain the arsenious and arsenic acid, and which are termed respectively *arsenites* and *arseniates.*

Arsenite of ammonia (NH_4OAsO_3) may be prepared by dissolving arsenious acid in solution of ammonia. It cannot be obtained in a solid form, for by evaporation the salt is decomposed, ammonia is evolved, and octahedral crystals are obtained, which are mere arsenious acid without a trace of ammonia.

Arsenite of potash ($2KO,AsO_3$) is procured by digesting the acid in a solution of the alkali. By evaporation, a saline mass is left, but no crystals of the salt are formed. This compound is employed in the preparation of arsenite of copper, sometimes called *Scheele's green.* It is also the basis of the *liquor arsenicalis* of the 'London Pharmacopœia Two other arsenites of potash have also been formed.

Arsenite of soda ($2NaO,AsO_3$) is prepared as the last mentioned. By evaporation, a viscid mass is obtained; and when the evaporation has been continued till the solution has acquired the consistence of a syrup, small granular crystals are obtained as it cools. Two other arsenites of soda are also known.

Arsenite of lime ($2CaO, AsO_3$) may be readily procured by mixing an aqueous solution of the acid with lime water; the arsenite being nearly insoluble in water, is precipitated in the state of a white powder: it contains water, is soluble in acids, and even in some saline solutions. It is poisonous.

Arsenite of baryta ($2BaO, AsO_3$) is a white powder, slightly soluble in water.

Arsenite of strontia ($2SrO, AsO_3$) is soluble in water.

Arsenite of copper (CuO, AsO_3 ?).This compound was first prepared by Scheele, and by him proposed as a pigment; and it has been long and extensively used as such, under the name of *Scheele's green.* It is formed by adding a solution of arsenite of potash to one of sulphate of copper (blue vitriol). By double decomposition, arsenite of copper is formed, and is precipitated of a fine green colour. The exact composition has not been determined: indeed, it is probable that more than one compound may be formed, or one may be mixed with variable quantities of hydrate of copper.

Arsenite of silver ($3AgO, AsO_3$) may be made by mixing a solution of nitrate of silver with one of arsenite of ammonia, potash, or soda. It is of a fine yellow colour; and the soluble salts of silver, like those of copper, are occasionally used to afford corroborative evidence in cases of poisoning by arsenic.

The *arseniates* are in several cases presented to us by nature. Thus, in Cornwall, arseniate of iron occurs in small green cubic crystals, and also several beautiful varieties of arseniate of copper. Arseniate of lime, called pharmacolite by mineralogists, is sometimes, though rarely, met with.

The alkaline and earthy arseniates are generally procured either by direct combination or by double decomposition; and the metallic arseniates usually, if not always, by the latter method. We shall describe the arseniates in the same order as the arsenites.

Arseniate of ammonia ($2NH_4O, HO, AsO_5$).—This salt is prepared by adding the alkali to a rather concentrated solution of the acid, until a precipitate appears. If this and the solution be exposed to spontaneous evaporation, large rhombic crystals are obtained. These crystals, when exposed to the air, lose half of their base, and are converted into *mono-arseniate of ammonia*. When subjected to distillation, the arseniate of ammonia decomposes as it becomes dry, ammonia, water, and nitrogen gas are obtained, and the arsenic is reduced.

The *mono-arseniate of ammonia* ($NH_4O, 2HO, AsO_5$) may not only be obtained, as above-mentioned, by exposing the neutral salt to the air, but also by adding arsenic acid to it. By slow evaporation, large octahedral crystals are formed: when heated, it yields arsenious acid, but no ammonia.

Tri-arseniate of potash ($3KO, AsO_5$).—It may be procured by saturating the acid with the alkali. It is an uncrystallisable deliquescent mass, and may also be obtained by fusing a mixture of arsenious acid and hydrate of potash. The arsenious acid acquires oxygen from the decomposed water, hydrogen gas being evolved, and sometimes a portion of the arsenious acid is reduced.

Mono-arseniate of potash (KO, AsO_5) is usually prepared by heating a mixture of arsenious acid and nitrate of potash. The nitric acid yields oxygen to the arsenious, so as to convert it into arsenic acid, which uniting with the potash, the mono-arseniate is formed. The mass, when dissolved in hot water, yields transparent crystals of the salt. The solution reddens litmus paper. The salt suffers no change by exposure to the air: its taste is cooling and saline, somewhat like that of nitrate of potash. The crystals contain water.

The *arseniate* and *mono-arseniate of soda* are crystallisable salts, but which do not require any particular notice. The *arseniates* of the earths are not of importance.

Arseniate of baryta and *arseniate of strontia* are both soluble salts: they are entirely artificial compounds, and applied to no use. With respect to the metallic arseniates, we have already stated that the arseniates of iron and copper occur in Cornwall: they may also be formed artificially. The *arseniate of silver* is of a brick-red colour, while, as already noticed, the *arsenite* is yellow. Some use is made of this difference in processes for detecting the presence of arsenic. Most metallic arseniates are insoluble in water, but dissolved by acids. As to the general properties of arsenical acids and salts, we shall merely remark that both the acids are precipitated yellow by sulphuretted hydrogen; the arsenites are precipitated yellow by the salts of silver, and green by those of copper; while the arseniates are thrown down red by the silver salts, and blue by the copper ones.

ARSENIC, DETECTION OF. Of all substances, arsenic is that which has most frequently occasioned death by poisoning, both by accident and design; we shall therefore briefly state the methods of ascertaining its presence.

Supposing a white powder to have been found under suspicious circumstances, the process to which it is to be subjected is that of reduction to the metallic state and sublimation, and for this purpose we employ a small glass tube, a spirit lamp and black flux, or fresh burnt and powdered charcoal. The tube should be thin, closed at one end, about one-fourth of an inch in diameter, and three to four inches long; those known by the name of *test tubes* answer the purpose extremely well. Black flux is a mixture of charcoal and carbonate of potash, prepared by deflagrating two parts of bitartrate of potash and one part of nitrate in a crucible. It is to be powdered, and immediately put into a well-stopped bottle to prevent its acquiring moisture from the air; the charcoal which it contains is derived from the decomposition of the tartaric acid, and the potash from that of the bitartrate and nitrate. Mix a small portion, a grain or two, or even less, of the suspected powder with twice its quantity of the black flux, and convey the mixture to the bottom of the tube by means of a trough of smooth writing paper, taking care that none remain adhering to the sides of the tube. Put a paper plug loosely into the orifice of the tube, and twist a piece of paper round the upper end of it, to serve as a handle; then expose the mixture to the flame of the spirit lamp. The potash of the flux retains the arsenious acid until it is sufficiently heated to be decomposed by the charcoal. If the quantity of arsenious acid be extremely small, then it is better to drop it into the tube, and to let fall a little powdered charcoal upon it. In a very short time after applying heat as before, the charcoal combining with the oxygen of the arsenious acid, the reduced metal rises in vapour, and condenses in the upper and cool part of the tube; it has a metallic appearance, and is of a brilliant dark steel-gray colour.

Although this effect may be regarded as evidence of the presence of arsenic, Dr. Turner has improved upon it by showing that the metal may be easily re-converted to arsenious acid, and exhibit the characteristic form and properties of that substance, although its weight may not exceed one-hundredth of a grain. This change is effected by holding that part of the tube which contains the arsenic about three-fourths of an inch above a very small flame of the spirit lamp; the metal again sublimes, and re-combining with the oxygen of the air in the tube, forms well-defined crystals of arsenious acid.

If no solid arsenious acid should be found, but is suspected to exist in solution, either in the food or in the contents of the stomach, then these materials, after being boiled with dilute hydrochloric acid, and strained through calico, should be tested by one or more of the following processes.

Reinsch's test.—Boil a portion of the strained liquid, obtained as just mentioned, with bright copper turnings or strips of copper foil, for half an hour. If the surface of the copper become dull during this operation, the fragments must be carefully washed with distilled water, dried at 212°, introduced into a clean and narrow glass tube, and then heated nearly to redness. If a sublimate condense on the cooler portion of the tube, it must consist either of arsenious acid or metallic mercury; the beautiful transparent octahedral crystals of the former cannot, however, be confounded with the brilliant metallic globules of the latter.

Marsh's Test.—This invaluable process for the detection of arsenic depends upon the formation of arsenuretted hydrogen, when any solution containing arsenic is brought into contact with nascent hydrogen. To apply it, the strained liquid above mentioned is introduced, together with a few strips of zinc, into the apparatus figured in the margin, the zinc being placed in the lower bulb. If the liquid be not already sufficiently acid to act readily upon the metal, it may be rendered so by adding either hydrochloric or sulphuric acid. On then inserting the cork and closed stopcock, the gas evolved gradually collects in the lower bulb, expelling the liquid into the upper one, until the zinc is left above the liquid, when further action of course ceases. On now cautiously opening the stopcock, the gas, which will be expelled by the pressure of the column of liquid, must be ignited, and the flame made to impinge upon the interior of a small porcelain cup or basin. The production of a brown or black stain upon that part of the porcelain upon which the flame has played, proves the presence of arsenic or antimony. If now a small quantity of solution of chloride of lime (bleaching-powder) be poured into the porcelain cup so as to cover the stain, the latter will disappear if it consist of arsenic. If the stain do not disappear, antimony is present; but the stain may also have contained arsenic, as it is impossible to perceive with certainty, whether or not a *portion* only of the stain has dissolved. Under these circumstances, to ascertain indubitably the presence of arsenic, recourse must be had to Fleitman's test, which must be applied to another portion of the original strained acid liquor.

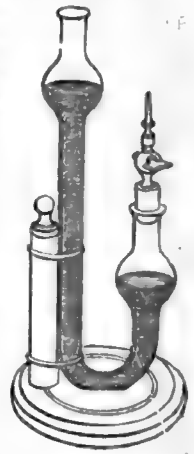


Fig. a.

Fleitman's Test. — This simple and very valuable test is founded upon the circumstance that when an arsenical solution is heated with excess of caustic soda or potash, in contact with zinc, arsenuretted hydrogen is evolved; whilst by a similar treatment of an antimonial solution, no antimonuretted hydrogen is liberated. It therefore affords a ready means of detecting arsenic with certainty, even in presence of antimony.

The following is the method of applying this test. A portion of the strained liquid above alluded to is placed in a test-tube, *Fig. a*, containing a few fragments of granulated zinc. A strong solution of caustic soda or of caustic potash is then added until the liquid is strongly alkaline, and the mouth of the tube being closed by a strip of filter paper, moistened with solution of nitrate of silver, the heat of a spirit lamp is applied to the liquid in the tube until gentle ebullition commences, care being taken to hold the tube in an inclined position, so as to prevent the contents from spirting upon the paper. If arsenic be present, the paper impregnated with silver solution will become tinged of a more or less deep brown colour; any such alteration in the colour of the paper is a positive proof of the presence of arsenic. The coloration of the paper is produced by the decomposition of arsenuretted hydrogen and the formation of brownish black arsenide of silver.

There are many other tests for the detection of arsenic, but the foregoing having been selected as the best and most conclusive, it is unnecessary here to allude to them.

It is of course necessary that all the chemicals used in the above tests should be first proved to be perfectly free from arsenic, by the application of the tests themselves. Zinc, sulphuric acid, and especially hydrochloric acid, even when the latter is sold as *pure*, are not unfrequently contaminated with arsenic.

ARSENIC, *Medical Properties of*. As metallic arsenic has no effect upon the human system, we shall mostly confine our observations to the employment and mode of action of the white oxide or arsenious acid, and its compound, the arsenite of potash. The characters of arsenious acid have been given above, but one remarkable circumstance connected with these requires to be noticed here; the degree of solubility depends on the degree of transparency or opacity of the specimen or portion employed. For example, 1000 parts of boiling water dissolve 97 parts of the transparent acid, retaining only 18 parts when cold; but an equal quantity of water will dissolve 115 parts of the opaque variety, and retain 29 parts when cold, the remaining parts being precipitated. It is manifest, therefore, that the strength of a solution must vary with the kind of specimen employed. This discrepancy is denied by Dr. Alfred Taylor. ('Guy's Hosp. Reports,' vol. iv .p. 83.) The precise character of the taste of white arsenic is a matter of dispute; it is generally said to be acrid and corrosive, followed by an impression of sweetness; but Dr. Gordon states, that it is *at first* always sweet, but afterwards somewhat acid. (Gordon, 'Dissert. Inaug. de Arsenico,' Edinb. 1814, p. 9; 'Edinburgh Medical and Surgical Journal,' vol. xi. p. 134.)

The white oxide of arsenic being so often employed for the destruction of human life, a dread of it exists, not only among the unprofessional part of the community, but even among medical men, which has caused it to be less tried, and its modes of action less studied, than most other medicinal agents of the *Materia Medica*. That it labours under a most unjust opprobrium cannot be doubted, for it is not so poisonous as many other articles frequently used, such as prussic acid and strychnia, while its curative influence is certainly very great.

If a small quantity of the white oxide of arsenic, such as $\frac{1}{30}$th or $\frac{1}{16}$th of a grain be swallowed, in about a quarter of an hour the individual experiences an agreeable sensation of comfort and warmth about the stomach, which gradually extends itself over the whole of the abdomen. The appetite and thirst are moderately increased, the secretion of urine becomes more abundant, and the evacuations from the intestines often more frequent, and of a pulpy or pappy character. From the intestinal canal the peculiar action propagates itself over the whole system. The heat of the surface is augmented, and the increased temperature is experienced particularly about the forehead and eyebrows, and the skin is bedewed with a breathing perspiration. At the same time an increased strength and frequency of pulse is felt. The whole muscular system acquires energy and elasticity; the involuntary muscles especially become more powerful and vigorous in their action; the respiration is gently accelerated. The nervous system partakes of the impulse communicated to the frame, and the spirits as well as the courage of the individual rise, liveliness and regularity characterising the whole functions of the system.

That the white oxide of arsenic is a tonic, therefore, is sufficiently clear; and that its employment in such doses as we have stated is not only safe but beneficial, may be satisfactorily proved. Not only are old worn-out horses endowed with new vigour, improved appetite, &c., by its use, but pigeons to which this article is given show greater appetite and liveliness than others without it; and in Upper Styria the peasantry use it as a seasoning with many articles of food, such as cheese.

It will not, we trust, be supposed that by bringing forward these facts and statements, we desire to lead any one to make a hasty or inconsiderate use of this very powerful agent. We only wish to show that much prejudice exists against it, in order that when circumstances seem to require its use, medical men may not be deterred from employing it from ignorance of its qualities, nor have to encounter unnecessary difficulties from the objections of others. That oxide of arsenic may accumulate in the system, or may give rise to slow poisoning, cannot be questioned; but if exhibited in appropriate cases, the morbid state of the system seems to act as an antidote to it, just as it acts as an antidote to the disease, health being the result of their neutralising power. Every medical practitioner knows what large doses of opium may be given with safety and benefit in tetanus, and some other diseases. It has been stated under ANTIMONY, that very large doses of tartrite of antimony can be borne in certain states of the system; and in the West Indies, during the state of insensibility following the bite of a snake called the *coluber carinatus*, eight grains of the white oxide of arsenic, and eighty drops of the tincture of opium have been given in the course of four hours, that is, one grain every half-hour, with the best effect. (See Paper by Mr. Ireland in 'Medico Chir. Transactions,' vol. ii. p. 393.)

White oxide of arsenic is not often given in the solid form, nor, owing to its variable solubility, is the solution frequently employed; the form most generally chosen is that of its combination with potass, or arsenite of potass: which is the basis of the *liquor Potassæ arsenitis* of the London Pharmacopœia, in the preparation of which the quantity of potass is scarcely sufficient to saturate the whole of the acid, some of which must consequently remain free in solution or be deposited. Before the regular introduction of this into medical practice, it had long been employed in Lincolnshire for the cure of intermittents, under the name of the *Tasteless Ague Drops;* and, from having been introduced into practice by Dr. Fowler, it is frequently called *Fowler's Solution.* It is never given in larger quantity than three or five drops, and should always be taken about half-an-hour after a meal, to prevent it coming into direct or immediate contact with the inner coat of the stomach.

Being considered eminently an anti-periodic [AGUE], it has been used in most diseases which partake of a periodic character; the chief of these we shall here notice, along with two or three others not possessed of a periodic character. It is most frequently employed in intermittent fevers; the greatest advantage is derived from it in the tertian and quartan forms, the quotidian often resisting this and all other remedies. Its beneficial effects may be increased by giving calomel first; cinchona bark may be given also during the employment of arsenical medicines, but it should rather be alternated with them than given at the same time; certainly they should not be given in the same formula or prescription, though, if the patient be very weak, other tonics may be given along with them. Opium is sometimes advantageously given along with them, but it should be employed in very small quantity.

It has sometimes been given in remittents, which approached nearly to the character of intermittents.

In rheumatic cases it has been used, and is most successful when the pains are markedly periodic, or true to a particular hour in their return. It is equally applicable whether these be general or local, as in some rheumatic affections of the eye. (See Travers 'On Diseases of the Eye.') In nodosities of the bones from rheumatism it is also very valuable.

In some affections, more especially of the nervous system, such as *tic doloureux*, and other neuralgic pains, it is useful. In *cardialgia*, or heartburn, when chronic, if combined with belladonna, it often affords speedy and lasting relief. It has sometimes been advantageously employed in hooping-cough, angina pectoris, epilepsy, and chorea, when tonics were required. In some chronic nervous affections of the mental faculties it has been found useful, such as melancholia and hypochondriasis; and in hydrophobia, tetanus, and the bites of serpents, it is certainly more valuable than any other means we are acquainted with. Mr. Brodhurst has proposed its employment during the period of *incubation*, before the formidable symptoms manifest themselves; this is a wise and sensible proposition.

In cancer it has been employed both internally and externally; the form generally used in the latter way is *pâte arsenicale*, but it is not free from danger, and requires great caution. Its internal employment has been mostly in cases where it depends upon constitutional rather than local causes; but if hectic fever be present, it will do more harm than good. It seems to be of more service in cancer of the lip and face, than in affections of the glands, as the mammæ or testicles. In cutaneous diseases, such as lepra or elephantiasis, it is often serviceable, and its beneficial action may be increased by giving *liquor potassæ* along with it.

We hold that the previous failure of other and more common remedies is a sufficient justification of the employment, with due caution, of arsenic in any of these diseases.

In case of an overdose, or of intentional poisoning by arsenic, it is proper that we should indicate an antidote, and point out the mode of treating such a casualty: both these are difficult. First, then, in the case of a substance so sparingly soluble, we cannot see how the stomach-pump is likely to be of service; more especially as the white oxide either adheres firmly to the inner coat of the stomach, or gets imbedded in its substance. A more rational plan is to give a large quantity of lime-water, cold, as the arsenite of lime is almost insoluble, and nearly inert. After that, an emetic of sulphate of zinc (ʒ i. in a pint of distilled water); then copious draughts of oil (castor oil if possible), or milk. After which the case must be treated on general principles. [ANTIDOTES; POISONS.]

The *Liquor Arsenici Chloridi* of the London Pharmacopœia is thought to be more serviceable in cutaneous diseases than the other preparations. Arsenite of soda has some advantages. (See Lloyd Bullock in 'Journal of Pharmaceutical Society,' vol. x. p. 359.)

Arsenic has been detected by Ménard in the mineral waters of Mont-dore, Ste. Nectano, and other springs, in which it exists in combination with various bases, especially soda. These springs are celebrated for their curative effects in cutaneous diseases. The efforts of the legislature to restrain the illegal employment of arsenic are praiseworthy, but can scarcely reach the multiform employments of it which are injurious to health. The paper-hangings of our rooms, the candles we burn, the toys and sweetmeats our children handle and devour, are too often coloured with arsenic.

In cases of poisoning, antidotes are needful; but no very efficacious one can be recommended. Hydrated sesquioxide of iron is useful in large doses, but is seldom at hand; hydrated magnesia, in large doses, is useful, and more generally procurable.

ARSENIC ACID. [Arsenic.]

ARSENIO-DIETHYL. [Organo-metallic Compounds.]

ARSENIO-DIMETHYL. [Cacodyl.]

ARSENIO-METHYLETHYL. [Organo-metallic Compounds.]

ARSENIO-TRIETHYL. [Organo-metallic Compounds.]

ARSENIO-TRIMETHYL. [Organo-metallic Compounds.]

ARSENIOUS ACID. [Arsenic.]

ARSENITES. [Arsenic.]

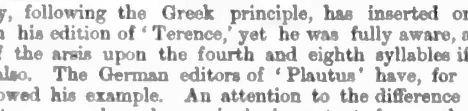
ARSENURETTED HYDROGEN. [Arsenic.]

ARSIS (ἄρσις, elevation) is a technical term in ancient music and ancient metrics. In the latter it denotes that elevation of the voice which we now call metrical accentuation; but whether it consists in a higher musical note, a greater volume, or greater duration of sound, or rather, perhaps, in all the three combined, is matter of dispute. The musician is said to have struck the ground with his foot to mark the arsis, and hence the Latin term *ictus* (stroke) has been used in the same sense. The arsis is opposed to the *thesis* (θέσις) or depression of the voice, the precise meaning of which is of course subject to the same ambiguity. The order in which the arsis and thesis recur, constitutes the law of any verse or metre. It must be recollected, however, that although only two terms are used, yet one arsis may be more energetic than another, one thesis weaker than another. Thus in the ordinary iambic measure of six feet, there are six places marked by the arsis, namely, every even syllable, the second, fourth, &c.; but the stronger arsis attaches itself to the second, sixth, and tenth. The Latin writers on metrics accordingly called the verse we are speaking of sixfold (senarius), while the Greeks applied it to the name of a triple metre (trimeter), the former including every arsis, the latter only those which are more marked.

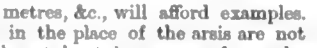
Bentley, following the Greek principle, has inserted only three accents in his edition of 'Terence,' yet he was fully aware, and often speaks of the arsis upon the fourth and eighth syllables if not the twelfth also. The German editors of 'Plautus' have, for the most part, followed his example. An attention to the difference of power in the stronger and weaker arsis is important for another reason. After the stronger arsis, the thesis must be very weak to mark the contrast, while after the other there may be admitted even a long syllable, provided it has not also the accent. The laws of the iambic, trochaic, Sapphic metres, &c., will afford examples. In many metres, certain variations in the place of the arsis are not merely permitted, but even desirable, at least in poems of any length. In our own iambic metre of five feet, commonly called the heroic verse, the arsis is often found upon the first instead of the second syllable. Again, in the hexameter of Homer, the dactylic arsis, or the arsis followed by two depressions, is the prevailing law; whereas in the Latin hexameter, in addition to the pure dactylic rhythm, we find a large proportion of lines in which there is an approach to an iambic rhythm at the beginning of a line, as in the second verse of the 'Æneid':

"Itáliam fáto prófugus | Lavínaque vénit.

Perhaps this variety may have been more pleasing to the Roman ear, as it is certainly more common in Latin hexameters, from an old attachment to the Saturnian verse, in which the iambic cadence commences, and the trochaic terminates the line; or, in other words, perhaps the Latin hexameter may be a compromise between the Greek hexameter and the Latin Saturnian. A metre in which the arsis is very commonly misplaced by the English reader is the Sapphic, the true melody of which runs thus:—



where and mark respectively the stronger and weaker arsis; the thesis; whereas the ordinary English intonation is



&c.; and thus a melody, which by Horace was selected as peculiarly adapted to the solemnity of the religious hymn, has been degraded by the English into the fit vehicle of burlesque and ridicule. An example may be seen in the pseudo-Sapphic ode on a Knife-grinder in the 'Antijacobin.' [Prosody; Accent.]

ARSIS and THESIS, in music, the rising and falling of the hand in beating time, from ἄρσις, "raising," and θέσις, "depressing." These terms were also used by the early composers to express the inversion of a subject. *Per arsin* is, when the air, or counterpoint, descends from acute to grave: *per thesin* is, when it ascends from grave to acute.

ARSON (from *ardeo*, to burn), in the technical meaning of the term, at common law, signified the offence of voluntarily and maliciously burning the house of another. This offence always amounted to felony by the law of England, and was punishable with death. But in order to constitute burning a felony at common law, it was necessary that the building destroyed should be a dwelling-house, or a part of it, or at least some of the buildings attached to it. The property destroyed must also have been in the possession (*suo jure*) of some other person than the supposed offender at the time of the fact committed. On these grounds, and on account of the obscure phraseology of several statutes, nice and doubtful questions constantly arose upon the trial of persons charged with arson, both with respect to the nature of the buildings destroyed, and the character of the possession of the proprietor. These ambiguities were removed by the statute 7 & 8 Geo. IV. c. 30, sec. 2, afterwards repealed by the 7 Will. IV. and 1 Vict. c. 89, by which (as extended and amended by subsequent acts) unlawfully and maliciously to set fire to any dwelling-house, any person being therein, is a capital felony; and unlawfully and maliciously to set fire to any church or chapel, or to any house, stable, coach-house, out-house, warehouse, office, shop, mill, malt-house, hop-oast, barn, or granary; or to any building or erection used in carrying on any trade or manufacture; or to any hovel, shed, or fold, or to any farm building, or any building or erection used in farming land, whether the same or any of them respectively be in the possession of the offender or of any other person, with intent thereby to injure or defraud any person is a felony punishable by penal servitude for life, or for a less period, or by imprisonment not exceeding three years. Setting fire to any hay, straw, wood, or other vegetable produce being in any farm-house or farm-building, or to any implement of husbandry therein, with intent thereby to set fire to such house or building, and to injure or defraud any person, involves (by the 7 & 8 Vict. c. 62) the same penalties as setting fire to the house or building with the like intent.

The before-mentioned statute 7 Will. IV. and 1 Vict. c. 89, also provides for the offence of setting fire to vessels, coal mines, and also to stacks of grain and vegetable produce, peat, coals, charcoal, or wood. By the 9 & 10 Vict. c. 25, s. 7, attempting to commit any of the above offences is made a felony which is now punishable by penal servitude not exceeding fifteen years, or imprisonment not exceeding two years.

The burning of a man's own house, if it be situate in a town, or so near to other houses as to endanger them, is a misdemeanour at common law, punishable with fine and imprisonment.

ART AND PART is a term used in Scotch law to denote the charge of contriving a criminal design, as well as that of participating in the actual perpetration of the criminal fact. The derivation of the phrase is uncertain. Sir George Mackenzie, in his 'Discourse upon the Laws and Customs of Scotland in matters Criminal,' says, that "by *art* is meant that the crime was contrived by the art or skill of the accused (*eorum arte*); and that by *part* is meant, that they were sharers in the crime committed, et quorum *pars* magna fui." By other writers it has been considered as an abbreviation of the Latin phrase of *artifex et particeps.* It is a charge of very extensive meaning, comprehending not only the offence of accessories before and after the fact according to the English law, and the *ope et consilio* of the Roman law, but also all interference and assistance at the time of the commission of the criminal act. By an ancient Scotch statute, passed in 1592, it is required that in all criminal libels or indictments, the offenders shall be charged as having committed the imputed offence 'art and part.' This enactment was occasioned, as its preamble intimates, by the frequent instances of failure of justice in criminal trials, in consequence of a variance between the evidence and the particulars detailed in the libel or indictment. Thus, previously to the statute, if A and B were charged with murder, and the indictment stated that A held the deceased while B stabbed him, and it appeared in evidence that the facts were reversed, and that B held him while A stabbed him, neither of the accused persons could be convicted. But by the insertion of the charge of 'art and part,' such a failure of justice could not occur; for in fact, both the panels, or prisoners, are substantially guilty 'art and part,' and are therefore comprehended in the general charge of the indictment. This subject is very copiously discussed in Hume's 'Commentaries on the Law of Scotland respecting the Description and Punishment of Crimes.'

ART-UNIONS. In the 'Report' issued in 1836 by a Select Committee of the House of Commons, which had been appointed in the preceding year "to inquire into the best means of extending a knowledge of the arts, and of the principles of design, among the people (especially the manufacturing population) of the country," and "to inquire into the constitution, management, and effects of institutions connected with the arts," it is observed that among exhibitions connected with the encouragement of art, the attention of the committee had been called to the institutions established in Germany under the name of 'Kunst-Vereine,' and which were even then being introduced into this country. "These associations, for the purchase of pictures to be distributed by lot," observe the committee, "form one of the many instances in the present age of the advantages of combination. The smallness of the contribution required brings together a large mass of subscribers, many of whom without such a system of association would never have been patrons of the arts." The committee further remark that Waagen and Von Klenze, two of the witnesses examined by them, highly estimated the advantages conferred on the arts by such associations, which, according to Waagen, were introduced into Prussia about the year 1825, under the patronage of the king and his minister Von Humboldt.

Down to the time at which this 'Report' was published, such associations had made comparatively little progress in this country; but shortly after its appearance a society was established under the name of 'The Art-Union of London,' which immediately obtained considerable support, and which soon became an important institution. The professed objects of this institution are "to aid in extending the love of the Arts of Design within the United Kingdom, and to give encouragement to artists beyond that afforded by the patronage of individuals;" and the mode in which these objects are attained is briefly as follows: —Every member of the association subscribes annually the sum of 21*s.* or upwards, those who choose to subscribe two, three, four, five or more times that amount being considered to hold a proportionate number of shares in the prospective benefits; and, on the closing of the annual subscription-list, which takes place early in the spring, the committee of management set apart a portion of the aggregate sum for the purpose of engraving and printing some work of art, a copy of which is given to every subscriber for each guinea subscribed. By the combination of a very great number of persons to subscribe for this one work of art, and the avoidance of risk, incidental expenses, and publisher's profits, this print, though superior to what would be charged a guinea in the ordinary course of trade, is supplied to the subscribers at so small a cost as to leave the greater part of the sum subscribed, as a fund applicable to the purchase of pictures, sculpture, and other works of art. This sum is divided by the committee into several portions, or prizes, ranging at the present time (1859) from 10*l.* to 200*l.*, and on the day appointed for the annual meeting of the society, these prizes are distributed among the subscribers by a process resembling the drawing of a lottery, which gives an equal chance for every guinea subscribed. The prizeholders are then allowed to select a painting or piece of sculpture to the value of their respective prizes from any of the annual exhibitions of works of art in the metropolis, for the current year, which works, when selected by the prizeholders, are purchased and paid for by the committee, who, at the close of the exhibitions, collect the pictures and sculptures together, and exhibit them gratuitously for some weeks, first to the subscribers and their friends, and afterwards to the public. When the selected works fall short of the amount of the prize, the difference is carried by the committee to the Reserved Fund of the association, and when they exceed it, the difference is paid by the prizeholder. A portion of the funds is also applied to the production of bronzes and medals, porcelain groups and statuettes, etchings, photographs, &c., which are distributed as prizes at the annual meeting. The amount of subscriptions in the first year, which closed in 1837, was 489*l.* 6*s.*, but it increased so rapidly that in 1844, it had reached 14,848*l.* It has since fluctuated considerably, but the last report showed that the subscription for 1858 was 11,658*l.*, of which 3,060*l.* was set apart for the purchase of works to be selected by the subscribers; 2,249*l.* for statuettes, bronzes, &c.; and 2,998*l.* for the engraving.

The popularity of the Art-Unions, properly so called, brought into operation several lotteries for the disposal of works of art, in which, notwithstanding the adoption of a similar course of proceeding, the principle was so essentially different, as to render them in fact mere revivals of a species of gambling speculation which has long been illegal in this country; and the difficulty of dissociating Art-Unions from lotteries unquestionably illegal, led government to issue a notice in April, 1844, which had the effect of suspending their operations for some months. A parliamentary committee was subsequently appointed to inquire into the subject, with a view to placing them on a safe and permanent basis, and so rendering them as subservient as possible "to the improvement and diffusion of art through the different classes of the community;" the result of which was the passing in the session of 1844, of a short Act to indemnify the managers against such penalties as they might be considered subject to; and eventually an Act was passed (9 & 10 Vic. c. 48), to legalise Art-Unions under the condition, that a royal charter shall have been obtained, or that the deed of partnership or other instrument constituting the association, with the rules and regulations, shall have been submitted to and approved by a Committee of the Privy Council.

Having described the principles and mode of procedure of the Art-Union of London, it may be proper to notice some other Art-Unions which have been since established, and which have adopted a different mode of distributing the selected works of art among their prizeholders. Of these, the oldest and most important is the Art-Union of Glasgow, established in 1841, and of which the annual subscriptions for the year 1855 amounted to 20,336*l.* As in the Art-Union of London, a copy of an engraving is given to each subscriber; but the pictures which are allotted as prizes are selected by the committee, the prizeholders having no choice, but each receiving the picture which falls to his lot at the annual meeting. The prizes for 1858 vary in nominal value from 3*l.* 3*s.* to 350*l.*

The Art-Union of Ireland, established in 1858, proposes to get rid of the great outlay rendered necessary by presenting each subscriber with an engraving; and instead, to increase the proportion of prizes, so that while in the older Art-Unions the prizes are in the proportion of one to every twelve or fifteen subscribers, in this, the prizes, "making large provision for those of the higher class, may be estimated at about one in every six" ('Address' of Committee). Further, every prize is to be selected by the prizeholders; and while "all above 5*l.* must be selected from paintings or sculpture exhibited in Ireland," prizes below that sum (of which there are to be a considerable number), may be selected from *any* work of art "anywhere on sale in Ireland, of a class approved by the committee."

The Crystal Palace Art-Union, established in 1858, chiefly aims at the production and distribution of works of ornamental art of a high order of artistic merit. Each subscriber of a guinea has the right of selecting one of the objects of ornamental art (including bronze and parian statuettes, articles of ceramic ware, photographs, &c.), "executed under the supervision of the council, the copyright of which, as far as possible, will be vested in the society," and of which the ordinary trade price would be not less than the amount of the subscription. Besides which, every subscriber is to have a chance of obtaining a prize from among works of fine or ornamental art, "of the highest class," which are to be selected by the council and exhibited at the Crystal Palace previous to the annual drawing.

ARTANTHE ELONGATA, the plant which yields the medicina agent known by the name of Matico. This plant belongs to the natural order *Piperaceæ*, and is the *Piper angustifolium* of Ruiz and Pavon, the *Piper elongatum* of Vahl, and the *Stephensia elongata* of Kunth. Although this plant has long been used by the natives of Peru as a remedy in various diseases, it was not known till recently that it produced the substance known as matico. The term matico is, however, applied in Peru to other substances, and Dr. Lindley states that the leaves of *Eupatorium glutinosum* were sent to him under that name.

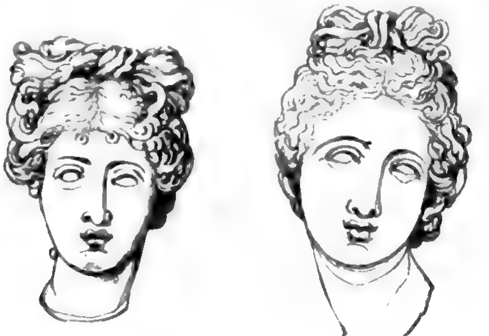
Artanthe elongata, the true matico plant, is a shrub about 12 feet high, with jointed stem and branches. Its leaves are harsh, short-stalked, lanceolate, acuminate, pubescent beneath, tessellated or rough on the upper side on account of the sunken veins. The spikes are solitary, cylindrical, and opposite the leaves; the bracts lanceolate and the flowers hermaphrodite.

It is a native of Peru, and is found at Huanuco, Cucheco, Panao, Chaclea, and Muna. It flowers from July to September. An infusion made with cold water is the best form of administration.

A'RTEMIS, one of the ancient Greek divinities, known to the Romans as Diana, whose attributes were so numerous and of such opposite kinds, that it would be difficult to imagine how they should have been assembled in the same deity, if we did not know that the imaginative spirit of the Greeks loved to invest their gods with the most opposite characters. In the poetry of Homer and Hesiod she appears as the daughter of Zeus and Leto (Latona), sister of Apollo, and the goddess who presides over hunting. She traverses the woods, armed with the bow and arrow, and attended by numerous nymphs. Her bow is employed, not only against the beasts of the forests, but also against man; and in those early poems she is represented as never yielding to the allurements of love. She is a chaste and pure virgin. In the 'Orphic Hymns' (35, 36), we find her invested with other attributes. There she assists at childbirth, is the assuager of pain, looks with benignant eye on the labours of man, and is the author to him of abundant harvests, of peace, and of health. In this she seems to have appropriated to herself part of the duties of Ceres, and indeed, according to Æschylus, she was daughter of that goddess. In a temple at Megalopolis in Arcadia her statue stood by the side of that of Ceres, and she was clothed with the skin of a hind; a quiver hung from her shoulder; she had a lamp in one hand, and two serpents in the other. (Pausan. viii. 37.) In the Greek tragic poets she appears under another character, according to which the favour of the goddess must be obtained by the sacrifice of human victims. Iphigenia, daughter of Agamemnon, on her return from the Tauri, introduced this barbarous feature in the worship of Artemis. At Sparta there was a temple of Artemis Orthia, where they exhibited an old wooden statue, said to be that brought by Iphigenia from the Tauri; and though in later times human victims were not offered, the thirst for blood, which the goddess was supposed to feel, was satisfied by the severe scourging of the Spartan youths before her statue. (Pausan. iii. 16.) All these various fables were collected by the Alexandrine poets of later times, and fitted to one another so as to form a whole.

The worship of Artemis was very general throughout Greece and the colonies; but she was more particularly the goddess of the Arcadians, if we may judge from the numerous temples found in that district. There almost every height, fountain, and river supplied her with a distinctive epithet, so the poet Alcman (who flourished probably B.C. 672) says, that she derives names from ten thousand mountains, cities, and rivers. She is Lycoatis on Mount Mænalus (Paus. viii. 36), Cnakeatis at Tegea (viii. 53), Stymphalia on Stymphalus (22), Cnacalesia and Condyleatis at Caphyæ (23): and it is curious to observe that this old Peloponnesian divinity is frequently found in connection with streams and rivers. She is *amnium domina*, 'mistress of rivers,' in Catullus (34, 12); λιμένεσσιν ἐπίσκοπος, *inspectress* or *superintendent of ports*, in Callimachus (iii. 40). Again, as Apollo was identified, by the later Greek writers, with the sun (Helios), so was Diana with the moon (Silene). [APOLLO.]

Artemis was a favourite subject with the artists of Greece, and they have generally represented her as a huntress. They endeavoured to invest her with all the freshness and vigour of youth: in the old style, where she is generally clad in the stola, the artist still contrived to indicate her full and well-formed figure. In the works of Scopas, Praxiteles, and Timotheus, Artemis was, like Apollo, represented of a slender form; her hips and breasts without the fullness of womanhood. The countenance is that of Apollo, only with a softer expression and more full; the hair is sometimes bound over the forehead, but more frequently in a bunch behind or on the top of the head in the



(Heads of Artemis in the British Museum.—First Græco-Roman Saloon.)

manner peculiar to the Dorians. The dress is a Doric vest (χιτὼν), either tucked up high, or reaching to the feet; and the shoes are Cretan. Sometimes a dead or dying stag lies at her feet. As a huntress she is represented in rapid motion. In temples she bears a torch as well as a bow. (See Filhol, 'Galérie Napoléon,' v. 366; Visconti, 'Iconographie,' xlii. 1; 'Diana Lochæa' in Millin, 'Monuments inédits,' ii. 34. (This subject is treated fully in Müller, 'Archäologie der Kunst,' §§ 363—365.) There are several representations of Artemis in the British Museum, besides the heads given above. One, a statue clothed in a long vestment, is a very fine figure, but has been incorrectly restored. In one of the slabs of the Phigalean frieze she is figured with Apollo in a car drawn by stags. We have not entered into the question whether there were several goddesses of this name, distinct from each other in their character and attributes; but we think that this opinion is by no means improbable. She is considered the same as the Bubastis (Pasht) (Herod. ii. 59) of the Egyptians, and is represented as a female with a lion's head. (Seyffarth, 'Geschichte des alten Ægypten,' Leipzig, 1833; Müller, 'Die Dorier' (translation) vol. i.; Voss, 'Mythol.' Br. iii. 1.

In the Roman mythology, the goddess *Diana* was considered as corresponding with the Artemis of the Greeks. But much confusion has arisen in the study of ancient mythology from the habit of looking upon the names of the Greek and Roman deities as convertible with one another. Where there are some points of resemblance, there are often still more of dissimilarity, especially as regards those deities which were the objects of religious honour among the Romans before the introduction of Greek and Asiatic forms of worship. The Saturn of the Romans, for example, is far from identical with the Kronos of the Greeks; Minerva, again, differs much from Pallas, and Diana from Artemis. The greater part of the deities strictly belonging to the Romans have names which have grown out of the language itself. This cannot be said of the Greek deities. Thus Dianus and Diana are properly two adjectives, derived from *dies*, 'day,' or, perhaps, originally 'light,' precisely as *quotidianus* from *quotidie*, and in this way they were the appropriate names of the god and goddess of light, the former representing the sun or greater light, the latter the moon. Dianus, by an easy change, would become Janus, as Diana, we know, was corrupted by the rustic population into Jana in their hymns to the new moon, beginning *Jana novella*. Thus again, *Bellona* is properly a feminine adjective, which with the noun *dea* signifies the goddess of war (from *bello*, war); so Pomona, the goddess of fruit (*pomo*); Portunus, or Portumnus, the god of harbours (*portu*); Vertumnus, of change (*versu*, anciently *vertu*); Silvanus, of woods (*silva*); Luna, or Lucina, the goddess of light (*luc*, and perhaps *luci*): Fortuna, the goddess of chance (*fort*, or more probably from an obsolete noun *fortu*). On the same principle, no doubt, are formed the names of Vulcanus (compare *fulgeo*, φλέγω, shine, blaze), Neptunus (compare νίπτω, wash, and *nympha*, a goddess of water), Saturnus (compare *satur*, full), Picumnus, Pilumnus, Faunus; and we might perhaps look upon Auctumnus (from *auctu*, increase) as a deity.

Another principle which pervades the Roman mythology is the division of each object of fear or desire between deities of either sex. (Niebuhr, 'Roman Hist.') We have already seen Dianus and Diana. Besides these, there occur Saturnus, the god of plenty; Ops, the goddess of plenty; Vulcanus and Vesta, the god and goddess of fire; Tellumo and Tellus, of earth; Neptunus and Nympha (Nimfa would be a more correct Latin form), of water; Jupiter or rather Jove, and Juno, of air. In the same way they had Mavors (or Gradivus), together with Bellona, to preside over war.

To return; as the huntsman of Italy preferred the night for his sport—

> Manet sub jove frigido
> Venator, teneræ conjugis immemor—

Diana, or the moon, naturally became the patroness of the chase, and so of the wood. Again, in her character as goddess of light, her aid was invoked in parturition. In this latter office she was also called Lucina, a term of precisely the same import from *luc*, 'light;' and the identity of the two goddesses is established by the contracted form Luna, which, like Diana, is the name of the moon.

Diana had a temple on Mount Aventine, and another near Aricia. Indeed her worship belonged strictly to Latium and the plebeians of Rome.

ARTEMI'SIA ABSINTHIUM (WORMWOOD)—*Medical Properties of.* This indigenous perennial plant is met with on waste places, but what is required for medical use is mostly cultivated. The upper part of the stem, with the leaves and unexpanded flowers, should be collected, for these parts possess the peculiar aroma, with a strong bitter taste; while the lower part of the stem is merely aromatic, and devoid of bitterness. (Geiger.) It imparts its properties to water, to alcohol, and to fermented liquids. The medicinal forms of it are—the watery infusion (best made with cold water) and the extract: but the domestic preparations are numerous; these are made either by digesting it with alcohol, to form a tincture, or by distilling it with spirits; that obtained in this last way from Switzerland is termed 'Eau d'absinthe,' and is a favourite liqueur, which becomes milky on the addition of water. It is also steeped in wines (Wermuth), or even rendered a constituent of the wine at the time of fermenting it [WINES], or drunk in small quantity while using any of the sweet wines, such as Tokay. This practice may have been derived from the ancients, most of whose wines were very rich and luscious, and who used wormwood, both before and after taking wine, to counteract the effects. (Paulus Aegineta.) In the west of England it is frequently steeped in cider, to be drunk by persons disposed to calculous complaints: a most judicious proceeding. Elsewhere it is steeped in ale. In the north of Europe it is used as a substitute for hops in the preparation of beer, and is nearly as good, as a little of it will preserve either beer or weak wines when ready to turn. The analysis by Heyne of 100 parts of the dried plant gave as its composition—volatile oil ?; bitter extractive, 4·0; gummy mucilage, 15·1; resin, soluble in ether, 8·6; resin, insoluble in ether, 3·4. The rest consists of woody fibre, water, and loss. Braconnot analysed the watery extract, and found—volatile oil, 0·15; green resin, 0·50; bitter resin, 0·233; albumen, 1·250; starch, 0·133; azotised matter, 1·333; bitter azotised matter, 3·0; woody fibre, 10·833; absinthate of potash, 0·333; sulphate of potash and chloride of potassium, traces; water, 61·2. Recently, a peculiar principle termed *Santonine*, crystallisable, colourless, and almost tasteless, and stated to possess very valuable anthelmintic properties, has been obtained from several species of artemisia, particularly Art. Contra. ('The Chemist,' vol. v., pp. 36, 91.) The term *Absinthine* is applied to the peculiar or bitter principle of Artemisia absinthium. The so-called salt of wormwood is merely the impure carbonate of potash, obtained from the incineration of this plant, which is very rich in alkaline salt.

Wormwood possesses the properties common to aromatic bitters, but it seems to possess also some peculiar ones rendering it worthy of more attention than it receives—neglect of indigenous remedies being prevalent in all ages. The bitter principle is readily absorbed, so that the flesh of animals fed upon it becomes manifestly bitter. Some have alleged that a narcotic power exists in it, and that the milk of cows, or of nurses, to whom wormwood is given, is noxious to infants. This is not clearly proved, nor is it certain that ale in which wormwood has been steeped (purl) is more heady than other ale. Absinthium greatly increases the appetite, and promotes digestion, particularly in torpid systems and debilitated constitutions. Those who, by excess, have impaired their stomachs, have recourse to wormwood to renovate their powers. Hence the demand among gourmands for the spirituous preparations, such as the crême d'absinthe. Where there is much gastric irritation or vascular excitement this is most improper. An infusion (made with cold water) may be given to consumptive patients, if no inflammatory state of stomach exists, with very great advantage, especially if aromatic sulphuric acid be added.

ARTERIES, DISEASES OF. Besides aneurism, the arteries are subject to other diseases. [ANEURISM.] The arterial tissues are liable to inflammation, which may be acute or chronic.

Acute Arteritis is either limited to a particular spot, or it spreads along the course of the artery. When limited, this disease arises from external injury, and is a common result of wounds and ligatures. In the milder forms, this inflammation is attended with the exudation of a plastic matter, which fills up the artery and leads to its obliteration, a result which is sought for in the application of a ligature to arteries. The inflammation may, however, proceed to suppuration and ulceration, when the coats of the artery are opened, and hæmorrhage is the result. In every instance of ligature such a result is carefully to be avoided. A still more intense form of inflammation may occur, and the result will be the death of the part and gangrene—a result which sometimes follows wounds involving the destruction of the arterial tissue. It may also come on from a ligature being applied too tightly.

In the treatment of such cases the ordinary remedies for inflammation should be applied. Cooling applications should be made to the part, and rest and an antiphlogistic regimen enjoined.

The spreading form of arteritis occurs in middle age, in persons of broken constitution. It is seldom confined to one vessel, but affects the arteries of a whole limb. The tracks of the inflamed arteries are painful to the touch, there is slight induration of the affected arteries, the pulse is feeble, and has a peculiar thrilling stroke. The surrounding textures are not often involved in the disease. The pulse in the affected arteries is feeble, has a thrilling stroke, and gradually diminishes till it finally ceases. The tissues surrounding the arteries are seldom affected with the inflammation, and the skin is not altered, except that it is pale.

The effects on the arterial coats are the production of turgescence, and a loss of the smoothness of the internal coat. There is a tendency of the blood to coagulate and become adherent in the inflamed vessel, and ultimately the canal becomes blocked up. In proportion as these changes are extensive, will be the general local mischief. The temperature and sensation of the part are diminished, and gangrene, unless the disease is arrested, sets in.

The treatment consists in the employment of antiphlogistic measures. Leeches may be applied to the part, and calomel and opium given internally. The employment of stimulants, both internally and externally, should be avoided.

Chronic Arteritis is of more frequent occurrence than acute, and is a state of the artery in which abnormal deposits are formed in the coats of the artery, and which frequently lead to the more serious derangements of the arteries. This disease is not to be detected by any symptoms during life, but is recognised after death by its effects on the arteries. The artery may be affected in spots, or throughout its whole extent. The internal coat of the artery is enlarged, and is less smooth and serous on its surface. Between the internal and middle coat there is a deposit of a soft, cheesy-looking, granular matter, either in points or patches. This deposit is usually called *atheromatous.* Under the microscope it is found to consist of fatty granules and molecules, which are frequently associated with crystals of cholesterine. The middle coat of the artery is frequently altered in its character, presenting a thin yellow opaque appearance. From this cause the elasticity of the artery is much impaired, its cohesion is diminished, it easily stretches, and is apt to tear. It is in this condition that dilatation of the artery, or true aneurism, takes place. It may also become the seat of ulceration, or it may tear at once, thus leading directly or indirectly to dangerous hæmorrhages. Although these changes are supposed to take place as the result of inflammation, there is no reason to believe that they may not go on quietly without inflammation. It is not improbable that the changes which thus go on in the artery are identical with those which produce fatty degeneration in the other tissues of the body. When this change takes place in the small arteries of the brain, it not unfrequently leads to an attack of apoplexy, from the rupture of the vessel and the effusion of blood upon the brain.

Calcareous deposits between the inner and middle coats of the artery may take place in the same way as the fatty deposits. In this manner the artery becomes ossified. In this case the arteries become hard and non-elastic, the internal coat is dry and shrivelled in appearance, and atheromatous deposits are found mingled with the calcareous.

The treatment of these forms of arterial disease, where they are suspected to exist, should consist in removing all causes that can contribute to hasten the changing condition of the arteries, and to prevent that action which may facilitate the enlargement, or endanger the bursting of the arteries.

Vascular or Erectile Tumour. This is a form of disease of the arterial tissue, sometimes called *Aneurism by Anastomosis.* There are three varieties: 1. The capillaries of the integument may become dilated so as to produce a discoloured elevation of the skin, more or less depressed. These tumours bleed copiously on the slightest abrasion, or from ulceration. It is commonly called *Nævus.* 2. The veins and arteries may be enlarged in the sub-cutaneous areolar tissue, producing a dark livid tumour of the skin. Copious hæmorrhage occurs from any rupture of the skin, but this may be generally arrested by pressure. Such tumours may occur under the mucous membrane, and are exemplified in those forms of hæmorrhoids which are situated partly within and partly without the verge of the anus. 3. The true erectile tumour, which is composed of dilated blood-vessels, which are closely crowded together, and open into each other at many points. "These openings may be of secondary formation; the result of close apposition in the dilated vessels. Or more probably they are primary; the structure consisting of a network of dilated capillaries; the openings of communication being the ordinary and original inosculations, and what were intervascular spaces being now condensed into mere fibrous bands. The whole constitutes a vascular network of great capacity and activity of circulation, supplied, for reception of the returned blood, with large and tortuous veins, whose lining membrane is plainly continuous with that of the abnormal vascular cells. Also in the neighbourhood are to be found the feeding arteries; originally, perhaps, twigs, now enlarged to trunks pulsating strongly, and obviously carrying on a plentiful and active supply." (Miller, 'Practice of Surgery.') Such is the nature of those tumours which partake of the character of true erectile tissue. Like this tissue also, these tumours become enlarged and diminished in size, according to the sluggishness or activity of the blood circulating through them. They are compressible, elastic, and of a reddish hue. They are usually subcutaneous, but they are also submucous. The most common situations are beneath the integuments of the face, head, neck, back, and buttocks. The tumour pulsates synchronously with the heart, and may be considerably diminished in size by pressure, but resumes its usual condition when the pressure is withdrawn. On auscultation, a beat is heard, dull and rough, sometimes accompanied by a vibratory thrill.

Ulceration is likely to occur in these tumours, and lead either to great hæmorrhage or their cure.

Erectile tumour may be treated in three different ways:—

1. The tumour may be removed. This is always better done by the ligature than by the knife.

2. The tumour may be starved by diminishing the arterial supply. This is done, as in cases of true aneurism, by the application of a ligature to the artery or arteries which supply the tumour with blood.

3. The structure of the tumour may be changed. This may be effected in various ways, as by pressure, the introduction of a needle, the application of caustic potash, nitric acid, or other agent. A hot needle may be run through, or a wire connected with the poles of a galvanic battery may be passed through the tumour. All these plans have been found to succeed with small erectile tumours.

Varix of the Arteries.—A tortuous and dilated condition of the arteries frequently comes on in the smaller arteries, and produces painful tumour. It may be removed in the same manner as varicose veins.

ARTERIOTOMY is the term applied to the opening of an artery for the purpose of drawing blood, as phlebotomy is applied to the same operation in a vein. When it is thought desirable to take blood in large quantity and with much rapidity, it is better taken from an artery than from a vein. This operation, however, is more difficult to perform, and may be attended with ulterior consequences. Hence phlebotomy or venæsection is always preferred, except under urgent circumstances, as the means of drawing blood from the system. When arteriotomy is performed for the sake of blood-letting, one of the superficial anterior branches of the temporal artery is generally selected. In this position the wound is easily healed afterwards by pressure. The accidental wounding of an artery, as is sometimes the case in bleeding from the veins at the bend of the arm, may lead to false aneurism and the necessity of placing a ligature round the wounded artery. Sometimes false aneurism follows arteriotomy in the temporal artery, and in this case it becomes necessary to ligature the arteries on each side of the wound. Sometimes on removing the compress after arteriotomy, an ulcer is found to be formed. If the ulceration spreads, the vessel may be opened and hæmorrhage occur. In this case also the artery must be tied.

ARTESIAN WELL. A description of well in which the water is obtained by means of a hole bored through an upper impermeable stratum to an underlying stratum, of a permeable character charged with water, and occupying a species of basin-shaped depression, in a still lower impermeable stratum; and also under such conditions of hydrostatic pressure upon the waters contained in the permeable stratum, as to cause them to flow over the surface of the ground at the point of outlet. The name is derived from the fact that wells of this description were first known, in north-western Europe, in the province of the Artois in France, where this method of obtaining water has been practised from a very early period. Properly speaking, an Artesian well is one in which the water from the lower stratum rises *above* the surface of the superincumbent impermeable stratum; but by extension the phrase has been applied of late years to any well in which water is obtained by means of a boring through which the waters of a lower stratum are enabled to rise sufficiently near to the surface to allow of their being economically used. It will be seen hereafter that in many instances borings, which were originally strictly Artesian, have at a later period lost the characteristic property of yielding waters flowing *over* the surface, so that in fact the logical correctness of the name as applied to a particular well may very often depend upon accidental conditions.

In order to secure, originally, the condition that the waters of an Artesian well should thus flow over the surface, it is necessary that the outcrop of the permeable stratum, from which the supply is derived, should be situated at a higher level than that of the edge of the overlapping impermeable stratum. In such cases, the water falling upon the exposed edges of the former, passes under the latter, until it meets with an inferior retentive stratum; and then if it cannot find, or make to itself an outlet, it will follow the surface of the impermeable, upholding stratum, in strict accordance with the laws which regulate the flow of water above ground. If, under these circumstances, an opening should be made through the overlying impermeable stratum, the water will rise to a height corresponding with the level at which it passed under the last-named impermeable stratum; excepting in so far as it may be affected by the friction it meets with in its traject, or by the existence of any natural overflows, created by the interruption of the containing basin; provided always that there should not exist any disturbance of the lower retentive strata of a nature to place the water-bearing stratum in contact with a still lower one which should not have any communication with the surface. The facts, and the theoretical reasoning, published with respect to the well of Grenelle, so strikingly illustrate the philosophy of similar operations, that a short account of it is subjoined.

Numerous wells had been sunk in the neighbourhood of Paris, and also, it may be added, near London, in which a supply of water was obtained from the permeable sand beds situated immediately above the chalk, and covered by the impermeable tertiary strata. At Grenelle, however, it was known, by experiment, that the permeable strata of the other parts of the basin were replaced by marls and clays, which intercepted the passage of the water; and therefore M. Mulot, the engineer of the well, supported by the theoretical reasoning, and by the authority of Messrs. Arago and Walferdin, resolved to seek a supply of water by boring through the chalk into the subcretaceous strata, which were believed to form a continous basin under Paris. At Elbœuf and at Rouen the chalk had actually been traversed, and the water had risen at the former locality to a height of 82 feet above the surface of the ground, or 109 feet above the level of the sea. M. Mulot thence concluded that as the surface of the ground at Grenelle was about 104 feet above the level of the sea, and was nearer the inland outcrop of the water-bearing subcretaceous strata, the water furnished by them would there flow over the surface. Messrs. Arago and Walferdin, in fact, found that the level of the lowest point of the valley of the Seine, in its course above the lower greensand formations, was situated at Lusigny, near Troyes, where the surface of the land was nearly 300 feet above the level of the plain of Grenelle; and they inferred from this fact that not only would the water overflow the borehole, but that it would also rise to a very considerable height above the ground. The great Artesian boring of Grenelle was commenced upon faith in this reasoning; and after eight years of indefatigable labour, in spite of all the accidents of the undertaking, and the sneers of the incredulous, the efforts of M. Mulot were crowned with signal success. After traversing the series of beds described below, a supply of water equal to about 800,000 gallons per diem was obtained from a depth of 1802 feet from the surface, or from a depth of about 1698 feet below the level of the sea; and this water rose to the level of 122 feet above the ground at Grenelle.

Before this result had been obtained, M. Walferdin made a series of observations upon the increase of temperature observable in excavations made in the neighbourhood of Paris; and he there found that the mean temperature of the surface being 51°·34, the temperature below the surface became constant at a depth of 94 feet below that level, and that it there invariably marked 53°·06. In the boring itself the thermometer marked, in the chalk, at a depth of 1319 feet from the surface, 76°·3; and in the gault, at a depth of 1657 feet, it marked 79°·61; thus showing that in the distance of 1553 feet below the line of constant temperature, the total increase of temperature was 26°·55, or about 1°·7 for every succeeding 100 feet. According to this law of increase of temperature, the water at the depth of 1802 feet below the surface ought to have risen with a temperature of 81°·96 nearly; and as they are stated to rise actually at the temperature of 81°·81, they must be considered to confirm, in a very striking manner, the theoretical reasoning of M. Walferdin. It may be added that the waters thus obtained are remarkably pure and soft, and that they are used for the municipal service of Paris. The bore-hole appears, however, to be exposed to occasional stoppages by the rising of sand.

The brilliant success of this boring at Paris brought Artesian wells into fashion, and a number of works of the same description were undertaken in various parts of Europe, within a very short period of the completion of the Grenelle well. Amongst the most important of these were the borings undertaken in the Rhenish provinces for bringing to the surface the waters of the brine springs of that district, some of which even exceeded the depth of 2400 feet from the surface. But no new phenomena of the subterranean strata were observed in these cases; nor was any doubt thrown upon the universal application of the laws of underground waters observed to prevail under Paris, till the result of some Artesian borings, in the neighbourhood of Tours, showed that it was impossible, *à priori*, to state infallibly the conditions which would prevail at great depths. M. Degoussée mentions in his 'Guide du Sondeur,' Paris, 8vo, 1847, that he himself had executed no less than sixteen deep borings in the Département de l'Indre et Loire, of which ten are in the town of Tours and six in its neighbourhood, and presented an average depth of about 500 feet. Two of these borings were, however, unsuccessful; and it appears that the conditions under which they occurred, with respect to the great water courses of the district, were such that it became necessary to suppose that the underground course of the waters was interrupted by means of a fault, or of an upheaval. At Calais, the results obtained by the great Artesian well there sunk were even more striking than those obtained near Tours; for after having in this case passed through the drift above the chalk, the chalk itself, and the whole of the subcretaceous strata, the boring was continued *in the transition rocks*, until it had attained a total depth from the surface of about 1150 feet. It will be necessary hereafter to refer to this well, and to the abnormal state of the geological formations under this district.

Very shortly after the completion of the Artesian well of Grenelle some operations of the same description were undertaken in England, of which the wells at Chichester and at Southampton were perhaps the most important. The former well was carried through the strata of the great Hampshire tertiary basin, then through the chalk, chalk-marl, and upper greensand, wherein it stopped at a depth of 1054 feet from the surface of the ground. Very little water was obtained from this boring; and, indeed, the low temperature at which the water stood in the well, led to the inference that the supply could not have come from the lowest level thus attained. The Southampton well was carried through the tertiary beds of the same Hampshire basin as had been traversed at Chichester; and in this case the total thickness of the series was not less than 434 feet. The boring was then carried through the upper and lower chalks, which here presented a thickness of 851 feet; and was finally abandoned in the chalk-marl, at a total depth from the surface of 1317 feet, without securing any valuable supply of water. A great number of Artesian wells had in the meantime been sunk in the tertiary basins of both London and Hampshire, and the drain thus established upon the subterranean watercourses of those formations was so great, that the waters which originally had flown over the surface of the ground, were no longer able to reach that height; and it became evident that the demand upon these water-bearing strata was rapidly exceeding the supply. Under these circumstances the Hampstead and Highgate Water Works Company resolved to renew under London the attempt which had been abandoned at Southampton; and their advisers argued that, inasmuch as the outcrop of the subcretaceous formations was continuous around the margin of the cretaceous basin surrounding and underlying the London tertiaries, excepting on the eastern border, those subcretaceous strata would be found under London just as they had been actually found at Paris.

This reasoning proved to be correct so far as the chalk-marl, the upper greensand, and the gault were concerned; but when those formations had been traversed (to a depth of 1113¼ feet) the boring tools, instead of entering upon the lower greensand, which theoretically had been expected, entered upon and traversed to a total depth of 1302 feet, a series of marls, clays, and sandstones, which appear in all probability to belong to the new red sandstone series: all the intermediate strata being absent.

The interruption in the series of the subterranean strata at Highgate corresponded in so very marked a manner with the analogous interruption previously observed at Calais, that geologists were forced to admit that their theoretical reasoning with respect to such subterranean strata could only present a character of certainty in so far as it enabled them to foretell what formations *would not* be found in any place, whilst it afforded no guarantee as to what *would* be found. In other words, the lesson derived from these two wells was, that the first attempts to secure a supply of water by means of an Artesian boring to a deep-seated, and hitherto untried, stratum were exposed to great dangers and difficulties, with respect to which the ordinary hypothetical reasoning possessed no character of certainty. Subsequently, the result of the Artesian boring, as it was commonly, but somewhat incorrectly called, at Harwich, added to the point of this lesson; for after traversing the tertiaries, the chalk, chalk-marl, upper greensand, and gault, the boring tools came, as at Calais, upon the transition rocks of a very early geological period, at a total depth of about 1200 feet from the surface. This result was, perhaps, the more remarkable from the fact that a successful boring had previously been made at Stowmarket, within a comparatively speaking short distance from Harwich, in which the lower greensand was found to occur in the position it might have been expected to have occupied in the ordinary geological order. More latterly still a very successful Artesian boring has been executed at Ostend, where a supply of water has been obtained, but only from the lower tertiaries, without traversing the chalk, at a depth of about 553 feet from the surface of the ground.

It would appear from these facts, and from the very remarkable success which has attended the efforts of the French military engineers to obtain water in the Desert of Sahara, that in all cases where the continuity of the subterranean water-bearing stratum is known to exist, Artesian wells may advantageously be resorted to, provided the quantity of water taken from them be not very considerable. From the experience obtained near Paris, Tours, and London, however, it would appear that the supply so to be obtained is very limited; and whenever the demand sensibly approaches the subterranean supply, the first effect produced is to lower the level of the water line, and thus very frequently to destroy the true Artesian character of the wells. In the neighbourhood of Tottenham, for instance, the water now hardly rises to the surface of the ground in some wells where formerly it overflowed.

The operation of boring for Artesian wells is effected usually by means of wrought-iron rods, of about 20 feet long each; the upper end of the first rod having a hook, by means of which it is suspended to the lever communicating to the system the necessary percussive motion, and the lower ends of all the rods bearing a he-screw fitting into the socket of the she-screw on the head of the lower ones. Below the suspending hook there is an eye intended to receive a hand lever, by means of which the workmen give, when required, a rotary motion. In traversing soft materials, such as chalk, clay, fine sand, &c., a mere rotary motion will suffice to ensure the descent of the boring tool carried by the lowest rod; and this tool, it must be observed, is modified so as to suit the various descriptions of soil. But in traversing rock, or hard formations, it is necessary to comminute the latter before the scoops can remove the materials; and this object is effected by raising, and then suddenly letting fall, the chisel, or cutting tool, which will of course descend with a force proportionate to its own weight, and the distance it has travelled. Very great precautions are necessary to guard against the rupture of the rods when the depth is great; and a number of ingenious contrivances have been introduced by MM. Degoussée and Œuyenhausen for the purpose of diminishing the weight thus cast upon the cutting tool, descriptions and illustrations of which will be found in Degoussée's 'Guide du Sondeur;' Burat's 'Géologie appliquée à la recherche des Minéraux utiles;' and to a 'Treatise on Well-digging and Boring,' in Mr. Weale's Rudimentary series. Of late years also M. Kind, a German engineer of considerable eminence, has introduced a modification of the boring tools to be used in deep wells, of which a detailed description will be found in the 'Proceedings of the Institution of Mechanical Engineers,' for July, 1854: and it appears from the experience obtained in several cases that the changes thus suggested have materially diminished the danger attending the rupture of the rods in consequence of their great weight, and of the vibrations to which they are usually exposed. The difficulties thus overcome are, however, very far from being the only important ones attached to this class of operations; for in the case of the boring now in progress, under the orders of M. Kind himself, at Passy, the advance of the work has been seriously impeded by the collapsing of the tubes, through the pressure of the running sands traversed. A similar accident has likewise taken place at Ostend; and even in the case of the celebrated well of Grenelle the supply of water, or the efficiency of the well, is at times seriously affected by the movements of the finer particles of the permeable water-bearing stratum, to such an extent indeed as from time to time to render it necessary to interrupt the distribution of the water in order to clean the tubes. In such cases as those in which the boring is originally carried through strata likely to yield waters of inferior or objectionable quality, as in marsh lands, or in the neighbourhood of the sea, special precautions are required to keep out those waters; and it is customary to employ in such cases cast-iron pipes. In traversing still deeper strata furnishing waters which it may be necessary to exclude, wrought-iron, or even copper pipes, are used. The mode in which these details are executed has the greatest influence upon the success of the operations, and they require a very extensive practical acquaintance with the various conditions of the loose strata, which so strangely modify the resistance to be dealt with. On this score also the boring of Artesian wells is strictly speaking an empirical art, just as it is on the score of the uncertainty with respect to the continuity of the underground strata; and it is for these reasons that the experience of an intelligent, practical, well-borer is a surer guide in such undertakings than any mere abstract philosophical reasoning.

Notwithstanding the disappointment encountered in the above cited cases of the Southampton, Calais, Highgate, and Harwich wells, which were undertaken mainly upon the recommendations of theoretical geologists, the reader who would become acquainted with the general conditions affecting the supply of Artesian wells must still consult the works of that class of writers. The most reliable information upon the subject is to be found, in addition to the works already mentioned, in Héricart de Thury's 'Considérations sur la Cause du Jallissement des Eaux des Puits forés,' Paris, 1829; Buckland's 'Bridgewater Treatise on Geology and Mineralogy,' London, 1837; and Prestwich's treatise 'On the Water-bearing Strata of London,' London, 1851. Delabeche's 'Geological Observer' contains some valuable remarks upon the subject; and the treatise inserted by M. Arago in the 'Annuaire du Bureau des Longitudes,' for 1835, may still be referred to with advantage.

ARTHANITIN (Cyclamin). A non-azotised crystalline body, extracted from the root of the *Cyclamen Europæum*. Its taste is bitter and astringent. It requires 500 parts of water for solution, is insoluble in ether, but dissolves easily in alcohol. Administered internally, it acts as a purgative and emetic. Its composition is unknown.

ARTHRITIS. [Gout.]

ARTICLE, the name given by modern grammarians to the two little adjectives *the* and *an* in the English language, and to words of like import in other modern languages, the former being called the definite, the latter the indefinite article. We do not attempt a more philosophical definition, because the separation of these words from the other adjectives of language, whether pronouns or not, appears to depend upon no very accurate principle; and the distribution of the parts of speech would perhaps not be the less philosophical, if the so-called articles were restored to their proper place. The indefinite article *an* is only a corruption of the adjective *one*, or, as our ancestors wrote it, *ane*; and *a* is a still more violent corruption of the same word. Thus in German *ein* is at once equivalent to our *one* and to *an*. In the same way the French *un*, Italian *uno*, Spanish *uno*, &c., are evidently derived from the Latin *unus*. On the other hand, the definite article will appear, on the slightest consideration, to be a corrupted demonstrative pronoun. The term article or αρθρον (a joint) was invented by the Greek grammarians, but as used by them it is only applied to the definite article, and also to what, by modern grammarians, is called emphatically the relative (who). Nor is there any inconsistency in applying the same term to these two notions, which will be found on examination to have a common origin. The element το (*to*) of the Greek language, corresponding in power to our word *this*, was employed perhaps originally to denote a physical object pointed out at the time by some action of the body; secondly, to an object mentioned just before, and thus mentally present both to speaker and hearer; or, lastly, to an object forthwith to be brought before the hearer's mind. In the second case we are likely to have a repetition of the defining particle, as: "I gave you *the* book *which* you asked for," or, what is equally good, except in rhythm, "I gave you *that* book *that* you asked for." It was from the contemplation of such a sentence as this that the Greeks considered the pair of words as performing the office of joints which connect the two propositions together; and to distinguish the one article from the other, that which precedes the noun (the) was called the *prepositive* article, and that which follows it, namely, the relative, the *postpositive* article. The qualifying terms are perhaps not very well chosen, inasmuch as the relative clause, frequently in the ancient languages, and sometimes even in English, precedes; but undoubtedly the term article is very expressive of these relative particles, which in all cases, or nearly so, do perform the duty of connecting two propositions together; and hence we ought not to be surprised that a large proportion of the conjunctions have their origin in the relatives or demonstratives. But the repetition of the defining, demonstrative, or relative particle is no way necessary. Whether we say "I gave you that book" (pointing to it), or, "You asked for a book that (or that book) I gave you," or, lastly, "I gave you that book you asked for," the word *that* performs in all cases the same duty. The two ideas thus logically connected in the expression—"I gave you the book that or which you asked for," are—"You asked for the book: I gave you the book." It is only a luxury in language to vary the forms according to the mere place in a sentence that a word may occupy; and if, in the more polished forms of the Greek language, we find the demonstrative, the definite article, and the relative distinguished, yet they are all evidently derived from a common parent, το, and its dialectic varieties. In Homer, the article, so-called, has still the power of a demonstrative; in Herodotus, the same element performs at times all the three offices. As we descend chronologically we find the tragedians still confounding the diverging forms of the relative and article, and even in certain phrases, retained by the later writers, traces of the same confusion arising from a common origin were yet to be seen. Matthiæ in his 'Grammar' has so fully acknowledged this triple power of the Greek pronoun, that he treats of the article under the three heads—1. of the article; 2. of the article as a pronoun (he means a demonstrative pronoun); 3. of the article for the pronoun relative.

The Latin language had but an imperfect definite article in its pronouns, *hic, ille, is*; but besides these we find the relative at times employed where the English idiom at least requires the demonstrative *this*; and what is called the conjunction *quod* (that), like the corresponding Greek ὅτι, or French *que*, has the form of a relative, and the meaning of a demonstrative. To trace the same analogy in the Teutonic languages, the German *der*, of which *de* only is radical, is at once demonstrative, relative, and definite article. So completely does the German agree with the Greek, that, when *der* threw off much of its demonstrative power to play the part of the mere article, a kind of doubled form, *dieser*, was adopted for the pure demonstrative, on the same principle of formation as οὗτος, from ὅς, with the same meaning in Greek. And lastly, the English philologist will find the same threefold power among the derivatives from the English allied root, *the*, namely, among the forms *this, that, then, than* (compare the Latin *quam*), *there, thence, the*, &c. The form *that* is still retained, as was before observed, with the power of the relative; but in the older writers, as Chaucer, *there, thence*, &c., were freely used, where we now only employ, *where, whence*, &c.

Horne Tooke, whose views of etymology were neither extensive nor accurate, has fancied that the English article *the* is the imperative of an Anglo-Saxon verb ðean, *to take*. ('Diversions of Purley,' Taylor's edition, ii. 63.) We need not repeat that it is allied to the German *der*, or rather the Dutch *de*, for the *r* is merely the characteristic of a masculine nominative, to the Gothic *sa* or *tha*, and through these to the Greek element *τό*, a form which actually occurs in the English *to-day* (ho-die), for which provincial dialects sometimes substitute *the-day*, thus testifying in favour of the theory; and no etymology for the English article will be satisfactory which does not equally apply to all these languages. In the same way the definite articles of the modern languages derived from the Latin are all referable to the Latin demonstrative *ille, illa*, &c. [Relative; Pronoun Demonstrative.]

ARTICLES OF FAITH. [Confessions.]

ARTICLES OF THE PEACE, a term applied to a recognizance or obligation to the crown, entered on record, and taken in some court by some judicial officer, whereby the parties acknowledge themselves to be indebted to the crown in the sum required, with condition to be void and of none effect if the party shall appear in court on such a day, and in the mean time shall keep the peace. (Blackst., *Comm.*, iv. ch. 18.)

ARTICLES OF WAR. [Mutiny Act.]

ARTICULATION. [Voice.]

ARTIFICIAL FLOWERS. Few employments of a mechanical or manipulative nature are more beautiful in their results than the production of artificial or imitative flowers. Nothing can well exceed the faithfulness of these imitations; every petal, leaf, and bud is imitated with an accuracy which must have required long observation and much ingenuity on the part of those who have practised this art.

The petals of flowers are imitated by ribbons, feathers, silk-worm cocoons, cambric, taffeta, velvet, or thin laminæ of whalebone shaped and coloured for the purpose. The stems are mostly formed of wires, wrapped round with paper, silk, or some other material of the requisite colour. The leaves and petals are mostly cut and embossed by stamping with dies having sharp cutting edges, and are united by means of wires and paste or cement. The modes of colouring are various. Seeds and similar objects, and small fruits, such as currants, are imitated by wax, glass, and other substances. Very beautiful imitations of some plants are made with wax, rice-paper, and shells. Besides the above materials, flowers are occasionally imitated in ebony, maple, box, satinwood, clove, nutmeg, pimento, jet, ivory, coral, pearl, sea-weed, and hair.

This manufacture is generally carried on in private houses, where a large number of persons (mostly females) work together, each taking certain departments, according to the principle of the division of labour; and the whole product is then sold to wholesale dealers, who supply the retail shops.

The French are especially distinguished in this art; all their delicacy of taste is brought to bear upon it. France sells annually to the extent of a million francs (40,000*l.*) to the foreigner; and England, with the United States, purchases more than half this amount.

We will take a rose, as a specimen of French imitative manufacture. The petals, the leaves, the calyx, the buds, the stamens, the stalk—all require distinct processes. First, for the petals. These are made of the finest cambric, which is cut out with punches, there being as many different sized punches as there are different sizes in the petals of a rose. Each petal, being held by pincers at the extreme end, is dipped into a carmine dye; then dipped into water to soften the tint at the edges; then touched with a brush to deepen the tint near the centre; and any little variegated spots, or even blemishes, are imitated by tinting with a brush. Next, for the leaves. These are made of Florence sarcenet, which is dyed to the proper colour, and stretched while wet that it may dry out perfectly smooth. The glazed surface of the leaf is imitated by coating the sarcenet with thin gum-water; while the velvety texture of the under surface is imitated either by a wash of coloured starch-water or by a layer of flock or cloth powder, such as is used in making flock paper-hangings. To imitate the ribs which form such a peculiar and beautiful characteristic of the leaves, several leaves, placed one upon another, are pressed between gaufroirs or goffering-irons, cut with the required indentations. Then we have the leaflets which form the calyx; the sarcenet for these is stiffened with starch-water while yet wet from the dyeing, and when dry the material is cut to the proper size and shape by punches. The buds are made of sarcenet or of kid, dyed or painted according to circumstances; they are swelled out to the proper shape by a stuffing of cotton, gummed flax, or crumb of bread, and are tied with silk at the end of thin iron wires. The stamens are made of silk, fixed at the ends of brass wires, and so shaped that the wire shall imitate the filament and the silk the anther; the silk anther, being dipped into a glutinous liquid, is made to retain some very small seeds which imitate the pollen. Lastly comes the building-up of the delicate structure: the stalk is made of iron wire, coated with cotton and green paper, and around this stalk are grouped and fastened the several parts which together form the imitative rose.

ARTIFICIAL FUEL. Some of the compositions recently introduced as substitutes for coal will be noticed under FUEL.

ARTIFICIAL HORIZON is generally a cylindrical cup, about three inches in diameter, or a rectangular trough, either of them about half an inch deep, and containing quicksilver. A circular plate of glass, whose surfaces should be accurately parallel to one another, is laid on the surface of the quicksilver in the cylindrical cup, but the trough is usually covered by a roof with two inclined planes, each of which is a frame carrying a plate of glass with parallel surfaces. By these means the wind is prevented from agitating the fluid.

The surface of the quicksilver being considered as a plane perpendicular to a diameter of the earth, or rather to a normal, at the place of the observer, is parallel to the rational horizon of that place; and consequently the angle between the plane of the quicksilver and a visual ray from the object to that plane, when corrected for refraction and parallax, is equal to the angular elevation of the object above the true horizon of the place.

Artificial horizons of the kind just mentioned are generally used on land for the purpose of obtaining the altitude of a celestial body by means of an octant, sextant, or reflecting circle, either held in the hands or supported on a small pillar; occasionally also it is employed to obtain the angular elevation of a terrestrial object, as the top of a tower, a mountain, &c. The rays of light from the object, falling on the quicksilver, are reflected from thence to the eye of the observer; and, by the laws of reflexion, the angles made with the reflecting surface by the incident and reflected rays are equal to one another; hence the reflected image of the object appears as much below the horizon, or surface of the quicksilver, as the object itself is above it; and on bringing, by the motion of the index of the sextant, the direct and reflected images to coincide, the angle read on the arc will, the eye being very near the quicksilver, be equal to twice the angle of elevation.

In a regular observatory, the trough containing the quicksilver is, sometimes, several feet long, in order to avoid as much as possible the necessity of changing its place according to the distance of the celestial body from the zenith.

When the atmosphere is very calm, water under a glass-roof may be used instead of quicksilver, but almost the least agitation of the air is sufficient to disturb the reflected image.

On a journey, the conveyance of quicksilver is often inconvenient; and therefore scientific travellers have attempted to use, as an artificial horizon, a circular plate of polished metal, or a dark glass, from which light may be reflected as from a mirror. The horizontality of such an instrument is ascertained by means of a spirit-level placed upon it, and the adjustment is effected by three screws which pass through the frame of the mirror at equal distances from one another.

Since, with the usual reflecting instruments, double altitudes exceeding about 120° cannot be observed, the artificial horizon just described would be useless, if the altitude of the object were greater than 60°; they can however be employed with instruments similar to those invented by Captains Fitzroy and Beechey, by which angles exceeding 180° may be observed.

The artificial horizons permit very accurate observations to be made on land, but it is evident that they cannot be used at sea, even though well suspended in jimbals, on account of the unsteady motion of the ship; and some means of enabling a seaman to observe correctly the altitudes of celestial bodies when the sea-line is invisible, or but faintly seen through the vapours near the horizon, is still a desideratum.

It is known however that when a conical or a cylindrical body, terminating at the lower extremity in a point, is caused to revolve rapidly on its axis, that axis soon takes, and for at least half an hour maintains, a vertical position; and efforts have been made to employ such a body, having a mirror on its upper surface, as an artificial horizon on board a ship. A 'Nautical Top,' as it was called, was proposed by a Mr. Serson, and is described in the 'Philosophical Transactions' for 1750; but, on being tried at sea, its irregularity was found to be great, and the contrivance was abandoned. The late Mr. Troughton however, in 1818, made considerable improvements on the original construction, but his success was not such as to render the machine available. He made the *top* at first cylindrical, but he afterwards gave it the form of a frustrum of a cone; the reflecting plane formed the upper surface, and immediately under this was a stem terminating below in a steel point, which rested on the concave surface of a small steel cup. A rapid motion was communicated to the machine by a series of wheels, of which the first was turned by means of a handle on its circumference.

The only contrivance which appears likely to serve the purpose of an artificial horizon at sea is a spirit-level applied to the face of an octant or sextant; and an instrument of this kind was proposed and executed by Troughton. The spirit-level, in a brass tube, was placed between the index and horizon glasses; and, through a perforation in the tube, the observer could see in the horizon-glass the reflected image of the bubble of air: a line was traced on the horizon-glass, and a contact of the limb, or centre, of the celestial body was to be made on this line at the instant that the latter appeared to bisect the reflected image of the bubble. The arc passed over by the index would then express the altitude of the celestial body above the horizon. Instruments very similar to this have been executed by Mr. Robinson, and, for merely nautical observations, they possess sufficient accuracy; the altitudes obtained with them being within two or three minutes of their true values.

ARTIFICIAL LIMBS, &c. Considerable mechanical ingenuity is displayed in supplying substitutes for limbs or other bodily organs which accident or any other cause has removed.

The art of the dentist, for instance, calls for no small amount of mechanical skill. First, there is the choice of the ivory which, from its colour, texture, and hardness, affords the best imitation of the natural teeth. Then there is the shaping of this ivory to the size and form of the tooth, whether single or double, front or back, upper or under. And lastly there are the remarkable contrivances—aided by golden palates, springs, wires, cement, gutta percha, or other substances—by which the tooth or mouthful of teeth are fixed in their places. Experience seems to show that few kinds of cheapness are so dear as cheap tooth-making: so great are the difficulties in supplying teeth that will readily eat their way through the difficulties presented to them. As for the succedaneums and metallic and other cements for stopping decayed teeth, their merit depends more on the quality of the material than on the mode of using. We see from time to time patents for new contrivances in dental surgery, which involve no small amount of ingenuity. One such was enrolled by Mr. Dinsdale, in which the manufacture of teeth, palates, and gums is described; and there are now many others.

An artificial eye is an example of glass manufacture; the shaping of the glass being much less difficult than the accurate imitation of the cornea and iris by means of pigments and dyes.

All those numerous examples of skill, which may more fittingly be called surgical *operations* than anatomical *contrivances*, we have nothing to do with here; but when a mechanician undertakes to supply a substitute for an arm, a hand, or a leg, we have as much right to claim it as a proof of constructive skill as a loom or a lathe, a plough or a clock. And here we mark how quickly a newly-discovered substance becomes brought within the scope of the operations. Is it caoutchouc? Then will the artificial leg-maker find out where to use it with advantage. Is it gutta percha? Then will he soon see where the combined elasticity and toughness of that remarkable substance are likely to be valuable. Accordingly, we find that many different materials are employed, either to give shape to the artificial hand, arm, or leg, or to give smoothness and softness to the surface, or to form the joints for the requisite movements. Wood, leather, caoutchouc, gutta percha, cork, iron levers, steel springs—all are employed; and much ingenuity is displayed in arranging the materials.

Sir George Cayley, who exhibited much inventive talent in various mechanical contrivances, made many trials to produce an artificial hand which should be less costly than those ordinarily constructed. He made the 'Mechanics' Magazine' the medium of communicating his experience in this matter. His first attempt was in 1845. The son of one of his tenants having lost a hand by accident, Sir George contrived a substitute which in many ways lessened the severity of the privation. The movements of this instrument are derived from the stump; a light frame-work fixes the apparatus to the upper part of the arm, and a lever connects this frame-work with the artificial hand. The arm is placed within padded rings of metal, which are connected by two long steel bars hinged at the elbow. When the wearer moves his arm by the usual action of the elbow-joint, he shifts a small metal bar near the wrist of the machine, which works two cog-wheels acting on each other; and these cog-wheels bring two steel springs together so as to enable them to grasp an object something in the manner of a thumb and fore-finger. The wheels and springs may either be left exposed, in the metallic state, or may be padded so as to represent a thumb and finger. It was found that although this artificial hand could be turned round a little way, it could not be turned so much as a quarter of a circle from its horizontal towards a perpendicular grasp; and there was, at the same time, no movement equivalent to the usual bending of the wrist, which gives so great a variety of positions to the natural hand. He therefore contrived a new arrangement of mechanism at the wrist, so as to superadd these two movements to those before possessed by the apparatus; this involved an increase of rather delicate mechanism.

At one of the soirées given by the President of the Royal Society in 1845, the boy for whom Sir George Cayley made the artificial hand was introduced, and Prince Albert "shook" him by his mechanical appendage. The hand had only one finger worked by the mechanism; but there were the proper number of cork fingers united side by side, and fixed to one broad thin steel plate, jointed, and covered with continuous leather, stitched down to mark the distinction of the fingers under it. But where a more expensive apparatus can be afforded, and the appearance of having a real hand is sought for, the thin steel plate can be separated into digits, though united at the base as in a common hand, and jointed at the proper places in due proportion to each finger.

In another form of artificial hand, made by Sir G. Cayley, in 1847, there is a case or sheath, into which the stump of the arm is introduced. A spiral spring is fixed at one end to this sheath, and at the other to a bent lever; while the middle of the lever is connected with the mechanism of rods which move the artificial thumb and fingers. In this arrangement, the wearer uses his sound hand to work his artificial hand. He presses a little button which is connected with the bent lever; by pressing this towards the wrist, the fingers and thumb open to receive any object they may be intended to grasp; and when this pressure from the other hand is taken off, the grasp takes effect, without further effort, till released by a contrary movement. The mechanism is very simple, and is attached wholly to the lower arm, near the stump. But as the sound hand must be taken from anything else it has to perform, at the time the artificial hand is thus put to work; and as it may on other accounts be inconvenient to work the apparatus in this way,—Sir George invented a very ingenious means of working the hand by the movement of the upper arm or shoulder-joint.

One of Sir George Cayley's contrivances, made by Mr. Buckingham, was shown at the Great Exhibition of 1851; as was also an ingenious artificial hand invented by Major Little of Woolwich.

M. Magendie described to the Paris Academy of Sciences, in 1845, an artificial arm, invented by M. Van Petersen. A sort of stays are fixed round the breast of the person; and from these are brought cords made of catgut, which act upon the articulations, according to the motion given to the natural stump. The apparatus was found to be very effective. It was tried (among other patients) on an invalid soldier, who had lost both arms in the wars of the empire, retaining only the stumps. With the aid of two of the artificial arms, he was able to perform many of the functions which had hitherto been performed for him. M. Magendie considered this contrivance to be the best substitute for a natural arm which had till then been introduced.

A curious example of mechanical anatomy is exhibited in Count Dunin's 'Model Man,' first made public in this country in 1851. It is intended to illustrate the different proportions of the human figure, and admits of being expanded from the size of the Apollo Belvidere to that of a colossal statue. The external part of the figure consists of a series of steel and copper plates sliding upon each other, and kept in contact by screws, nuts, and spiral springs. Attached to these plates, and within the figure, are metal slides, having projecting pins at their extremities; these pins are inserted in curved grooves cut in circular steel plates—the curvature of the grooves being so arranged that when the steel plates are put in revolution by a train of wheels and screws, the slides belonging to each particular part of the figure are expanded or contracted in correct proportion. The elongation of the figure is accomplished either by sliding metal tubes, provided with racks, and acted upon by a combination of wheels, or by screws and slides, as found most applicable for each particular part. Besides these symmetrical adjustments, each part of the figure has an independent and separate adjustment, by which it may be thrown out of symmetry, and made to represent the deformities or peculiarities of form in any individual. So intricate is the mechanism to produce all these movements, that the figure comprises 7000 plates, springs, slides, wheels, tubes, nuts, screws, and other pieces of metal. This remarkable piece of mechanism could easily be made applicable in the artist's studio; but the inventor seems to have had more especially in view the use of the model to assist in measuring and making clothes for large numbers of men, such as an army—the different sizes and shapes of the men being imitated by the model.

ARTIFICIAL STONE. [CEMENT.]

ARTILLERY, a word believed to be of French origin. Menage derives it from the old word *artiller*, to fortify. Vossius ('De Vitiis Sermonis,' lib. iii. cap. 1) says the ancient word, instead of Artilleria, was *Arcualia*, from *Arcus*, a bow; the earliest military engines of this description having arisen out of improvements upon the bow and arrow. Artillery, in its most general signification, implies all kinds of missiles with the engines used in propelling them. Since the application of gunpowder to projectiles, it has chiefly been confined to large ordnance, or cannon, mortars, howitzers, &c., to which rockets are now to be added, and includes their ammunition, appurtenances, and means of transport, as also the men and officers employed in working them.

It was long after the nations of the east had formed war into a science, that military engines, such as are comprised in the term artillery, were invented. The earliest were, in all probability, those for casting stones of prodigious weight. Of Uzziah (B.C. 1000), 2 Chron. xxvi. 15, it is said, "And he made in Jerusalem engines, invented by cunning men, to be upon the towers and upon the bulwarks, to shoot arrows and great stones withal. And his name spread far abroad; for he was marvellously helped till he was strong."

Among ancient engines of artillery, the *Battering-ram* has been usually included, though it certainly is not embraced in the ordinary or in any other definition of that word. Pliny, whose authority in such a matter is small, says it was invented at the siege of Troy; but Homer makes no mention of it. The first notice of this engine is probably in Ezekiel, where the prophet speaks of a feigned siege of Jerusalem as a sign for the Jews (iv. 2): "set battering rams against it round about;" and again (xxi. 22), "appoint battering-rams against the gate." Ezekiel lived about 590 years B.C. The next mention of the battering-ram is in the Peloponnesian war, B.C. 429 (Thucyd. ii. 76); and we are certain that it was used a century afterwards at the siege of Motya by Dionysius the Elder. The ram was sometimes used, but not commonly, in the middle ages.

The names Balista, or Ballista, and Catapulta, imply a Greek origin. The balista was for throwing stones; the catapulta for propelling darts and arrows. The invention of the latter of these instruments, or rather its re-invention, is ascribed by Pliny (lib. vii. 56) to the Syrians; but Diodorus (lib. xiv.) and Plutarch ('Apophth.,' edit. Wyttenb., 4to, Oxf. i. 533) say they were contrived in Sicily, about the same time with the battering-ram, alluding to a period not earlier than B.C. 300. Ælian ('Var. Hist,' vi. 12) ascribes the invention to Dionysius the Elder himself, in Sicily. The balista is attributed by Pliny to the Phœnicians. Both instruments were unquestionably much used in the Roman times. They are mentioned in Cæsar, Cicero, Livy, Seneca, Tacitus, and other writers, and were employed in great numbers by Titus at the siege of Jerusalem. Two thousand machines for throwing darts and stones were surrendered to the Consul L. M. Censorinus when he marched against Carthage. (Appian, lib. viii., 'De Rebus Punicis,' § 80.) Ammianus and Vegetius are both particular in describing the construction of the balista. Vegetius, who lived in the 4th century, under Valentinian, speaks of balistæ, onagri, scorpiones, arcubalistæ, fustibuli, and fundæ, as engines of artillery (lib. iv. c. 22).

We have no evidence that machines of this description were known in England previous to the arrival of the Normans. According to the testimony of William of Poictou, machines of wood (exclusive of the cross-bow) were used for pouring forth showers of arrows even at the battle of Hastings; so early were they introduced in the Norman time. It is worthy of notice, that among the tenants *in capite* in the Domesday Survey, *balistarii* occur, as well as *arcu-balistarii*. Artillery, however, in the Norman period, was most frequently used in sea-fights, when not only stones and darts were discharged from the machines, but pots of Greek fire, quick-lime, and other combustible materials. Robert of Bruce (in Peter Langtoft's 'Chronicle'), speaking of Richard I.'s wars against the Saracens, says, that in his barges and galleys he had mills, which were turned by the wind, and by force of the sails threw not only fire, but stones which were taken from the Rhine.

It would be tedious to enumerate all the arts and all the machines which were employed in the middle ages in assaulting and defending towns and castles. Indeed, few sieges of great importance occurred without the invention of some new engine. Grose, in the preface to his 'Antiquities of England and Wales,' has given the names and figures of a considerable number. Some of these were distinguished by the appellations balista, catapulta, espringal, trebuchet, mangona, mangonel, bricolla, petrary, matafunda, berfrey, and war-wolf. Père Daniel also mentions a machine called engine-a-virge, used by the English in France, as late as the reign of Charles VII. Of the vast force of these machines surprising stories are related in our chronicles. The engines used by Edward I. at the siege of Stirling Castle in 1303, according to Hemingford, threw stones of 300 pounds weight.

This ancient artillery continued to be used in sieges for a considerable time, in some instances for two centuries, after the invention of gunpowder and cannon. (See Père Daniel, 'Histoire de la Milice Françoise,' tom. i., p. 319.) Greek fire continued also to be employed in war long after the introduction of fire-arms, particularly in the attack and defence of strong places, as at Ypres and Burburgh in France, in 1383. (Walsingh., edit. Camd., pp. 302, 303.)

The invention of gunpowder however by slow degrees brought about a total alteration in the art of war. Colonel Chesney states, in his work 'Observations on Fire-Arms' (published in 1852), that the fact of cannon-balls having been propelled by gunpowder as early as A.D. 1200 in India, is established by the following passage in the Hindoo poet Chosed :—"Oh ! chief of Gaqué, buckle on your armour, and prepare your fire-machines ;" the fire-machines alluded to being described in another passage in the following words :—"that the culivers and cannons made a loud report when they were fired off, and the noise of the ball was heard at a distance of 10 coss, or nearly 1445 yards." There is no reason for believing that this is the first or even an early instance of the use of cannon in the east, where gunpowder had probably been known for a long time, and the mention of the use of incendiary projectiles amongst the natives of China and India at an earlier date is often met with. Colonel Chesney, in the same work, thus proceeds to trace the introduction of artillery into Europe :—"The Moors, according to Condé, used artillery against Zaragossa in 1118 ; and in 1132, a culverin of 4 lbs. calibre, named Salamonica, was made. In 1157, when the Spaniards took Niebla, the Moors defended themselves by machines which threw darts and stones by means of fire ; and in 1157, Abd'almumen, the Moorish king, captured Mohadia, a fortified city near Bona, from the Sicilians, by the same means. In 1280 artillery was used against Cordova, and in 1306 or 1308 Ferdinand IV. took Gibraltar from the Moors by means of artillery. Ibn Nasan ben Bia, of Grenada, mentions that guns were adopted from the Moors and used in Spain in the 12th century, and that balls of iron were thrown by means of fire in 1331."

Barbour, in his 'Metrical Life of Robert Bruce,' tells us that cannon (which he calls "crakys of war") were used by Edward III. in his first campaign against the Scots in 1327. Du Cange, in the article 'Bombarda,' shows that the French used cannon at the siege of Puy Guillaume in 1338 ; and that Edward III. used them at the battle of Crecy, as well as at the siege of Calais in 1346, seems agreed. Four pieces planted on a little hill at the battle of Crecy did great execution among the French troops, and having been before unheard of in France, contributed as much by the surprise as the slaughter to the success of the day. (See Rapin, vol. i., p. 425.) This seems to have been denied by some authors, in consequence of the supposed silence of Froissart. The Emperor Louis Napoleon, however, in his work on Artillery, alludes to a passage in a manuscript of Froissart, preserved in the library at Amiens, which proves that he was neither ignorant nor silent of the fact. Another ancient manuscript mentions the pay of the artillerymen that Edward III. had in 1346, when he landed at Calais, "masons, carpenters, engineers, &c., gunners and artillerymen, some at 1*s.*, 10*d.*, 6*d.*, and 3*d.* per diem." It is clear, however, that if cannon were used by the French at Puy Guillaume in 1338, they could not have been the absolute novelty asserted at Crecy in 1346. By degrees, the use of cannon became more and more common. Petrarch, in his 'Dialogues' on the Remedies of Good and Bad Fortune, written in 1358, describes cannon as no longer rare, or as viewed with astonishment and admiration.

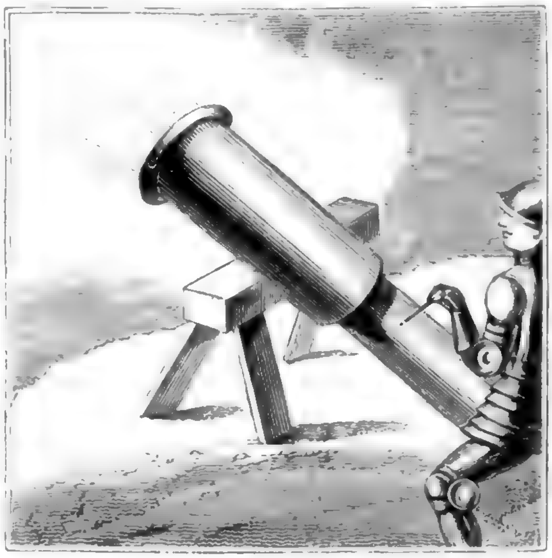
Cannon, or, as they were then called, bombards, were the most ancient fire-arms. The first cannon were clumsy and ill-contrived, wider at the mouth than at the chamber, and so like a mortar that Dr. Henry supposed the idea of them might have been suggested by that in which Schwartz, a chemist of the beginning of the 14th century, who is said by the Germans to have discovered gunpowder, pounded his materials. They were all made of iron, without any mixture of other metals ; and consisted usually of bars or pieces of iron fitted together lengthways, and hooped with iron rings. Some of them were too long, and others of them too short. In a word, the art of making cannon was still imperfect.

Both gunpowder and cannon were made in England in the 14th century. This appears from a commission given to Sir Thomas Norwich by Richard II., in 1378, to buy two great and two small cannon in London, or in any other place, and also to buy certain quantities of saltpetre, sulphur, and charcoal, for making gunpowder. (Rym. 'Fœd.' tom. vii. p. 187.) From the same commission, as well as from other evidence, it appears that cannon-balls were at first made of stone ; for the same person is therein commanded to purchase six hundred balls of stone, for cannon, and for other engines.

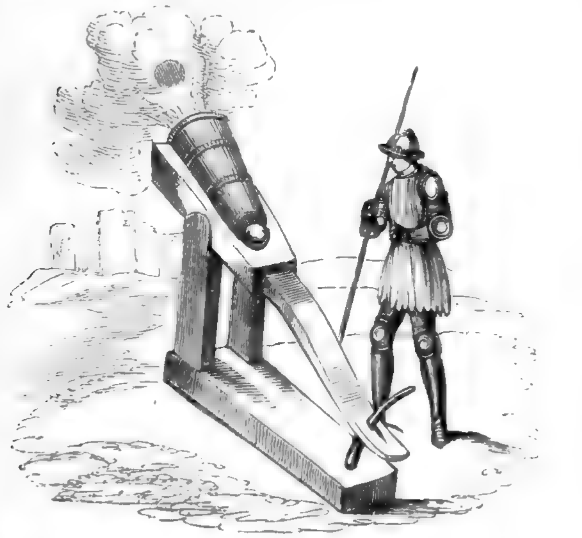
Besides great guns, which are still named cannon, a smaller kind of ordnance called *hand-cannon* came into use at this period. They were so small and light that one of them was carried by two men, and fired from a rest fixed in the ground. (Père Daniel, tom. i. lib. vi. p. 321.) The 400 cannon, or the greater part of them, with which an English army besieged St. Malo, in 1378, mentioned by Froissart (Lord Berner's Transl. chap. cccxxxii.), must have been of this kind : though Dr. Henry conjectures that these hand-cannon were first brought into Britain by the Flemings who accompanied Edward IV. in his return to England in 1471. The Scots, he adds, had a kind of artillery at this period peculiar to themselves, called *carts of war*. They are thus described in an Act of Parliament in 1456 : "It is thocht speidfull, that the king mak requeist to certain of the great barrons of the land that are of ony myght, to mak carts of weir, and in ilk cart twa gunnis, and ilk ane to have twa chalmers, with the remanent of the graith that effeirs thereto, and an cunnand man to shute thame." By another Act, in 1471, the prelates and barons are commanded to provide such carts of war against their old enemies the English. (Henry, 'Hist. Brit.' from Black Acts, James II. act 52, James III. act 55.)

The instruments of artillery of the middle of the 15th century, though all called by the general name of cannon, were of very different kinds, shapes, and sizes, and distinguished from each other by particular names. The letters which Edward IV. addressed to different persons in 1481, for the resistance to invasion from Scotland, speak of "bumbardos, canones, culverynes, fowelers, serpentynes, et alios canones quoscumque, ac pulveres sulphureos, saltpetre, petras, ferrum, plumbum, et omnimodas alias stuffuras pro eisdem canonibus necessarias et oportunas." (Rym. 'Fœd.' tom. xii. p. 140.)

A French translation of 'Quintus Curtius' by Vasqua de Lucene, a Portuguese, written in 1468, preserved in the British Museum, and which formerly belonged to Philip de Cluys, a Knight and Commander of the order of St. John of Jerusalem, has one or two early representations of the larger sort of cannon, which are here exhibited.



Monstrelet illustrates the clumsy form as well as the clumsy management of ancient cannon. Under the year 1459 he says, "while King James (of Scotland) was observing the effect of his artillery (at the siege of Roxburgh Castle), one of the rudely contrived cannons of that age, consisting of bars of iron girded with circles of metal, suddenly burst : a fragment struck his thigh, and the great effusion of blood produced a death almost instantaneous. The Earl of Angus, who stood next to James, was wounded." Under 1478 he says, "A great bombard, that had been cast at Tours, was brought to Paris the Monday before Epiphany to be proved, and was for this purpose drawn out into the fields in front of the bastile of Saint Anthony. It was pointed towards Charenton, and when first fired threw the ball as far as the gallows on the bridge of Charenton ; but as those present did not think it had discharged all the powder that had been put into the chamber, they ordered it to be recharged, and the chamber perfectly cleaned of all that remained within it, which was done, and an iron ball weighing five hundred weight, put into its mouth, before which stood John Maugué, the founder of it. As the ball rolled down the bombard, by some unknown accident the powder in the chamber took fire before the match was put to it, and by its discharge tore in pieces John Maugué and fourteen other persons, whose heads, legs, arms and bodies were blown into the air. The ball killed a poor innocent bird-catcher



that was attending his nets in the fields, and the bursting of the bombard maimed fifteen or sixteen others, several of whom died; so that by this accident twenty-two or twenty-three persons lost their lives. The remains of John Maugué were collected, put on a bier, and carried to St. Merry for interment; and proclamation was made through the streets of Paris that all people should pray for the soul of John Maugué, who had lost his life in the king's service." (Johnes's 'Monstrelet,' 4to., vol. iv. p. 402-403. In 1477, when Louis XI. made his attack upon different towns of Flanders and Picardy, he ordered bombards of prodigious length and weight to be cast at Paris, Tours, Orleans, and Amiens. His iron bullets were cast at the foundries at Creil, and his stone bullets made at the same time in the quarries near to Peronne.

About the middle of the 14th century, fusible metals were employed, on the continent, in the construction of cannon, especially bronze, which combines suitable tenacity with moderate hardness. Guns were not cast in England till 1521, in the reign of Henry VIII., when brass guns were cast, and iron guns about 1547. Both Henry VII. and Henry VIII. appear to have been very anxious to foster the science of artillery in England, employing a number of Flemish gunners for that purpose. Guns were at this period cast hollow, the bore being formed by a core which was kept suspended in the centre of the hollow mould into which the metal was run, and which formed the cast.

It is probably bronze that Stowe alludes to in a passage of his 'Annals.' He says, "this year, 1535, John Owen began to make brass ordnance, as cannons, culverines, and such like. He was the first Englishman that ever made that kind of artillery in England; his issue of his name and the name of Pitt have continued unto the days of King James most ready and exquisite gun-makers for the general service of the kingdom." A beautiful specimen of this sort of ordnance, cast at Utrecht in 1544, and presented by the States of Holland to Queen Elizabeth, is still preserved at Dover Castle. Other specimens, both English and foreign, a little later in period, may be seen at the Tower of London, and in the Royal Arsenal at Woolwich, as well as in many of the foreign arsenals. The sizes of cannon, generally speaking, in the 16th century, were considerably diminished, and forms of greater elegance were given to their exterior.

Robert Borthwick, an artist in the service of King James IV. of Scotland, had attempted the establishment of a foundry at Edinburgh a short time previously. Some of his guns, which remained in Lesly's time, had this inscription: 'Machina sum Scoto Borthuik fabricata Roberto.'

The largest cast cannon now existing is a brass one at Bejapoor, called Malick é Meidân, 'the lord of the plain;' it was cast in commemoration of the capture of that place by the Emperor Alum Geer, in 1685. Its extreme length is 14 feet 1 inch; the diameter of its bore 2 feet 4 inches. An iron shot for this gun of proper size would weigh 1600 pounds.

For *Mortars* we are indebted to workmen who were employed by Henry VIII., and for cast-iron ordnance to the reign of Edward VI. Under the year 1543, Stowe says, "King Henry, minding wars with France, made great preparation and provision, as well of munitions and artillery, as also of brasse ordnances, amongst which, at that time, by one Peter Bawd, a Frenchman born, a gun-founder, or maker of great ordnance, and one other alien, called Peter Van Collen, a gunsmith, both the king's feed men, who conferring together, devised and caused to be made certain mortar-pieces, being at the mouth from eleven inches to nineteen inches wide; for the use whereof the said Peter and Peter caused to be made certain hollow shot of cast-iron, to be stuffed with fire-work or wild-fire, whereof the bigger sort for the same had screws of iron to receive a match to carry fire kindled, that the fire-work might be set on fire, for to break in small pieces the same hollow shot, whereof the smallest piece hitting any man would kill or spoil him. And after the king's return from Boulogne, the said Peter Bawd by himself, in the first of Edward VI., did also make certain ordnance of cast-iron, of divers sorts and forms, as fawconet, fawkons, minions, sakers, and other pieces. Unto this Bawd, John Johnson, his covenant servant, surviving his master, did likewise make and cast iron ordnance cleaner and to better perfection, to the great use of this land. His son Thomas Johnson is yet living, a special workman. In the year 1595 he made forty-two cast pieces of great ordnance of iron for the Earl of Cumberland, demy cannons, weighing 6000, or three ton the piece." ('Annals,' edit. 1631, p. 584.)

It appears from Sir William Monson's 'Naval Tracts,' that the *Falcon* was a species of ordnance of two inches and a half bore; weight of shot two pounds; that the *Demi-Culverin* was another kind, of four inches bore; weight of the shot nine pounds and a half: and that the *Mynion* was another of three inches and a half bore; weight of the shot four pounds. The *Culverin* was a species of ordnance of five inches and a half bore; weight of the shot seventeen pounds and a half. The *Fowler* is not described by Monson, but is mentioned by Lodge in his 'Illustrations of British History,' vol. i. p. 4, as in use in the time of James I. The *Sacar* or *Saker*, according to Monson, was a piece of ordnance of three inches and a half bore; weight of shot five pounds and a half.

The invention of *Petards* is due to the French civil wars. They were first used by the Huguenots in 1580, at the siege of Cahors in Quercy. (Du Thou, tom. viii. p. 376.) Montelimar and Embrun in Dauphiné were taken by Lesdigecéres in 1585, principally by means of petards. (*Ibid.* tom. ix. pp. 404, 405.) According to Père Daniel (cited in 'L'Art de Verifier les Dates,' tom. i. p. 655), red-hot balls, revived in 1782 at Gibraltar, were used by Marshal Matignon during the siege of La Fère in 1580. But we learn from Elmham's 'Life of Henry V.,' p. 155, that they had an earlier origin. He says, that when an English army, commanded by the Duke of Gloucester, besieged Cherbourg in 1418, the besieged discharged red-hot balls of iron from their cannon ("massas ferreas rotundas, igneis candentes fervoribus a saxivomorum faucibus studuerunt emittere") into the English camp, to burn the huts in which the soldiers were lodged.

The *Howitzer*, an improvement upon the mortar, is said to have been invented by Belidor, and was first used at the siege of Ath in 1697. The *Carronade*, a sort of short cannon, or rather long howitzer, was invented by General Robert Melville, about the year 1779.

Iron Rockets of different sizes, varying in weight from sixteen to more than forty pounds, were invented during the last war by Sir William Congreve, and are now called Congreve Rockets. They were first used at the bombardment of Copenhagen, afterwards against the Boulogne flotilla, then at Flushing, and subsequently at the battle of Leipzig. A rocket establishment now forms a regular branch of the British military service.

It was not till about the beginning of the 18th century that guns were cast solid, as at present. A man of the name of Marity, who had a foundry at Geneva, offered his invention, of boring guns that were cast solid, to the court of France, by whom it was accepted. At Lyon, where he was first established, and afterwards at Strasbourg, he constructed guns on this plan, which were found on trial to be very successful. From Fosbrooke we take the following table of the ordnance used in the time of Elizabeth, and shortly before her reign, and it is surprising to see how little we have changed the calibres or diameter of bore of our guns during this period, exactly three centuries since her accession to the throne.

	Pounder.		Inches.		Pounder.
Cannon Royal	66	Diam. of bore	8½	Answering to our	68 or 8 in. gun.
Cannon Serpentine	53½	,,	7	,,	56
Bastard	41	,,	7	,,	42
Demi Cannon	33	,,	6¾	,,	32
Petro	24	,,	6	,,	24
Culverin	17½	,,	5½	,,	18
Demi Culverin	9½	,,	4	,,	9
Sacker	5½	,,	3½	,,	6

The reason for retaining the old calibres has evidently been, that on the introduction of each improved form of gun, it was made to suit some class of ammunition, already in the service, which would otherwise be wasted.

From that time to the present the form and construction of guns have been gradually improved, both in heavy ordnance and in light or field artillery. Gustavus Adolphus was the first who introduced field artillery; at least, what we understand by that term, namely, artillery that can be moved with ease and rapidity, and accompany, according to its calibre, either cavalry or infantry, in all their movements. In 1631, he won his great victory of Leipzig, principally by his artillery; some of his guns were of a most peculiar construction, an interior metal cylinder strengthened by rope wound round it, and covered with boiled leather. Frederick the Great still further improved field artillery, and under him it was capable of taking part in the most rapid movements.

Artillery, in the present day, has become a most important arm, and has modified the methods of putting the principles of strategy and tactics in execution, though it can never change the principles themselves. This will be at once evident, when we consider that it is essentially offensive, being only used offensively even in defence. It has no power of acting by itself, but, confined solely to reaching distant objects with its projectiles, is employed in the preliminary contest so to break the formation of either the attacking or attacked enemy, that the main power of the army, the infantry, may be able to resist the attack, or successful in their charge. And though the ancients had no such powerful propellent arm, yet their slingers, archers, cross-bow and javelin men were employed with the same object, the range, if we may so express it, being much less and more confined.

Artillery has also given a great advantage to civilised over barbarous nations, the science required in the construction, and the expense in the armament of troops with this powerful arm, having placed the latter wholly at the mercy of the former; reversing the facts of former days, when barbarous nations, constantly trained in war, were more than a match for their more civilised, and thereby more or less effeminate, neighbours. Such was the case in the Western Empire, which soon fell before the hordes of Germany.

The long trains of artillery, with their accompanying carriages for ammunition, &c., cause much greater immobility in modern armies. They cannot perform those rapid evolutions, in sight of an enemy, by which victories were gained in former times. The armies are extended over a much longer front, both to allow room for the artillery, and to avoid the ravages that would be caused by artillery in dense masses. Actions, which formerly could be clearly seen and described, are now confused and hidden by the smoke. The gaining of victories, therefore, depends much more on the genius of the general in a judicious selection and proper disposition of troops on the field of battle. And though the powers of destruction have been much increased, both the numbers and disproportion of the slain in both armies has been much decreased, for battles have been often fought and won where the opponents have hardly come into collision; and when they have, it has only been partial and of short duration, and not the sanguinary hand to hand contest of former times.

Artillery is now divided into two classes, light, or field, and heavy; the former consisting of horse artillery, field batteries, and batteries of reserve and position, which are of an intermediate description; the latter of siege and garrison artillery. Horse artillery is organised with light guns, well horsed, to accompany cavalry in all its movements; the field batteries, with heavier guns, but still able to make rapid movements, on occasion, for concentration, &c., to accompany the infantry; the batteries of position and reserve, with a still heavier description of gun, though intended to accompany an army in the field, are not intended to make rapid movements, but, to a certain extent, remain in the same position during an action, or arm any field-works that may be thrown up. The siege and garrison artillery consist of the heaviest guns for which transport can be provided, or the exigencies of the service may require. The following table, extracted from General Lewis's article on Artillery in the 'R. E. Aide-Mémoire,' with slight alterations, shows the constituent subjects of artillery most concisely stated:—

- Personnel
  - Horse Artillery.
  - Rocket do.
  - Foot do.
    - Field.
    - Garrison.
  - Invalid gunners.
  - Master gunners.
- Materiel.
  - Ordnance
    - Iron
      - Guns.
      - Howitzers.
      - Mortars.
      - Carronades.
    - Brass
      - Field guns.
      - Field howitzers.
      - Mortars.
    - Rocket
      - Field.
      - Heavy.
  - Carriages
    - Travelling
      - Field.
      - Siege.
    - Standing
      - Wood.
      - Iron.
  - Platforms
    - Ground
      - Wood.
      - Stone.
    - Traversing
      - Wood.
      - Iron.
  - Ammunition
    - Powder.
    - Shot and shells.
    - Case or canister, spherical case, grape.
  - Stores in general.

- Instruction
  - Academical for officers.
    - Theoretical
      - Mathematics.
      - Fortification.
      - History and geography.
      - Plan drawing.
      - Landscape drawing.
      - Languages.
    - Practical
      - Drills — both infantry and artillery.
      - Sword exercise.
      - Gun and mortar practice.
      - Repository course.
      - Laboratory course.
      - Foundry, proof, and carriage department—courses.
  - Elementary tactics for non-com. officers and gunners
    - Theoretical
      - A course of elementary instruction in the schools.
    - Practical
      - Infantry drill, and other exercise of arms.
      - Field battery exercise.
      - Gun, mortar, howitzer, and rocket practice.
      - Repository course.
      - Partially laboratory course.

The personnel, in the English army, is formed in one corps, called the Regiment of Royal Artillery, which, however, consists of 14 battalions of 8 companies each, called the Foot Artillery, and a horse brigade of 10 troops, which furnishes the personnel of the horse artillery; the men composing these troops are permanently employed as horse artillery, whilst the companies of foot artillery are sometimes employed in the field batteries, and sometimes in garrison or siege duties; a certain number of men, however, enlisted as drivers, always remain as such.

As experiments are, at the present time, being carried on with a gun of novel construction and great power, invented by Sir W. Armstrong, which will most probably be introduced into the service and cause great alterations, field artillery will be further treated under that head. For the present mode of making CANNON, see that article, and for the theory of artillery see GUNNERY. The size and description of the various guns in the service will be found under ORDNANCE.

ARTILLERY PARK. This term is applied both to the camp of one or more field batteries, and to the enclosure, where, during a siege, the general camp of foot artillery and depôts of guns, matériel, &c., are collected. In consequence of the number of carriages, horses, stores, &c., attached to artillery, and which it is necessary to keep separate, their camp is often enclosed off by picket-posts and ropes, or the carriages are so arranged as to form an enclosure. The position of the parks of the various field batteries attached to an army will of course be fixed by the general rule which holds good for all arms; that each should occupy the same relative position that it would in action, and that its length of front should be the same. This will, however, be modified by the nature of the ground, and by the necessity that exists for artillery having its support close to it, which would render its being placed on the extreme flanks very objectionable. Ordinarily the battery or batteries attached to a division of an army should take up their encamping ground immediately in rear of the intervals between the brigades, so as to be able to move up at a moment's notice; the battery being encamped in line either at full or half intervals. With a large force, the greater portion of the ammunition and stores, with the artillery of reserve, are collected in what is called the grand park, the position of which should be chosen with a view of its being accessible, by the roads in its vicinity, to the whole army.

ARTILLERY TRAIN, a number of guns with their carriages, ammunition, waggons, &c., complete, and fit for marching.

ARTIZANS. In this country it is customary when a young artizan has served his apprenticeship, for him to enter at once as a journeyman; to settle down in some town, usually where he has been apprenticed; and there to work for any master who will employ him. Among the less respectable workmen, or when trade in general is dull, the *tramp* system is acted on; the artizan goes from town to town, a sort of homeless wanderer, seeking work wherever it may be found, and often forced to associate with disreputable companions.

But in Germany the custom is different. There a kind of tramp-system is not merely looked forward to, but is compulsory. The *wanderschaft* of a German workman is a transition period between the life of an apprentice and that of a master. In many parts, both of Germany and of Switzerland, an apprentice cannot obtain his freedom and become a master until he has spent a certain number of years in following his calling beyond his native country. He is furnished on setting out with a book called a *wander-buch*, in which his various employers insert certificates of his service and conduct. In his wanderings he is generally assisted and succoured, not only by the trade to which he belongs, but by the donations of travellers. Many English travellers in Germany have encountered these young workmen, trudging along the roads, with knapsack on back. Mr. Symonds ('Arts and Artizans, at Home and Abroad'), states that, while certain evils arise from this system, it tends on the other hand to give the young men an amount of general information more varied and extensive than is commonly met with among English workmen.

In the Vorarlberg (a part of the Austrian dominions) the male inhabitants are accustomed to leave home early in the spring, go to Switzerland and France, exercise the trades of masons and house-builders during the summer, live with the utmost possible frugality, and return to the Vorarlberg in autumn with the savings of their labour.

The silk-weavers of Lyon have a very strict system of classification. There are small masters, workmen, and apprentices; besides the capitalist-manufacturers who set all to work. The masters or *chefs d'ateliers*, are owners of a few looms, and have fixed residences. The workmen, or *compagnons*, have neither capital, looms, nor houses; they work the looms belonging to the master, live and board with him, and receive half the money gained by the looms they work—the other half going for house-rent, risk, wear and tear of machinery, &c. The *apprentices* are from 15 to 20 years of age; they are taught by the *chefs d'ateliers*, with whom and for whom they work.

ARTOTYRITES. [COMMUNION.]

ARTS, DEGREES IN, such as are now given in our universities, appear to have originated with the incorporation of those bodies in the 11th and 12th centuries. Previous to this period, the distinctions were for the most part of masters and scholars only, as in our grammar-schools of the present day.

The term *master* is believed to be the oldest among those of graduation. Eugenius II. by the 34th canon of a council held at Rome in 826, mentions the appointment of magistri and doctores in the same sentence:—"ut magistri et doctores constituantur, qui studia literarum, liberaliumque artium, ac sancta habentes dogmata assidue doceant" (that masters and doctors be appointed who may continually teach the knowledge of learning and the liberal arts, and the received opinions in religion). This was confirmed by a decree of Leo IV. in another synod at Rome, in 853, (Muratori, 'Antiq. Ital.' tom. iii. col. 830.)

Du Pin, 'Nouvelle Bibliothèque des Auteurs Ecclesiastiques,' 4to. Paris, 1700, tom. x. p. 171, states that the academies or universities which were originally established, were in the 13th century reduced to form. That of Paris, which had begun to be formed in the preceding century, had grown famous from the number of its scholars, and for the masters with which it furnished all Europe. In its origin, he adds, it was composed of *Artists*, who taught the sciences and philosophy; and of Divines, who made commentaries on Peter Lombard's 'Book of Sentences,' and explained the Holy Scriptures. Mention of these two faculties only occurs in the constitutions made for the university by the Cardinal di S. Stefano, legate of Pope Innocent III. in 1215. The whole number of arts was originally *seven*, and these were distributed into the *trivium*, comprehending grammar, logic, rhetoric; and the *quadrivium*, comprehending music, arithmetic, geometry, astronomy. Artidoctor and artista are ancient names for masters of arts, mentioned by Du Cange.

Gregory IX. whose pontificate continued from 1227 to 1241, is said first to have instituted the inferior rank of *bachelors*; whose name was derived from *bacilla* (little staves), either because they were admitted by receiving a little wand, or because as following the title adopted for the novices of the soldiery, who exercised with sticks, in order to learn to fight with arms. The bachelors were exercised in disputations, of which the masters were the moderators. Much upon the etymology of the names of bachelor and master may be seen in Bacmeister's 'Antiquitates Rostochienses,' in the third volume of the 'Monumenta Inedita Rerum Germanicarum,' fol. Lips. 1743, col. 953. The honours conferred upon learned men, in the form of these degrees, greatly increased the number of scholars in all the universities of Europe. For an able sketch of the origin and influence of universities in the middle ages, the reader is referred to the 3rd vol. of Savigny's celebrated work, 'Geschichte des Römischen Rechts in Mittelälter,' c. 21.

From several passages in Wood's 'History and Antiquities of the University of Oxford, there can be little doubt but that the degrees both of bachelor and master of arts were conferred there in the time of Henry III. and the degree of master of arts probably much earlier. The study of law, both canon and civil, and the institution of the Faculty of Law, in which degrees were given, are said to have come into the university in 1149, under the influence and fostering care of Vacarius. (Gutch's edit. of Wood, vol. i. p. 52.)

Wood, quoting the commentaries of one Whetley upon Boëthius, written in the time of Edward I., says, "When the said bachelor was created master, the chancellor gave him the badges with very great solemnity, and admitted him into the fraternity with a kiss on his left cheek, using these words, 'En tibi insignia honoris tui, en librum, en cucullum, en pileum, en denique amoris mei pignus, osculum; in nomine Patris, et Filii, et Spiritûs Sancti.'" (*Ibid.* p. 59.)

The examinations for the degree of B.A. (bachelor of arts) in Oxford have been remodelled by the Examination Statutes of 1850, by which it has been enacted, that all students shall pass three public trials before proceeding to their B.A. degree; these are—

I. Responsions, which are holden three times in each year (that is, 5th of December, Monday after the 4th Sunday in Lent, Thursday after the 1st Sunday after Trinity), and are to be passed in the third to the seventh term inclusive. The subjects of this examination consist of one Latin and one Greek author; Euclid, Books I. and II., or Algebra to Simple Equations inclusive, and Arithmetic as far as the extraction of the square root inclusive, in addition to which a passage of English to be translated into Latin, a paper of Grammatical questions, and a paper of Arithmetical or Mathematical questions are set to all the candidates, who are also examined *vivâ voce*.

II. The First Public Examination under moderators to be passed between the eighth and the twelfth term of standing, taking place twice in the year, and commencing on the 20th of November, and the Wednesday next after the 1st Sunday after Easter; at this examination honours are awarded both in Classics and Mathematics. In order to acquire Classical honours the candidates are desired especially to bring up poets and orators; Homer, Virgil, Demosthenes, and Cicero, being recommended by name. The highest honour cannot be obtained without Logic, which has great weight in the distribution of both honours; Euclid and Algebra however may be substituted for Logic. Philological and critical questions are proposed, as well as Greek and Latin translations in prose and verse. For those who are not candidates for honours (Pass-men), the subjects are Four Gospels in Greek (save in the case of persons not members of the church of England, when some one Greek author is to be substituted), one Greek and one Latin author, of which one must be a poet, the other an orator; in addition to which a piece of English to be translated into Latin, a paper of Grammatical questions, and a paper of Mathematical or Logical questions are set to all the candidates.

III. The Public Examination (held twice in the year, commencing on the Thursday after the 2nd Sunday after Easter, and the 24th of October), at which the candidates must pass in two schools at least (though not necessarily in the same Term), as early as the thirteenth, and for honours as late as the eighteenth term of standing. Prior to the examination the candidates must present a certificate from a Professor, or Public Reader, showing that they have attended two courses of public lectures.

There are four schools, the first of which, that of 'Literæ Humaniores,' has to be passed *first, and by all.*

Candidates for honours may add to the subjects in Divinity prescribed for the pass examination, one or more of the apostolical Epistles and Ecclesiastical History. They have to take up the Greek and Latin languages, Greek and Roman history, Chronology, Geography, Antiquities, Rhetoric, and Poetic, Moral, and Political Philosophy. Logic, which has great weight in the distribution of honours, must be tendered by all who seek to obtain a first or second class. Those who are not candidates for honours are expected to take up the Four Gospels and the Acts of the Apostles in Greek, Sacred History, the Evidences, and the Thirty-nine Articles, with Scripture proofs, unless they are not members of the Church of England, when an equivalent in Greek or Latin, or some one Greek or Latin author is required. One philosopher and one historian, Greek or Latin (no translations into Latin are set).

The second school is that of Mathematics; the minimum for which is the first six books of Euclid, or the first part of algebra: the subjects for honours being mixed as well as pure mathematics.

The third school is that of Natural Science, where the minimum consists of an acquaintance with the principles of two out of these three branches of natural science, Mechanical Philosophy, Chemistry, and Physiology, and with some one branch of science which falls under mechanical philosophy. Candidates for honours are expected to show an acquaintance with the principles of the three branches of natural science named above, and of some one of the physical sciences falling under the above-named branches of natural science.

In the fourth school, that of Law and Modern History, the minimum consists of the History of England from the Conquest to the Accession of Henry VIII., with Blackstone on Real Property; or from the Accession of Henry VIII. to that of Queen Anne, with Blackstone on Personal Property. Justinian's Institutes may be substituted for Blackstone. For honours, the candidates have to present, in addition to the above, in Law, the first and second volumes of Stephen's Commentaries (substituting for these, Justinian's Institutes, and Smith on Contracts); and Wheaton on International Law, or Grotius, Books I. and II.; and Modern History down to 1789. Adam Smith on the Wealth of Nations may also be offered.

After the candidates have been examined, the names of those who have honourably distinguished themselves in the first and second public examinations are distributed, in alphabetical order, into three classes, together with the names of their colleges, under the two divisions of *In Schola Litt. Gr. et Lat.*, and *In Schola Disc. Math.* Those who distinguish themselves in the second public examination are arranged alphabetically in four classes, with the names of their colleges, under these four divisions: *In Literis Humanioribus; In Scientiis Math. et Phys.; In Scientia Naturali; In Jurisprudentia et Hist. Mod.* A fifth class, giving the numbers without the names, is added to each of these divisions. Printed copies of the schedule containing these classes are sent to the chancellor, to the vice-chancellor, to the heads of houses, to the proctors, and to the refectory and common room of each college and hall.

Sixteen terms are required for the degree of bachelor of arts in Oxford from all except the sons, and eldest sons of the eldest sons, of English, Scotch, and Irish peers, and of peeresses in their own right, as well as baronets, and the eldest sons of baronets and knights, when matriculated as such, and not on the foundation of any college; all such persons are allowed to be candidates for the degree after having completed two years' residence. But of these sixteen terms, residence for twelve only is necessary. Of these terms, Michaelmas and Hilary are each kept by six weeks' residence, and Easter and Trinity by three weeks each.

In Cambridge, those who proceed to the degree of B.A. undergo a previous examination (known ordinarily by the name of the *little go*) in the Lent term next after, or next but one after, that in which they have kept their first term, according as such first term be or be not a Lent term: the subjects of which, for those students who are not candidates for honours in the mathematical, classical, and law triposes, are one of the Four Gospels in the original Greek, Paley's 'Evidences of Christianity,' one of the Greek and one of the Latin classics, the Elements of Euclid, Books I., II., & III., and arithmetic; whilst all those students who are candidates for honours in either of the above-mentioned triposes have to pass an examination additional to the one just described in Euclid, Books IV. and VI.; algebra, including quadratic equations, ratio, and proportion; and elementary mechanics.

Between the previous examination and that for the degree of B.A., all students who are not candidates for honours are required to attend the lectures for one term of one out of a certain number of professors specified by grace of the senate Oct. 31, 1848, and to pass a satisfactory examination (conducted by such professor and an assistant examiner) in the subjects of such lectures, at any time between the little go and the degree examination. The mode of proceeding to degrees in arts has been altered by, and in consequence of, the new statutes of the university, which received the royal assent in August, 1858. One most important change has been made by them in the matter of residence, nine terms being the time now required for the degree of B.A.; and, in order to keep any of these terms, a residence of two-thirds of such term is exacted. In consequence of these alterations, changes have been made in the times of examination for the B.A. degree. In the first place, there is no longer an examination for the ordinary degree in the month of January; in the next, there is now in every term an examination for the ordinary B.A. degree on the Thursday before the end of the first two-thirds of each term; and, in the third place, as the great majority of candidates will in all probability present themselves at the examination in the Easter term, at that only are those approved to be arranged in four classes. The subjects of examination for these students are, the Acts of the Apostles, in the original Greek; one of the Greek, and one of the Latin classics; the history of the English reformation; Euclid, books I.—IV. inclusive, and propositions i.-vi. of Book VI.; together with certain parts of algebra, mechanics, and hydrostatics. The examination of those who contend for honours is conducted according to regulations confirmed by a recent grace of the senate, which enacts that questions and problems shall be proposed to the candidates on eight days, the first three being assigned to the more elementary, and the last five to the higher parts of mathematics; that after the first three days an interval of eight days shall elapse, and on the seventh of these days the moderators and examiners shall declare what persons have acquitted themselves so as to deserve honours, who are then to be admitted to the examination in the higher parts of mathematics. After this examination, the moderators and examiners, taking into account the examination of all the eight days, arrange all the candidates who have been declared to deserve mathematical honours into the three classes of wranglers, senior optimes, and junior optimes, which classes are published in the Senate House at nine o'clock on the Friday morning preceding the general B.A. admission. The subjects of the examination on the first three days are, Euclid, Books I.—VI., Book XI., props. i.-xxi., Book XII. props i. ii.; arithmetic and the elementary parts of algebra; the elementary parts of plane trigonometry; the elementary parts of conic sections, treated geometrically; the elementary parts of statics, treated without the differential calculus; the elementary parts of dynamics, treated without the differential calculus; the 1st, 2nd, and 3rd sections of Newton's Principia; the elementary parts of hydrostatics, treated without the differential calculus; the elementary parts of optics; and the elementary parts of astronomy.

By a comparatively recent enactment, it has been declared that the examination of candidates for honours in the classical tripos shall be open to all students who are of proper standing, and that all who obtain honours in the classical tripos shall be entitled to admission to the degree of B.A.

The examinations for the mathematical and classical triposes, and for the ordinary degree of B.A., are conducted entirely by printed papers; at that for the little go, each candidate has to pass a short trifling *viva voce* examination, in addition to that conducted by printed papers.

Bachelors of arts in both universities, though graduates, are considered to be *in statu pupillari*, that is, they are still under nearly the same discipline and control as the under-graduates, except attendance on college lectures. The legislative bodies of the universities consist of those who are masters of arts or who have taken a higher degree.

Masters of arts, in both universities, wear a gown of Prince's stuff, with a semicircular cut at the bottom of the sleeves. The Oxford hood, for a master, is of black silk lined with crimson. At Cambridge, the master wears a silk hood entirely black; the distinction between regents and non-regents is now abolished.

The bachelors of both universities wear black gowns of Prince's stuff; that of Oxford is with a full sleeve, looped up at the elbow, and terminating in a point. At Oxford, the bachelor's hood is edged with fur: at Cambridge, it is lined with lamb's wool.

For further information on the education of Oxford and Cambridge, particularly with reference to the degree of B.A., the fees, &c., see 'Journal of Education,' Nos. i. iii. iv. viii. x. xiii. xv.; on that of Dublin, Nos. xi. xii.; and on the Scottish universities, Nos. vii. viii. ix.; the Oxford, Cambridge, and Dublin 'Calendars;' and also 'Occasional papers on university matters' published at Cambridge by Macmillan & Co.

ARTS, FINE. The Fine Arts are generally understood to comprehend those productions of human genius and skill which, through the medium of the beautiful, more or less address themselves to the sentiment of taste. Art was first employed in embellishing objects of mere utility; but art so employed is now distinguished as Ornamental Art; the office of the Fine Arts is to meet our impressions of beauty or sublimity, however acquired, by imitative or adequate representation. The capacity of the human mind for receiving such impressions, whether directly from nature or through the medium of the arts, depends greatly on civilisation, and that leisure which supposes that first wants are satisfied; but there exists no state of society, however ignorant, in which some symptoms of taste and some attempts to arrest the beautiful are not to be met with. The difference between such efforts and the most refined productions is a difference only in degree. The fact of the existence of the arts in some form may be always taken for granted, and it would only remain to regulate their influence and direct their capabilities aright.

The arts are peculiarly interesting as human creations. They are composed of nature operating on human sympathies, and reflected through a human medium; and as nations, like individuals, present ever-varying modifications, so the free growth of the fine arts partakes of all these varieties, and may be compared to the bloom of a plant, true to its developing causes whatever they may be, and nurtured in the first instance by the soil from which it springs. In barbarous or degenerate nations, the sentiment of the beautiful has ever been attained only in the lowest degree, while a false excitement, founded on the suppression of the feelings of nature, may be said to have usurped the place of the sublime. We smile at the simple attempt of the savage to excite admiration by the gaudiness of his attire; but we should shudder to contemplate the scenes which his fortitude or obduracy can invest with the attributes of sublimity. The just value of life, the characteristic of that civilisation which reduces the defensive passions to their due limits, at the same time naturally elevates the sources of gratification by pointing out the pleasures of the mind as distinguished from those of sense; and the perception of the beautiful is in its turn the cause, as it is in some degree the result, of the rational enjoyment of life.

The great use of the arts is thus to humanise and refine, to purify enjoyment, and, when duly appreciated, to connect the perception of physical beauty with that of moral excellence. But it will at once be seen that this idea of usefulness is in a great measure distinct from the ordinary meaning of the term as applicable to the productions of human ingenuity. A positive use results, indeed, indirectly from the cultivation of the formative arts, precisely in proportion as their highest powers are developed: for it will be found that at all times when the grandest style of design has been practised with success, and particularly when the human figure has been duly studied, the taste thus acquired from the source of the beautiful has gradually influenced all kinds of manufactures. Again, as illustrating science, the fine arts may be directly useful in the stricter sense, but this is not the application which best displays their nature and value. The essence of the fine arts, in short, begins where utility in its narrower acceptation ends. The abstract character of ornament is to be useless. That this principle exists in nature we immediately feel, in calling to mind the merely beautiful appearances of the visible world, and particularly the colours of flowers. In every case in nature, where fitness or utility can be traced, the characteristic quality or *relative* beauty of the object is found to be identified with that fitness;—a union imitated as far as possible in the less decorative parts of architecture, furniture, &c.; but where no utility save that of conveying delight (perhaps the highest of all) exists, we recognise the principle of *absolute* beauty. The fine arts in general may be considered the human reproduction of this principle. The question of their utility therefore resolves itself into the inquiry as to the intention of the beauties of nature. The agreeable facts of the external world have not only the general effect of adding a charm to existence, but they appeal to those susceptibilities which are peculiarly human, and it becomes necessary to separate the instinctive feelings which we possess in common with the rest of the creation, from that undefinable union of sensibility and reflection which constitutes taste, and which, while it enlists the imagination as the auxiliary of beauty, is, in its highest influence, less allied to love than admiration. It is this last feeling which the noblest efforts of the arts aspire to kindle, which not only elevates the beautiful, but reduces ideas of fear and danger to the lofty sentiment of the sublime, which, as its objects become worthier, is the link between matter and mind, and which tends to ennoble sympathy and increase self-respect.

With regard to the classification of the arts, those are generally considered the most worthy in which the mental labour employed and the mental pleasure produced are greatest, and in which the manual labour, or labour of whatever kind, is least apparent. This test would justly place poetry first; but the criterion should not be incautiously applied; for in architecture, where human ingenuity is most apparent, and even where the design is very simple, a powerful impression on the imagination may be excited from magnitude, proportion, or other causes. In such cases, however, it will still be evident that we lose sight of the laborious means in the absorbing impression of the effect, and the art thus regains its dignity. It would be an invidious as well as a very difficult task to assign the precise order in which painting, sculpture, architecture, and music, would follow poetry; but it may be remarked, that the union of the arts is a hazardous experiment, and is often destructive of their effect. This is most observable in the attempts to combine the principles of sculpture and painting. The union of sculpture with architecture may seem an exception, but sculpture so employed becomes subordinate to the sister art and a means of expressing more emphatically the idea of the edifice. The drama itself, which unites poetry with many characteristics of the formative arts, and with music, is in constant danger of violating the first principles of style, viz., the consistency of its conventions; and in the more intimate union of poetry and music, the latter, though the inferior art, is too independent and too attractive to be a mere vehicle, and accordingly usurps the first place. The true principle seems to be that the arts in their higher manifestations must be kept apart; or one must be entirely subordinated and made subsidiary to the other.

All the fine arts it will be seen have something in common. Art is a means of rendering cognisable by the senses an idea or conception which has been formed in the mind of the artist. [ÆSTHETICS.] Art therefore is creative. A true work of art is a representation, not an imitation. Every such work is individual; owes its special value to the thought, or to the mental idiosyncrasy, of the artist, and makes its appeal to the imagination and the judgment—to the emotional and the critical faculties. But whilst there is a consonance in the fundamental idea of all the fine arts, each has its own technical medium, and special conventions, and each therefore has, as we have said, its own distinctive and specific style.

The history and the principles, the specific style and the technics, of the several arts will be found treated of under their respective heads, or the references there given.

ARTS, MANUFACTURING. As the fine arts are destined to the production of objects beautiful rather than useful; so do the manufacturing arts produce results useful rather than beautiful. But in all the later stages of society, these two divisions have tended to coalesce into one: the useful and the beautiful, the *utile et dulce*, being found reciprocally to lend strength to each other. The union of Science with the Arts is becoming, in our own day, more and more apparent.

The establishment of Art-Manufactures, in which sculptors and painters of eminence are employed to design models and patterns for manufacturers; the formation of schools of design, where drawing and modelling with an especial relation to manufactures are taught; the still more recent establishment of artizan schools, where similar instruction is given under different arrangements—all point to a union between fine art and manufacturing art; while mechanics' institutions, lyceums, popular treatises on Science—so far as they have realised the anticipations concerning them—indicate a union between Science and Manufactures. Again, such discoveries as those relating to Photography, Electography, &c., lead to a union between science and fine art. Thus do all three—Science, Art, and Industry—stand in intimate relation one to another.

One of the most remarkable existing collections of specimens in art and manufacture is the Conservatoire des Arts et Métiers, at Paris. This noble institution was the virtual carrying out of a suggestion made by Descartes a century and a half ago—namely, to build a series of large halls, each to contain all the implements necessary to some one trade or department of industry, and to attach to each department a lecturer for the instruction of the people. The institution, which has existed more than sixty years, is supported by a grant of 150,000 francs per annum from the French government. The contents are extensive and well arranged. In one hall or apartment are ancient and mediæval tools, machines, and models; in a second, acoustic instruments of various kinds; in a third, mirrors, and other kinds of optical instruments; in a fourth, porcelain and pottery ware of very choice kinds; in a fifth, articles in Venetian and other glass; in a sixth, chemical and electrical apparatus, old and new. Arranged in other parts of the building are halls and galleries filled with specimens of watch and clock making; drawings and models to illustrate descriptive geometry and the arts of construction; printing types, of every size and nation; models of steam engines and other prime movers of machinery; weights and measures of all ages and nations; weaving and knitting machines; the apparatus used in the manufacture of the *assignats*—the bank notes so famous during the early days of the French revolution; agricultural implements, and models of farm buildings; &c. An ancient chapel has been converted into a lecture and reading room; with the ceiling, walls, floor, and fittings decorated to illustrate ornamental art, and shelves filled with a well-selected library of books in arts and sciences. One of the most interesting halls is filled with objects purchased by the French Government at the Great Exhibition of 1851, in Hyde Park. In most of these halls and galleries, frequent lectures are given to the working men of Paris. Somewhat similar, but at present less complete, is the Museum of the Department of Science and Art at South Kensington.

The exhibition of art-manufactures at Edinburgh in 1857, and portions of the magnificent Art-Treasures Exhibition at Manchester in the same year, were examples of a kind of public display much adopted lately—gradually educating a taste for art among purchasers and producers.

The British Government have annually applied, from the year 1836 to 1859, to parliament, for a grant or grants in furtherance of the cause of education in matters of fine art, manufactures, mining, and science. The systems adopted have been curiously varied, and not always well directed; yet the results have been important—not so much in training up able artists and workmen, as in awakening general attention (partly by public exhibitions, some permanent and some periodical) to the necessity for culture as a forerunner of skill. Some of these government proceedings will be noticed under SCIENCE AND ART, DEPARTMENT OF, and the articles there referred to.

ARUNDEL MARBLES, certain pieces of sculpture, consisting of ancient statues, busts, mutilated figures, altars, inscriptions, &c., the remains of a more extensive collection, formed in the early part of the 17th century by Thomas Howard, Earl of Arundel and Norfolk, and presented, at the suggestion of John Evelyn, in 1667, to the University of Oxford, by Mr. Henry Howard (afterwards Duke of Norfolk), the Earl of Arundel's grandson.

Thomas Howard, Earl of Arundel and Surrey, the founder of this collection, was the only son of Philip, first Earl of Arundel of his family, by Anne, sister and co-heir of Thomas, the last Lord Dacre of Gillesland. He was born in 1586, and in 1603 he was restored in blood by act of parliament, and to such honours as he had lost by his father's attainder, as well as to the earldom of Surrey, and to most of the baronies which had been forfeited by the attainder of his grandfather, Thomas, fourth Duke of Norfolk. The dukedom itself was detained from him. In 1607 he was made a privy-councillor, and in the same year went to Italy, where (with the exception of a brief interval in which he returned to England) he remained till 1614. It was during his residence in Italy that he commenced the formation of his remarkable collection of works of art. After his return to England, he was made, in 1621, Earl Marshal, and subsequently he was created Lord High Steward, in which capacity he presided at the trial of the Earl of Strafford. In 1633 he was sent as ambassador to the Queen of Bohemia and the States General; and in 1636 ambassador extraordinary to the Emperor Ferdinand II. He was created Earl of Norfolk in 1644, and soon afterwards left England. He died at Padua October 4, 1646.

When Lord Arundel determined to collect a gallery of statuary, he retained two men of letters for that purpose. The well-known John Evelyn was sent to Rome, and Mr. (afterwards Sir William) Petty undertook a hazardous journey to the Greek islands and the Morea. In the islands of Paros and Delos, Petty's indefatigable researches had been rewarded with ample success, when, on his voyage to Smyrna, he was shipwrecked on the coast of Asia opposite Samos, and escaped only with his life. At Smyrna he acquired many marbles of great value, particularly the celebrated Parian Chronicle. Still the jealousy of Villiers was active in interrupting Lord Arundel's pursuit, and the delight of his retired hours. Sir Thomas Roe, then ambassador at the Porte, is generally said to have been instrumental (at the suggestion of Villiers) in thwarting Petty's proceedings. But it appears from the correspondence of Roe with the Earl, printed in Appendix B, of Mr. Sainsbury's recently published 'Original Papers Illustrative of the Life of Sir Peter Paul Rubens,' that he really assisted Petty as far as he could do so without incurring the displeasure of the minister. Of Petty, Roe writes to the Earl, "There never was man so fitted to an employment, that encounters all accidents with so unwearied patience; eats with the Greeks on their worst days; lies with fishermen on planks at the best; is all things to all men, that he may obtain his ends, which are your lordship's service." The earl was unquestionably fortunate in procuring the service of such men as Evelyn and Petty, but he also found other zealous assistants in his undertaking. From Mr. Sainsbury we learn that Sir Dudley Carleton, the minister at the Hague,—himself a judge of works of art far superior to most educated Englishmen of his time, and a diligent collector,—was one of the first to contribute to the Earl of Arundel's collection; and that, besides Sir Thomas Roe, "Sir Isaac Wake at Turin, Sir Balthasar Gerbier at Brussels, Sir Francis Cottington and Lord Aston at Madrid, were ambassadors from England, severally written to, and urgently requested to assist him, and give their countenance and support to his several agents in the collection of matters of art" (p. 269).

Lord Arundel having assembled in his gallery his various acquisitions from Greece and the Continent, adopted the following arrangement of his marbles: the statues and busts were placed in the gallery; the inscribed marbles were inserted into the wall of the garden of Arundel House; and the inferior and mutilated statues decorated the garden itself. We learn from catalogues, that the Arundelian collection, when entire, contained 37 statues, 128 busts, and 250 inscribed marbles, exclusive of sarcophagi, altars, and fragments, and the inestimable gems, which included the "very rich collection, as well of medals as other intaglios, belonging to the cabinet he purchased of Daniel Nys (of Venice), at the cost of ten thousand pounds." (Evelyn, 'Diary.')

This was, as his contemporary Peacham notes in his 'Compleat Gentleman,' the first collection of Greek and Roman sculpture formed in this country. It was doubtless the example and influence of the Earl of Arundel which originally induced Charles I. to study and encourage the fine arts, and to form his magnificent collection of paintings.

In 1642, when Lord Arundel left his country, Lord Orford says he transported himself and his collection to Antwerp: Dallaway says (what was no doubt the truth) that his gems, cabinet pictures, and curiosities, only were removed. He adds, "In the general confiscation made by the parliament, the pictures and statues remaining at Arundel House were in some measure included. Many were obtained by Don Alonzo de Cardenas, the Spanish ambassador to Cromwell, and sent into Spain, with the wrecks of the royal collection."

When Lord Arundel died, he divided his personal estate between his eldest and second surviving sons, Henry Frederick Lord Maltravers, and William, afterwards Viscount Stafford. Henry, second son of the former and sixth Duke of Norfolk, succeeded to the elder son's share, and in 1667, influenced by the previous recommendations of Selden as well as Evelyn, gave a part of his moiety (the inscribed marbles) to the University of Oxford; the remainder descended to his son Henry, the seventh duke, and were afterwards mostly possessed by his divorced wife.

Arundel House and gardens were converted into streets about the year 1678, when it was determined to dispose of the statues by sale. It was proposed by the agents to sell the whole collectively, but no purchaser could be found. A division was in consequence made. One portion, consisting principally of busts, was purchased by Lord Pembroke; these are now at Wilton. A second was purchased by Sir William Fermor (the father of the first Earl of Pomfret), who removed them to his seat at Easton Neston in Northamptonshire, where such as were capable of being repaired had their defects amended and supplied by one Guelfi, an artist who misconceived the character and attitude of almost every statue he attempted to make perfect, and ruined the greater number of those which he was permitted to touch. Henrietta Louisa, Countess Dowager of Pomfret, in 1755, transferred these marbles also to the University of Oxford, where they became again united to the inscribed marbles. Mr. Theobald, in a communication to the Society of Antiquaries, made in 1758, says that many of the broken statues, which were thought not worth repairing, were begged by one Boyden Cuper, who had been a servant in the family, and removed by him to decorate a piece of garden-ground which he had taken opposite Somerset Water-gate, in the parish of Lambeth; a place of resort for citizens and others in holiday-time, and long afterwards known by the name of Cuper's Gardens. Here they continued till about the year 1717, when Mr. John Freeman, of Fawley Court, near Henley, in Oxfordshire, and Mr. Edmund Waller, of Beaconsfield, in Buckinghamshire, happening to see them, and observing something masterly in the designs and drapery of several, and that they were fragments of very curious pieces of sculpture, agreed for the purchase of them at the price of 75*l*. One moiety of these went to Beaconsfield, and the other to Fawley Court. A few statues and broken fragments were given to a Mr. Arundel, a relation of the Duke of Norfolk, who rented a waste piece of ground on the opposite shore of the river, which afterwards became a timber-yard; one or two of these were subsequently given to the Earl of Burlington, and went to Chiswick House. A few elegant remains were carried to Mrs. Temple's seat at Moor Park, near Farnham, in Surrey. Various other fragments, which were not thought worth removing, were buried in the rubbish and foundations of the houses in the lower parts of Norfolk Street, and the other buildings on the gardens. Several of these, including a few trunks of statues, dug up at a later time, were sent down to the Duke of Norfolk's seat at Worksop Manor.

The divorced Duchess of Norfolk, by whom the busts and statues were sold, also possessed the cameos and intaglios, and bequeathed them, at her death, to her second husband, Sir John Germaine. His widow, Lady Elizabeth Germaine, who valued them at 10,000*l*., offered them, about 1755, for that price to the curators of the newly-founded British Museum, who were not in a situation to bestow so large a sum upon the purchase; and she finally gave them to her niece, Miss Beauclerk, upon her marriage with Lord Charles Spencer, from whom they passed to his brother the Duke of Marlborough; and are now known by the name of the Marlborough Gems.

Sir William Howard, when afterwards Lord Stafford, succeeded to a house built for his mother, the Countess of Arundel, by Nicholas Stone, in 1638. It stood near Buckingham Gate, and was called Tart Hall. The second share of Lord Arundel's curiosities was deposited there, and, at a sale in 1720, produced 8851*l*. 19*s*. 11¾*d*., and the house was soon after levelled to the ground. This information appears upon the minutes of the Society of Antiquaries.

Dr. Mead bought at this sale Lord Arundel's favourite bronze head of Homer, which is introduced into his portrait by Vandyke; at Dr. Mead's sale it was purchased for 136*l*. by Lord Exeter, who gave it to the British Museum, where it is now considered as a head of Pindar. Lord Orford says, that the coins and medals of the Arundel collection came into the possession of Thomas, Earl of Winchelsea, and in 1696 were sold by his executors to Mr. Thomas Hall.

The greater part of the Greek inscriptions in the Arundel Collection now at Oxford were obtained, as has been already noticed, at Smyrna, where Gassendi says the celebrated Peiresc, who was engaged in similar pursuits, had first discovered them. According to this account, one Samson, Peiresc's factor, had paid fifty crowns for the curiosities, but the Turks having seized on Samson and his collection, with a view to obtain a higher price, the Earl of Arundel commissioned Mr. Petty to redeem the whole. They arrived in England in 1627, soon after which at the suggestion of Sir Robert Cotton, they were carefully examined by the learned Selden, in conjunction with two other eminent scholars. Selden, in 1628, published his 'Marmora Arundelliana,' a thin quarto volume, in which twenty-nine Greek and ten Latin inscriptions of this collection are deciphered and illustrated. The Arundel inscriptions were, at first, let into the wall which surrounds the Sheldonian theatre, each marked with the initial of the name of Howard. They were, however, soon increased by the accession of Selden's private collection, and some other donations; so that the whole amounted to 150 inscribed marbles, including tablets, altars, pedestals, stelæ, and sepulchral monuments. An edition of the whole was now undertaken, at the desire of Dean Fell, by Mr. Humphrey Prideaux, then student of Christchurch, but afterwards dean of Norwich, which appeared under the title of 'Marmora Oxoniensia, ex Arundellianis, Seldenianis, aliisque conflata,' fol. 1676. They were edited with great care, and illustrated by the annotations of the editor, Selden, Lydiat, and others. This work was republished fifty-six years afterwards by Michael Maittaire, under the title of 'Marmorum Arundellianorum, Seldenianorum, aliorumque Academiæ Oxoniensi donatorum; cum variis Commentariis et Indice, Secunda Editio,' fol. Lond. 1732; with great augmentations as to comment. An 'Appendix,' consisting of three Greek inscriptions, subsequently given to the University, was published in 1733, fol. In 1763, the 'Marmora Oxoniensia' were again published in a new and splendid form, under the auspices of the University, by Dr. Richard Chandler of Magdalen College; including the ancient inscriptions collected by Sir George Wheler and Messrs. Dawkins, Bouverie, and Wood, during their travels, some of which Dr. Richard Rawlinson possessed, and a few others; with engravings of statues, busts, and other marbles, to the number of 167 articles, 103 of which belonged to that part of the Arundel Collection which the countess dowager of Pomfret had given to the University. The Greek inscriptions of this collection, 'Ad Chandleri exemplar editæ,' were separately published at Oxford in 1791, in a small octavo volume.

The Arundel and Pomfret marbles are at present preserved at Oxford in two rooms, beneath the Bodleian Library; but it is proposed to remove them to the new Oxford Museum. Of the Arundel portion, that which the University places at the head of its collection is the Greek inscription known by the name of the PARIAN CHRONICLE, so called from the supposition of its having been made in the isle of Paros about B.C. 263. Another inscription of interest is a treaty concluded between Smyrna and Magnesia, for the protection of Seleucus Callinicus, engraved on a pillar in the temple of Venus Stratonicis, at Smyrna, about B.C. 244.

Among the more important marbles of the Pomfret donation are the colossal torso (for that portion only is antique) of a Minerva Galeata, restored as a statue by Guelfi; a Venus Vestita, or Leda; Terpsichore; a young Hercules; an Athleta, which has been called Antinous; a female figure, unrestored, of early Greek work; and three statues of senators, one of which is usually considered as Cicero. This last was etched by Woolridge.

Some of the statues in this collection, which have been restored, as far as the ancient portions go, have no positive attributes of the characters of gods, heroes, &c., which Guelfi, who restored them, made them represent.

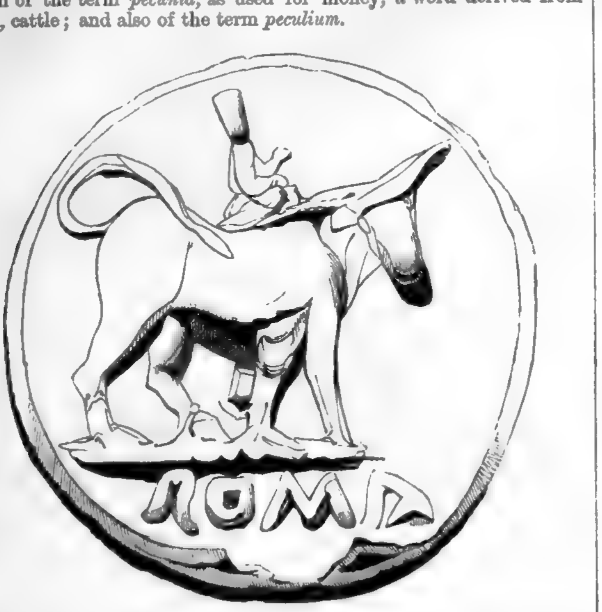
(Dugdale's *Baronage*, tom. ii., p. 277; Lodge's *Portraits of Illustrious Personages*; Selden's *Marmora Arundelliana*, and the *Marmora Oxoniensia* of Prideaux, Maittaire, and Dr. Chandler; Gassendi's *Life of Peiresc*; Gough's *British Topogr.*, vol. ii. p. 127; Lord Orford's *Anecd. of Painting*, edit. 1786, vol. ii. p. 124; Dallaway's *Anecd. of the Arts in England*; Sainsbury's *Original and Unpublished Papers Illustrative of the Life of Rubens*, 8vo, 1859, Appendix B.)

AS, among the ancient Romans, was a weight, consisting of twelve *unciæ* or ounces; it was also called *libra, libella,* and *pondo*, or the pound. Pitiscus ('Lexicon Antiq. Rom.') gives its etymology from the Greek ἄς, used in the Doric dialect for εἷς, signifying an integer or whole, one entire thing; but we can find no authority for this word ἄς. Others, as we learn from Budæus ('De Asse et partibus ejus,' lib. v. 8vo. Lugd. 1551, p. 146), have more correctly considered As to be equivalent to Æs, a piece of copper or brass. (Varro L. L. v. 36, Spengel.)

As, Assis, or *Assarius* (Eckhel, 'Doctrina Num. Vet' tom. v. p. 2) was likewise the name of a Roman coin of copper, or rather of mixed metal, which varied both in weight and composition at different periods of the Commonwealth; but which originally actually weighed a pound, whence it was called *As libralis*, and somtimes also *Æs grave*.

The first coinage of this description, according to Pliny (lib. xviii. c. 3; xxxiii. c. 13), took place in the reign of Servius Tullus, which, if Sir Isaac Newton's chronology of Rome is adopted, would be about the year B.C. 460, or 587 on other authority. The first Ases of Tullus had the figure of a bull, ram, boar, or sow upon them.

Varro ('De Re Rustica,' lib. ii. c. 1), Pliny, and Plutarch ('Poplicola,' edit. Bryan. tom. i. p. 226), assert that the most ancient Ases were so marked. This, in fact, according to the two last writers, was the origin of the term *pecunia*, as used for money, a word derived from *pecus*, cattle; and also of the term *peculium*.



The next in point of antiquity to the As which bore the figure of an animal, is considered by Pinkerton to be the As which was stamped with the two-faced head of Janus on one side, and the prow of a ship on the other. See Pinkerton's 'Essay on Medals,' vol. i. p. 100, who

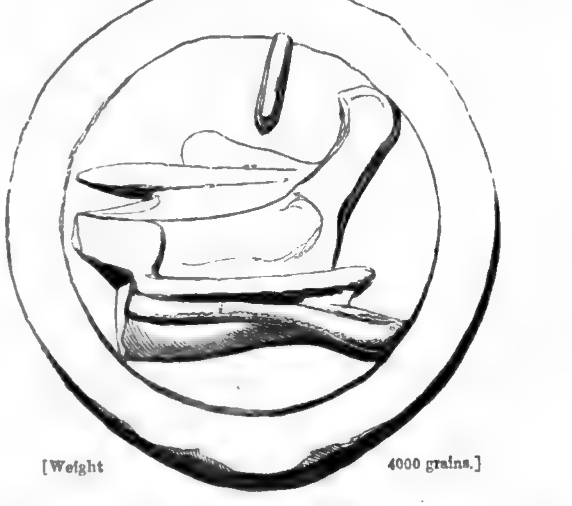
[This As weighs 3872 grains.]

adopts his opinion of this being the second As in point of antiquity, from a manuscript 'Dissertation on the Etruscan and Roman early Coins,' written by Dr. Charles Combe. Ovid, in his 'Fasti,' expressly alludes to the As thus marked; and it is described by Pliny (xxxiii. 3). The head of Janus was usually so accompanied, because, according to an old fable, Saturn arrived in Italy by sea.

> "'Multa quidem didici; sed cur navalis in ære
> Altera signata est, altera forma biceps?
> Noscere me duplici posses in imagine,' dixit,
> Ni vetus ipsa dies extenuasset opus.
> Causa ratis superest: Tuscum rate venit in amnem
> Ante pererrato falcifer orbe Deus."
>
> Ov. *Fasti*, lib. i. 229—234.

The figures on this coin will explain the expression used by the Roman boys in tossing up—*capita aut navim*, 'heads or ship.' (Macrob. 'Sat.' i. 7.)

The earliest Ases were cast, probably in imitation of the Etruscan coins, which the Romans, in this instance, appear to have copied. In the British Museum there are even four Ases united together, as they were taken from the mould or matrix, in which many were cast at once. In most of the Ases preserved in our cabinets, the edge shows evidently where they were severed from each other, and where the



[Weight 4000 grains.]

piece at the mouth of the mould was cut off. From being cast, it will be judged that they are not very correctly sized. As the As fell in weight, the smaller divisions were not cast, but struck.

According to Pliny, the As continued of its original weight till the first Punic war, when, the treasury of the state being exhausted, it was reduced to two ounces. This, however, is improbable, and is confuted by the coins themselves; since we find ases of all weights, from the pound downward to Pliny's two ounces. The As must, therefore, he says, have gradually diminished to ten ounces, to eight, to six, to four; and when the size was so much reduced, still more gradual diminutions must have taken place to three, and to two ounces. One or two of the pieces which remain might even imply that the decrease was more slow, to eleven, to ten, to nine, &c., but it is to be observed that neither the As nor its parts were ever correctly adjusted as to size, so that the marks upon them only, not their comparative magnitude, distinguish the divisions.

The middle of the first Punic war being about the year of Rome 502, or B.C. 250, supposing Pliny to be correct, would be the time of the reduction of the As to two ounces.

Pliny adds, that in the second Punic war, when Q. Fabius was dictator, and the Romans were pressed by Hannibal, the As was further reduced to one ounce. This event is ascribed to the 537th year of Rome, or B.C. 215, being thirty-six years after the former change. He adds, again, that, by the Papirian law, Ases of half an ounce were coined. *Mox* is the word which Pliny uses to indicate the time of this change. A. Papirius Turdus, who was tribune B.C. 178, is suggested by Pighius (ii. 343) as possibly the author of this law; but Eckhel ('Doctr. Num. Vet.' vol. v. p. 5) considers the time uncertain. This weight of the As, however, continued till Pliny's time, and long after.

Pinkerton offers the following sketch of a plan to determine the ages of the different sorts of Ases from their weight:—The As libralis, coined by Tullus, with the figures of oxen, &c., about 167 years after Rome was built, according to Sir Isaac Newton, or B.C. 460; As libralis, with Janus and prow, 400; the As of ten ounces, 300; eight, 290; six, 280; four, 270; three, 260; two, according to Pliny, 250; one, also from Pliny, 214. But this scheme is conjectural, at least down to B.C. 250, and may be considered as intended rather for the amusement of the collector, than as instruction to the sober inquirer.

The As libralis with the head of Janus is the most common form now found of the As, previous to its being reduced to two ounces; a circumstance which shows that form to have been of long duration.

The exact period when the parts of the As were first given, in their proportions of weight and value, is not now ascertainable; but the best authors on numismatic science agree that the time was not very far removed from that of the first coinage of the As.

The coined divisions of the As were the *semis, quincunx, triens, quadrans* or *teruncius, sextans,* and *uncia*. There were other divisions of the As by weight, which it may be proper to enumerate concisely. These were the deunx of eleven ounces, the dextans of ten, the dodrans of nine, the bes of eight, the septunx of seven, the sescuncia of an ounce and a half, and the semuncia of half an ounce. But none of these have been found in a coined form in numismatic cabinets; they are therefore universally considered to have been nominal sums. Indeed it is clear they would not be wanted, for $6+5=11$; $6+4=10$; $6+3=9$: so that these nominal sums were made up of the real coins by adding them.*

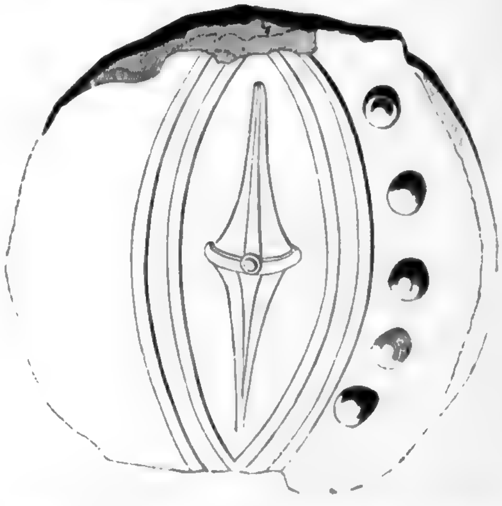
The *Semis, Semissis,* or *Semi-As,* half the As, or six unciæ, was of various types, but always marked with an S. The one here engraved represents a female head on one side, with a strigil behind, or perhaps a hook for reaping or other agricultural purposes, and a head of Pallas on the other: the S, at length, occurs on both sides. Mionnet (' De la Rareté et du Prix des Médailles Romaines,' tom. i. p. 5); and Akerman (' Descr. Cat. of Rare and unedited Roman Coins,' vol. i. pp. 6, 7) have

[Weight 2101 grains.]

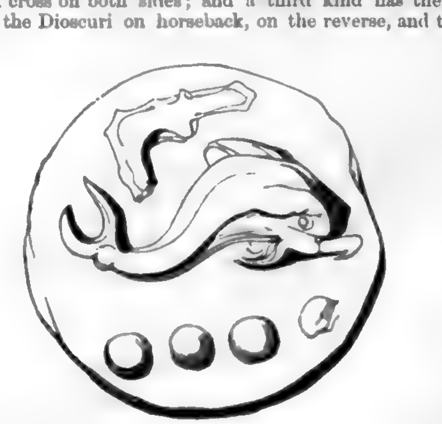
enumerated many different varieties. See also Rasche (' Lexicon Rei Num.' v. Semissis).

The *Quincunx,* the division of five ounces or portions of the As, is of very rare occurrence. All the other portions of the As have been copied for the present work from original coins in the British Museum; but the Quincunx, it is believed, exists in no cabinet at present in this country.

Our present representation of it has been copied from a work entitled ' De Nummis aliquot æreis uncialibus Epistola,' by the Cardinal de Zelada, 4to. Rom. 1778, a volume of extreme rarity, written for the express purpose of illustrating the passages already quoted from Pliny.



The Quincunx here given represents, on one side a bearded head; and, on the other, a buckler, or shield, bearing five globules on the dexter half, which indicate its value. Another type is said to represent a sort of cross on both sides; and a third kind has the head of Apollo, with the Dioscuri on horseback, on the reverse, and the word



ROMA; both these also bear the globules. The last-mentioned type is preserved in the Imperial Cabinet at Vienna.

* Horace (' Ars. Poet.' l. 325) says, the Roman youth learn to divide the As into a hundred parts:

> " Romani pueri longis rationibus Assem
> Discunt in partes centum diducere."

Possibly this passage has a reference to a centesimal division of the As then in use.

It is possible, however, that this which we have engraved may not be a genuine Roman Quincunx; other cities in Italy and Magna

[Weight 1571 grains.]

Græcia had their own Ases, and their divisions, marked in the same manner as those of Rome herself. (Compare Eckhel, *ut supr.* p. 11—13.) These are usually called, in contradistinction, Italian Ases. Such were those of Velitræ, Tudertia, Luceria, Populonia, Panormus, Pæstum, &c.

The *Triens* was the third of the As, or piece of four unciæ. The type here engraved bears a dolphin on one side with the strigil above: on the other is a thunderbolt.

Four globules, or pellets, to indicate its value, occur on both sides. Other types will be found enumerated in Mionnet (*ut supr.* pp. 7, 8); and Akerman (pp. 10, 11). Eckhel says, the head of Pallas was very frequent upon the Trientes ('Doctr. Vet. Num.' tom. v. p. 15). Pliny says (xxxiii. 3) that both the Triens and the Quadrans bore the type of a ship.

The *Quadrans* was the fourth of the As, or piece of three unciæ. The types of this were various also (Rasche, 'Lex. Rei Num.' v. Quadrans); but the value of the coin was uniformly denoted by three globules. On the Quadrans here represented, an open hand and strigil occur on both sides.

[Weight 1108 grains.]

Others have a dolphin, grains of corn, a star, heads of Hercules, Ceres, &c., on the obverse.

The *Sextans* was the sixth of the As, or piece of two ounces. The coin here engraved

[Weight 779 grains.]

bears on one side a caduceus and strigil, on the other a cockle shell. The value is denoted on each side by two globules. On some Sextantes the value is designated on one side only.

The *Uncia*, twelfth of the As, or piece of one ounce, is marked by a single globule. The type we have selected

[Weight 186 grains.]

bears on one side an ear of barley, and on the other a frog. For the varieties of type, compare Mionnet (p. 13); Akerman (p. 17). Eckhel describes one with the head of Pallas on one side, and on the other the prow of a ship: a globule by the side of each.

As the As fell in weight larger denominations of coin were struck, bearing names relative to the As. The As was latterly marked I. The *Dupondius*, or double As, was marked II. The *Tressis* III. The *Quadrussis* IV. There were even *Decusses*, or pieces of ten Ases, in copper, marked X. Olivieri mentions one in his own cabinet weighing upwards of twenty-five Roman ounces, which must have been cast when the As was about three ounces; for, as has been mentioned, they are far from being correctly sized. In the Museum Etruscum is a Decussis of forty Roman ounces, cast when the As was four ounces. The Denarius, Quinarius, and Sestertius were silver coins. According to Pliny, when the As was reduced to one *uncia* in the second Punic war, the *Denarius*, which was originally equivalent to 10, the Quinarius to 5, and the Sestertius to $2\frac{1}{2}$ Ases, were respectively made equivalent to 16, 8, and 4 Ases. On this subject see SESTERTIUS.

Notwithstanding that the As fell, it still continued to be called libra; and in fines of estates, and in other old customs, was, nevertheless, held to be a pound weight of copper. See Cornutus on Persius; that annotator lived in the reign of Domitian. The word *As* was also used in accounts for the whole of any heritage, &c., to late times. *Hæres ex asse* was the phrase used by the jurisconsults for an heir to a whole estate. (Pitisci, 'Lex.' v. As.) It is thus used by Martial (vii. 65), and elsewhere. The word As, indeed, with its subdivisions and multiples, was used generally as the representative of number, both in defining measures of length, the proportions of an inheritance, &c.

The Ases drawn for this article, from specimens in the British Museum, have been carefully weighed. A comparison of the weights will show that the parts do not correspond accurately with one another, or with the integer As. Our specimens may probably not all belong to one epoch, nor all to the city of Rome.

ASAFŒTIDA. A gum-resin obtained from incisions made in the upper part of the root of the *Ferula asafœtida*, which grows in Persia. Asafœtida as met with in commerce consists of agglutinated masses of a brownish colour, possessing an excessively disagreeable odour and taste. Its specific gravity is 1·327. It is very imperfectly soluble in water, but may be dissolved in alcohol rendered either acid or alkaline. According to Brande it consists of

Resin	48·85
Volatile oil	4·60
Gum	19·40
Bassorin	6·40
Acetate of potash / Malate of potash / Extractive matter	1·40
Malate of lime	·40
Sulphate of lime	6·20
Sulphate of potash	trace
Carbonate of lime	3·50
Alumina and oxide of iron	·40
Sand and vegetable fibre	4·60
Water	6·00
	101·75

The *resin* is soluble in alcohol, and yielded analytical results leading to the formula $C_{40}H_{26}O_{10}$, but it is probably a mixture of several substances. The *volatile oil*, to which the characteristic odour of asafœtida is due, is obtained by distillation with water. It is colourless and transparent, very volatile, and possesses a bitter and acrid taste. It is soluble in alcohol and ether, but nearly insoluble in water. Sulphur is one of its constituents.

Asafœtida is used in medicine, and is employed as a condiment amongst some Oriental nations. The green leaves of the plant, and the roasted roots, are also eaten.

ASAFŒTIDA is a gum-resin, obtained from the roots of *Narthex*, or *Ferula asafœtida*, a perennial plant, growing in Persia, in Khorassan, and in the province of Laar. In its recent and purest state it is white and transparent, but by exposure to the air it becomes of a clear brown colour, sometimes verging to red or violet, and of a waxy appearance. At the ordinary temperature of the air it is of the consistence of wax, slightly viscid or glutinous, and becoming soft with the beat of the hand, by which the grains are united into smaller or larger lumps, which, when broken, contain many almond-like pieces. The portions which correspond to this description constitute the best kind of asafœtida, which is called asafœtida in grains.

The inferior sort is dark brown, of a dull, fatty appearance, viscid and greasy, containing portions of the stalks, and other impurities: it is called asafœtida in masses.

Sagapenum, the source of which is unknown, is by many supposed to be a kind of asafœtida.

The smell of asafœtida is penetrating, very disagreeable, and lasts some time. The taste is bitter, unpleasantly aromatic, of an alliaceous or garlic-like character. Its chief component parts are volatile oil, resin, and gum; and it is soluble in vinegar, proof spirit, and yolk of egg. Triturated with water, it forms an emulsion, from which the resin is gradually precipitated. Asafœtida can only be powdered at the temperature of freezing (32° of Fahrenheit); but even after being powdered, though kept in a cool place, it is apt again to run into masses.

An artificial asafœtida is sometimes formed of resin and garlic juice; but this has only a weak smell, and is more perfectly soluble in alcohol.

Asafœtida acts on the human system as a stimulant, more especially of the nerves of the chest and abdomen. It also influences, like all gum-resins, the vessels distributed on the lower portion of the abdomen, or the pelvis. Though not so heating as its chemical composition might lead us to expect, it not only directs the blood more powerfully to these organs, but ensures its uniform supply. It is also a valuable antispasmodic, in irregular action of the muscles either of the respiratory or digestive organs.

Its power of at once rousing the nervous system and promoting the flow of blood towards the enfeebled stomach and bowels, renders it very serviceable in imperfect digestion, attended with constipation.

From a knowledge of its powers in such cases, the Romans employed it along with their food, as the Persians still do.

In hysteria it is extremely useful, both during an attack of spasm, and during the interval between the paroxysms.

In colic, and even ileus, its action is often rapid and effectual, especially if thrown into the rectum: in this way, cases of the most obstinate constipation, especially in hysterical females, have yielded to it.

In asthma, in the later stages of hooping-cough, and in the cough of old age, in cough occurring in weakly subjects, not connected with inflammation or tubercles, above all, in the cough of hysterical females, it is of very great service. In the last-mentioned case, it is improved by combination with myrrh and preparations of iron, as it likewise is when employed to act on the uterine system.

It is also employed externally, as a means of keeping up counter-irritation; and a convenient plaster may be formed by adding 1-12th part of camphor to 11-12ths of asafœtida. For internal exhibition, pills, or tincture, or watery solution (which must be used immediately after it is prepared), are the ordinary forms of administration. In cases of organic disease of the heart, especially enlargement, and in fulness or congestion of the brain or spinal chord, or in any organic diseases of these, asafœtida is improper.

ASARONE ($C_{40}H_{26}O_{10}$)?—*Asarin*, *Asarite*. A volatile principle, obtained from the *Asarum europæum*. It has a remarkable tendency to crystallise in beautifully definite forms. It however readily assumes an amorphous condition, from which it is again easily restored to its crystalline state. The facility which this circumstance affords for the study of crystallisation in general, has been taken advantage of by Schmidt, who has published a paper on the microscopic appearances of this substance during its crystallising condition in the 'Annalen der Chemie und Pharmacie,' for February, 1845.

Asarone is soluble in alcohol and ether, fuses at 104° Fahr., and boils at 536°, but is then partially decomposed.

ASA'RUM, a genus of Plants, belonging to the family of the *Aristolochieæ*. It was formerly employed as an emetic, instead of ipecacuanha; but, from the violence of its effects, it is now properly laid aside in medical practice. It is still however used in veterinary medicine to vomit and purge. [ASARUM, in NAT. HIST. DIV.]

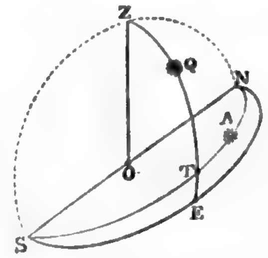
ASBOLINE. [SOOT.]

ASCENDANT. [ASTROLOGY.]

ASCENSION, RIGHT and OBLIQUE, and ASCENSIONAL DIFFERENCE, astronomical terms, of which the two latter are nearly out of use, while the term *right ascension* is preserved, in a somewhat different signification from its original meaning, to denote one of the angles by means of which the position of a star is ascertained.

If we suppose a person at the equator, looking directly towards the east, and raising his arms on each side till they are horizontal, his fingers will then point towards the two poles (which at the equator are in the horizon), and a line drawn through his arms will be a part of the axis on which the heavens appear to turn. Every star will rise vertically; that is, if the diurnal motion were quick enough to justify the phrase, would appear to shoot above the horizon directly upwards. The great circle of the heavens which his eye traces out as he raises his head without turning to right or left, is the equator, and the same point of the equator rises every day with the same star. If there be a remarkable star in the equator, from the rising of which the spectator chooses to begin his *astronomical day*, he will know the time of rising of any star as soon as he knows how far the point of the equator which rises with it is from the star at whose rising he begins to count the twenty-four hours.

Suppose, for example, it is 60°; then, since the whole 360° of the equator rise in twenty-four hours, 60 of them will rise in four hours, or the star will rise at four o'clock of his astronomical day.



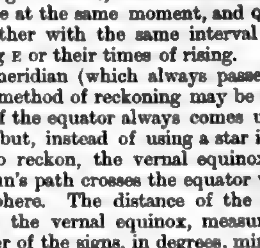
Let O be the spectator, N and S the north and south poles, E the east point of the horizon, E Z part of the equator, and A the star. Through the north and south poles and the star draw a circle N A S, cutting the equator in T. Then, if Q be the star at the rising of which the astronomical day begins, the number of degrees in Q T is the right ascension of the star.

Instead of the horizon N E S, any other circle may be substituted which passes through N and S; for example, the meridian N Z S. For, draw any circle through N and S, then the diurnal motion will bring A and T upon that circle at the same moment, and Q and T will pass that circle one after the other with the same interval as occurred between their times of passing E or their times of rising.

Substituting the meridian (which always passes through the poles) for the horizon, this method of reckoning may be used in any latitude. For the same point of the equator always comes upon every meridian with the same star; but, instead of using a star in the equator as the point from which to reckon, the vernal equinox is preferred, or the point at which the sun's path crosses the equator when he ascends into the northern hemisphere. The distance of the point of the equator just mentioned from the vernal equinox, measured upon the equator according to the order of the signs, in degrees, minutes, and seconds, is the right ascension *in space* [see ANGLE] of the star. The same turned into time [see ANGLE] is the right ascension in *time*, and indicates the interval which elapses between the times when the equinox and star severally come on the meridian. The whole time which a star takes to complete its diurnal revolution, or the *sidereal* day [DAY], it must be recollected, is not the common solar day, but about four minutes shorter.

The old term *oblique ascension* is an extension of the *right ascension*, as derived from our first illustration, to the *oblique* sphere, in which one pole is above the horizon, and the other below.

Let P be the north pole, Z the zenith, E Q the equator, Q the vernal equinox. Let A be a star at its rising, and T the point of the equator which comes to the meridian with it (and would rise with it to a person at the equator). In the latitude represented in the figure, E is the point of the equator which rises with it, and Q E is what used to be called the oblique ascension; the right ascension is Q T, and T E the difference between the oblique and the right ascension, was called the



ascensional difference, but was principally applied to the sun, because when turned into time, it shows the time before or after six o'clock, of sunrise. The ascensional difference is found by the following formula:—

$$\text{Sin. asc. diff.} = \text{tan. latitude} \times \text{tan. star's declination.}$$

When the star's declination is north, *from* the right ascension *take* the ascensional difference; when south, *to* the right ascension *add* the ascensional difference: the result is the oblique ascension.

For the method of determining the right ascensions of the stars, see TRANSIT INSTRUMENT; EQUINOX.

ASCENSION DAY, a festival of the Christian church, on which the ascension of Our Lord is believed by some authors to have been celebrated from the very first century of the Christian era. It has been held for ages on the Thursday next but one preceding Whitsunday. (See Brady's 'Clavis Calendaria,' vol. i. p. 357.) It is also called *Holy Thursday*, a name by which it has been known in this country at least as far back as the time of King Alfred, in whose laws it occurs, On þone halȝan þunreſ dæȝ (or the holy Thursday).

It was on this day, or on one of the three days which immediately preceded it, and which were considered as days of preparation for it, that in ancient times the minister of every parish, accompanied by his churchwardens and parishioners, was accustomed to go round the limits of his district, to deprecate the vengeance of God, to beg a blessing on the fruits of the field, and to preserve the rights and boundaries of the parish. The week in which Ascension Day occurs is usually called Rogation Week, from the Rogations or Litanies which were used in the perambulations. The Anglo-Saxons called the days of this week Ganȝ daȝaſ (walking days), from the perambulations which were made. In London such parochial processions are still observed on Ascension Day itself; and also in some provincial places. In the parish of Lanark, in Scotland, as late as 1845 the 'Statistical Account of Scotland' states that on "Landmark-day, there are processions to inspect the marches of the town-lands. As a method of impressing the boundaries upon the memory, all persons attending for the first time are ducked in the river Mouss." The custom is said to be of Saxon origin.

Pennant, in his 'Tour from Chester to London,' p. 30, tells us that on Ascension Day the old inhabitants of Nantwich piously sang a hymn of thanksgiving for the blessing of the Brine. A very ancient pit, called the Old Brine, was also held in great veneration, and, till within these few years, was annually, on that festival, bedecked with boughs, flowers, and garlands, and was encircled by a jovial band of young people, celebrating the day with song and dance.

It was upon Ascension Day, too, that the Doge or chief magistrate of Venice was formerly accustomed, by throwing a gold ring into its bosom, annually to espouse the Adriatic Sea; using the words 'Desponsamus te, Mare, in signum perpetui dominii." We espouse thee, O Sea, in testimony of our perpetual dominion over thee.—This practice, which is said to have originated in a grant from Pope Alexander III. to the Venetians, of power over the Adriatic Ocean as a man has power over his wife, ceased only with the government of the Doges.

ASCE'TICS (*ἀσκηταί*), a term applied to the pugilists, wrestlers, and other athletæ, among the ancient Greeks, who prepared themselves by abstinence for their combats; subsequently, the term was extended to all those who practised the severity of virtue. The exercise of severe virtue among the Pythagorean and Stoic philosophers was called *ἄσκησις, askesis*: it consisted in chastity, poverty, watchings, fasts, and retirement. The ascetics seem to have had an eastern origin. The Brachmans, Germani or Sarmani, Samanæi, Hylobii or Allobii, Gymnosophistæ in Asia, and other sects in East-Africa, were ascetics, who like the present Sanyasseans, Talapoins, and Bonzes, in eastern Asia, exercised their ingenuity in devising new methods of self-torture. For the Jewish ascetics, see the articles NASIREANS, ESSENES. According to Eusebius ('Hist. Eccles.' ii. c. 23), James the Just, the brother of Jesus, was an ascetic at Jerusalem before the destruction of that city. The Christians were in the earlier centuries more distinguished by their purity of morals than by ascetic austerities. In the 2nd century, the Christians began to distinguish between the commands given to all believers and the evangelical advice which they supposed to be applicable to those only who aimed at the higher sanctity of ascetics, founding their belief more particularly on some passages in St. Paul's epistles, in which he speaks of struggling against the flesh. This double doctrine, as Mosheim calls it, induced many persons to endeavour to attain a higher degree of communion with God, by practising watchings, abstinence, labour, and hunger, hoping thus to raise the soul above all external objects and all sensual pleasures. The Christian ascetics were divided into *abstinentes*, or those who abstained from wine, meat, and agreeable food, and *continentes*, or those who, abstaining from matrimony also, were considered to attain to a higher degree of sanctity. The early ascetics were most numerous in Egypt and Syria. Many laymen as well as ecclesiastics were ascetics in the first centuries of our era, without retiring on that account from the business and bustle of life. Some of them wore the *pallium philosophicum*, or the philosophic mantle, and were therefore called Christian philosophers, and formed thus the transition link to the life of hermits and monks, which was regulated in the 4th century. In modern times asceticism is occasionally used to signify any peculiar austerity of life.

(Mosheim, *De Rebus Christ. ante Const. Max.* p. 311, &c.; Neander's *Kirchen-Geschichte.*)

ASCLEPIADINE. A non-azotised substance of unknown composition met with in the root of the *Asclepias vince toxicum*. It is bitter and emetic.

ASCLEPION ($C_{40}H_{32}O_6$). An inodorous, tasteless, white and neutral substance met with in the juice of the *Asclepias syriaca*. It is insoluble in water and alcohol, but soluble in ether, fuses at 219° Fahr., and at a higher temperature decomposes, emitting an odour like burning caoutchouc.

ASH; ECONOMICAL USES. The uses of the ash in the arts are very numerous. The wood is both elastic and tough; it is used for the felloes and spokes of wheels, the beams of ploughs, the tops of kitchen tables, milk-pails, oars, blocks and pulleys, handles for spades and other instruments, hop-poles, hoops, crates, basket-handles, fence-wattles, and numerous other purposes. In the neighbourhood of the Staffordshire potteries the ash is cultivated to a great extent, and cut every five or six years for crate-wood, which is in much demand in the pottery district. The ashes yield good potash; the bark is used for tanning nets and calf-skins; the leaves and shoots are used for food by cattle; dishonest traders use ash-leaves for adulterating tea; the seeds or *keys* are sometimes pickled as a sort of salad, and they are also used in Siberia to give a flavour to water for drinking. The sap is used for some medicinal purposes. The *Flowering Ash* yields a juice which solidifies into manna.

ASHES, the remains of anything burned, whether of vegetable or animal origin, and to a certain extent of mineral bodies also.

Vegetable ashes. Ashes vary in composition according to the nature of the plant, the soil in which it grows, and the manure used upon it. The substances usually contained in the ashes of land plants are potash, soda, lime, magnesia, silica, the oxides of iron and of manganese, chlorine, carbonic acid, sulphuric acid, and phosphoric acid. Alumina occurs rarely, and sometimes oxide of copper has been met with. Very frequently more than one-half of the ashes of vegetables consists of carbonate of lime. The quantity of ashes varies, not only according to the soil, age, and aspect of the plant, but also in different parts of the same plant, from 2 to 6 per cent. of its weight, after drying in the air. The soluble part of wood ashes consists of the alkaline sulphates, carbonates, and chlorides; while the insoluble matter is chiefly composed of carbonate of lime, and probably of magnesia, phosphate of lime, and phosphate of iron.

The incineration of wood is a most important operation; from its ashes are obtained the immense quantities of impure potash, and the carbonate called *pearlash*, imported from America and other countries. The sap of plants contains also other vegetable acids, as the oxalic, citric, tartaric, malic, &c.; and the salts which these form with potash are decomposed by heat, and yield the carbonate. The ashes of land plants yield principally the salts of potash, such as *barilla*—those of marine plants afford a large quantity of soda salts, and especially the carbonate, such as *kelp*.

Coal ashes are extremely various both in their appearance and composition. Thus, much of the coal of the north of England, under common circumstances, burns to a cinder, which is a mixture of the ashes of the coal with some carbonaceous matter requiring rather a high temperature to burn it, on account of its being enveloped by incombustible matter. The coal of Somersetshire burns to red ashes, evidently coloured by peroxide of iron: those of the Staffordshire coal are nearly white. The quantity of ashes yielded by different kinds of coal varies considerably; according to Kirwan, Wigan coal contains 1·57 per cent, of ashes; Whitehaven coal 1·7, and Swansea coal 3·33 per cent.; they consist principally of silica and alumina, with small quantities of lime, sometimes magnesia, and also peroxide of iron; but they do not contain either the chlorides, phosphates, or alkaline salts found in wood-ashes. *Peat ashes* differ chemically from both the other kinds.

Animal ashes resulting from the burning of bones and other animal solids, consist principally of phosphate of lime, with traces of salts of lime, magnesia, and soda.

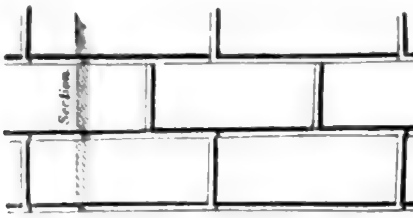
Mineral ashes, such as those of Vesuvius, as examined by Vauquelin, were grayish in colour; they were tasteless, and found to consist of alumina, oxide of iron, muriate of ammonia, sulphate of lime, potash, copper, manganese, lime, and charcoal. Vauquelin also analysed the ashes ejected in the same year from Ætna; they were of a gray colour, and in fine powder; they contained sulphur, sulphates of lime, copper, and alumina, and several other mineral ingredients.

The *ashes* of domestic economy, comprising not only the coal-ash from the grate, but a quantity of dust and miscellaneous fragments, are a valuable commercial article. The ash-heap of a dust contractor has a large money-value, for much of the waste serves as material for manufactures.

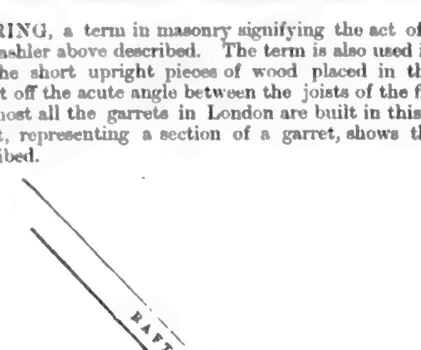
ASHLAR, rough stones of various sizes. This term is applied to free-stones when they are first taken out of the quarry.

ASHLER, a facing made of squared stones. In countries where stone is scarce and expensive, ashler principally consists of thin slabs of stone used to face the brick and rubble walls of buildings. These slabs are generally from four to six inches thick. Ashler is of several kinds. *Plane ashler* is so called when the surface of the stone is made quite smooth. Nearly all the public buildings of London in which stone is used are more or less faced with plane ashler. When the stone shows on its surface a series of narrow parallel flutings, the work is called *tooled ashler*. This is principally to be met with in the basements of buildings where the stone is set with flutings running perpendicularly. There is also an ornamental kind of ashler, very common in buildings, produced by slightly cutting into the stones, so as to make a depression, along one, two, or more of the sides of the joints. This kind of ashler is called *rusticated ashler*. The Banqueting Hall at Whitehall, Somerset House, the Bank of England, and St. Paul's Cathedral, may be taken as examples of rusticated ashler in London:

an example of rusticated ashler on the north side of the western entrance of St. Paul's Cathedral is given in the cut.



ASHLERING, a term in masonry signifying the act of bedding in mortar the ashler above described. The term is also used in carpentry to signify the short upright pieces of wood placed in the roof of a house to cut off the acute angle between the joists of the floor and the rafters: almost all the garrets in London are built in this way. The annexed cut, representing a section of a garret, shows the ashlering above described.



ASHTORETH. [Astarte.]

ASH-WEDNESDAY. This, which is the first day of Lent, had formerly two names; one was *Caput Jejunii*, "the head of the fast," the other was Ash-Wednesday, so called from the ancient ceremony of blessing ashes on that day, with which the priest signed the people on the forehead in the form of a cross, adding this admonition, "Memento, homo, quod cinis es, et in cinerem reverteris:" "Remember, man, that thou art ashes, and shalt return to ashes." "Mannerly to take their ashes devoutly," is among the Roman Catholic customs censured by John Bale in his 'Declaration of Bonner's Articles,' 1554. The ashes used this day in the Church of Rome were said to be made from the palms consecrated on the Palm-Sunday before. In Bishop Bonner's 'Injunctions,' A.D. 1555, we read that "the hallowed ashes given by the priest to the people on Ash-Wednesday are to put the people in remembrance of penance at the beginning of Lent, that their bodies are but earth, dust, and ashes." The ancient discipline of sackcloth and ashes on Ash-Wednesday is at present supplied, in the English established church, by reading publicly on this day the curses denounced against impenitent sinners, when the people are directed to repeat an "Amen" at the end of each malediction. Compare Wheatley 'On the Common Prayer,' 8vo, 1722, p. 227; Brand's 'Popular Antiquities,' vol. i. p. 79. Brady, in his 'Clavis Calendaria,' says, the primitive Christians did not commence their Lent until the Sunday now called the first in Lent. Pope Felix III., in the year 487, first added the four days preceding the old Lent Sunday, to complete the number of fasting days to forty, of which it actually consists. Pope Gregory the Great introduced the sprinkling of ashes on the first of the four additional days, which gave it the name of Ash-Wednesday; and the council of Beneventum, in the year 1091, strictly enjoined the observance of the ceremony, which was abolished in England at the Reformation, and a commination service, as above alluded to, substituted in its stead.

ASIATIC SOCIETIES. The enthusiastic ardour of Sir William Jones in acquiring a knowledge of the languages and literature of the East led him, in 1784, soon after entering upon his judicial functions at Calcutta, to endeavour to interest others in the same pursuit, and thereby to initiate a society in that city on the plan of the Royal Society of London for the purpose, as he intimates in a letter to the Governor-General of India (Warren Hastings), "of inquiring into the history, civil and natural; the antiquities, arts, sciences, and literature of Asia." The Governor-General readily patronised the undertaking; and the society was speedily inaugurated under the presidentship of Sir William himself, who delivered a learned and very interesting discourse on the occasion. To Sir William Jones, therefore, is due the credit of having, in the initiation of the Calcutta Society, set the example which has been followed in the institution of similar bodies in other parts of the world.

The Calcutta Society has been eminently successful. The first volume of its literary labours and scientific proceedings was printed in 1788, in quarto, under the title of 'The Asiatic Researches,' which series was continued up to Vol. XX., published in 1836. In 1832, the society resolved to commence the printing of an octavo journal, or rather to take under its immediate superintendence a scientific journal then existing at Calcutta, under the name of 'Gleanings of Science,' edited by the celebrated James Prinsep. Vol. I. of the 'Journal of the Asiatic Society of Bengal' was issued in 1832; and the work has appeared at regular intervals up to the present time (1859), when it comprises 26 vols., containing, in the aggregate, a vast amount of original information on almost every subject of interest relating to man and nature in Asia. The first 7 vols. are especially rich in the antiquarian, archæological, and numismatical papers of Mr. Prinsep. These papers have been recently collected into 2 vols. 8vo, with notes and elucidations, by E. Thomas, Esq., late of the Bengal C. S., under the title of 'Essays on Indian Antiquities of the late James Prinsep, F.R.S.'

In addition to its own researches and journal, the Bengal Society has been enabled, through the liberality of the late East India Company, to print, under its auspices, various texts of native works, accompanied generally by English translations, under the title of 'Bibliotheca Indica,' the first volume of which appeared in 1836; and the series now comprises about 25 different works, in 4to and 8vo, principally in Arabic and Sanscrit literature.

It was not till about 1820, that the prototype of the Calcutta Asiatic Society was adopted by the orientalists of Europe. At this period a Société Asiatique was formed at Paris, which, in 1822, commenced the publication of the 'Journal Asiatique,' under the editorship of those well-known scholars, Chézy, Klaproth, Remusat, St. Martin, De Sacy, and others of minor fame. The journal has continued to be published with undeviating regularity, and at the end of 1858 comprised no fewer than 70 vols. 8vo, divided into five series. The Société Asiatique has also printed at its own expense some 14 oriental works, besides encouraging by its patronage the printing of several others; and these are sold to the public at prices varying from 1½ to 200 francs per copy.

Nearly simultaneous with the formation of the Paris Society was that of London. In January, 1823, Mr. H. T. Colebrooke, one of the earliest inquirers into the Sanscrit language and literature, convened a meeting of gentlemen at his own house, which resulted in the foundation of the present 'Royal Asiatic Society of Great Britain and Ireland.' The society was well received by the Anglo-Indians of England, and was graciously patronised by William IV., who granted it a royal charter in 1824. The earlier literary labours of the society are recorded in three quarto volumes, dated 1827-35, the contents of which have added greatly to our knowledge of eastern matters. The communications of Mr. Colebrooke and Mr. H. H. Wilson, in these volumes, on the religion, metaphysics, and philosophy of the Hindus, have attracted much attention.

Relinquishing the quarto form of its Transactions, the society commenced the printing of a Journal in octavo, the first of which was issued in 1834. Up to 1858, the Journal had reached its 16th volume. This series contains many learned and valuable papers. Nor must it be forgotten that it was through this society's Journal the antiquarian world was first made acquainted with the remarkable discoveries of Colonel (now Sir Henry) Rawlinson, in the cuneiform writing of ancient Persia, Assyria, and Babylonia. In the year 1838, Colonel Rawlinson sent his first reading of part of the famous Behistun inscription of Darius Hystaspes; and, in 1839, a general précis of the contents of the inscription itself. Several papers on cuneiform literature by Sir Henry have since been printed in the Journal; as also by Dr. Hincks, Mr. Fox Talbot, and Mr. Norris, the present secretary of the institution. Such was the public interest attached to Sir Henry Rawlinson's discoveries, that the House of Commons, in 1856, readily voted a grant of 1000*l.* to the Society in aid of its expenses in printing these interesting memorials of ancient days.

In 1828, a committee originated among the members of the Royal Asiatic Society, who put forth a prospectus for translating and publishing Eastern authors. Colonel Fitzclarence (afterwards Earl of Munster), and Sir Gore Ouseley, took a very active interest in the proceedings of this committee; and considerable funds were collected by annual subscriptions. Since its formation up to the present time, the Oriental Translation Committee has printed or patronised upwards of seventy translations or editions of Oriental books, many of them of high interest,—such as Wilson's 'Vishnu Purana;' De Gayangos's 'Mohammedan Spain;' and the great 'Lexicon' of Haji Khalfa, translated and edited by the learned Arabic scholar, Prof. G. Flügel, of Dresden, in seven thick volumes 4to.

In 1840 another committee emanated from the society, having for its object the publication of oriental texts exclusively. This body have printed the original texts of thirteen authors, in Sanscrit, Arabic, Syriac, and Persian; but from the want of adequate public support, its proceedings are now in abeyance,—as are also, we regret to learn, the proceedings of the translation committee.

It deserves mention, too, that in 1836, the society gave birth to a "committee of commerce and agriculture," the idea of which originated with the Right Hon. Holt Mackenzie and Dr. Royle. After printing a volume of its proceedings, it was dissolved in 1841, when Dr. Royle entered upon his office at the India House for investigating the vegetable products of India—an office which appears to have been suggested by the proceedings of the committee now referred to.

The parent society in London has affiliated as branches the following associations:—1. The Literary Society of Bombay; 2. The Literary Society of Madras; 3. The Asiatic Society of Ceylon; 4. The Asiatic Society of Hong Kong; 5. The Literary and Scientific Society of Shanghai; brief notices of which we shall give *seriatim*.

1. The Bombay Society was instituted in 1804, under the presidentship of Sir James Mackintosh. It has printed 3 vols. of 'Transactions,' in 4to (1819–23); and 5 vols. of 'Journal,' in 8vo (1844–57).

2. The Madras Society owed its origin to Sir John Newbolt. It printed a thin volume of 'Transactions,' in 4to in 1827; since which it has published 19 vols. of its 'Journal,' in 8vo, dated from 1834 to 1838.

3. The Ceylon Society was instituted in 1845, under the patronage of the Governor-General of the island, Sir Colin Campbell. Between 1846 and 1853, it had printed two volumes of its 'Journal;' but we are not aware whether it has published anything since.

4. The China branch at Hong Kong was founded in 1847; and has printed four parts of 'Transactions,' between 1847 and 1855.

5. The Shanghai Society dates from 1858 only; and has printed but one portion of its 'Journal.'

The 'Deutsche Morgenländische Gesellschaft' was instituted in Leipzig, in 1846, under the auspices of Lassen, of Bonn; Rödiger and Pott, of Halle; and Fleischer and Brockhaus, of Leipzig. Its 'Zeitschrift' commenced in 1847, and may be considered a continuation of Ewald and Lassen's 'Zeitschrift für die Kunde des Morgenlandes,' published at Göttingen and Bonn in 1837-50, in 7 vols. 8vo. Its present editor is Dr. H. Brockhaus; and such has been the industry of its contributors that, up to 1858, it comprised twelve dense volumes, with a copious index to the first ten. In addition to the publication of its own proceedings, the society has patronised other oriental works,—such as the 'Indische Studien.' It has also commenced a series of 'Abhandlungen,' &c., one volume of which has appeared.

At Batavia, in Java, a society having similar objects to those already noticed, was founded about 1780; which has published a 'Verhandlingen van het Bataviaasch Genootschap,' &c., which has reached many volumes; and it now prints a 'Tydschrift,' &c. There was also formed a few years since, at Amsterdam, a Royal Institute of Netherlands India, which publishes 'Bijdragen,' &c., besides separate works on subjects connected with the Indian Archipelago.

An oriental society originated at Boston in 1842, and during the next year received from the government an Act of incorporation, under the name of 'The American Oriental Society, for the purpose of the cultivation of learning in the Asiatic, African, and Polynesian languages.' It publishes a 'Journal,' which in 1856 had reached its fifth volume. The library and collections of this society have been recently located in Yale College, New Haven, Conn.

ASPARAGIN ($C_8H_8N_2O_6+2$ aq.).—*Althein, Asparamide.* A substance obtained by concentrating the juice of asparagus until, on cooling, it deposits crystals, which, on recrystallisation from water, are pure asparagin. It is met with also in many other plants, as for instance, in the roots of liquorice, marsh-mallow, and comfrey; in the leaves of belladonna; in the young shoots of hops, in dahlia tubers, &c. Asparagin crystallises in octohedrons or rhombic prisms, which are hard and brittle; they are tolerably soluble in hot water, only slightly so in cold, and insoluble in alcohol and ether. Its solution possesses a slightly acid reaction; but the acid qualities of asparagin are not well pronounced, since it is capable of combining both with acids and bases.

By heating a solution of asparagin in an acid, *aspartic acid* and ammonia are produced.

$$\underbrace{C_8H_8N_2O_6}_{\text{Asparagin.}} + 2HO = \underbrace{C_8H_7NO_8}_{\text{Aspartic acid.}} + \underbrace{NH_3}_{\text{Ammonia.}}.$$

A similar decomposition of asparagin also takes place under the influence of alkalies, and even water heated beyond its boiling point under pressure can produce the same transformation.

Treated with hyponitrous acid, asparagin is converted into malic acid, with separation of nitrogen and water.

$$\underbrace{C_8H_8N_2O_6}_{\text{Asparagin.}} + \underbrace{2NO_3}_{\text{Hyponitrous acid.}} = \underbrace{C_8H_6O_{10}}_{\text{Malic acid.}} + N_4 + 2HO.$$

Asparagin when pure is quite permanent in solution; but impure aqueous solution of asparagin soon begins to ferment, the asparagin disappears and is entirely converted into succinate of ammonia.

$$\underbrace{C_8H_8N_2O_6}_{\text{Asparagin.}} + 2HO + H_2 = \underbrace{C_8H_4O_6,\ 2NH_4O}_{\text{Succinate of ammonia.}}.$$

ASPA'RAGUS, a genus of monocotyledonous plants belonging to the natural order *Asphodeleæ*. It is easily recognised by its very narrow leaves, which drop off the branching stem as soon as they begin to wither, by its small greenish-white or yellowish regularly-formed flowers, and by its seeds being enclosed in a pulpy fruit.

Unlike the principal part of monocotyledonous plants, and especially of those which belong to *Asphodeleæ*, the stems of the different species of asparagus branch like those of dicotyledons, and even become hard and woody; some of them twine and scramble over other shrubs, and certain species even hook themselves to their supporters by means of their stiff and spiny branches, which are stunted and destitute of leaves.

The species are natives of the temperate and tropical regions of the old world, but they are not found wild in either North or South America. The most remarkable one is the common cultivated asparagus which is found in sandy and maritime places in most parts of the middle and south of Europe, the Crimea, and also of Siberia and Japan. It is too well-known a plant to require description, and we shall therefore occupy ourselves exclusively with the method of cultivating it for its succulent and agreeable heads.

An asparagus plant consists of a cluster of fleshy roots connected by the stem, where a quantity of buds are formed, from which branches are yearly emitted. The heads are those branches in a young and tender state; their quality depends wholly upon their size and rapid growth. These are the simplest considerations that are involved in the cultivation of asparagus; the question is how the largest size and the most rapid growth are to be attained.

Seeing what the natural situation of the asparagus plant is when wild, it will be obvious that it should have a light soil which offers little resistance either to the emission of its roots or the protrusion of its stems; the soil should also be capable of both receiving and parting with water readily. Accordingly gardeners take care that all stiff loam, or stones, or solid masses of earth are separated from the soil of their asparagus beds, and that they are completely drained by having trenches 2½ feet deep cut between the beds.

To give vigour to the shoots, manure is added in as great a quantity as the cultivator can afford to apply it; when the seed is sown, or the young plants finally placed in the situation in which they are to produce a crop, an abundant supply of decayed manure, or of bones, or of parings of horses' hoofs, is buried below them; and they are also annually top-dressed with finely pulverised manure, when the beds are arranged in the winter. Attention being paid to these circumstances, asparagus is one of the easiest vegetables of all to cultivate; but no art or skill will produce precisely the soil which is most favourable for its growth. This exists naturally in some places in the fittest of all possible states, and it is there only that it is to be obtained in its greatest perfection; as in the rich alluvial soil of Battersea, Mortlake, and other places round London: in some of these villages it is produced of such extraordinary size that 110 heads in a state fit for the kitchen have been known to weigh more than 32 lbs. There are those who think that this gigantic asparagus is a peculiar variety; but it is ascertained that, on being removed into less favourable soils, it gradually loses its vigour and degenerates into the common kind.

The most convenient breadth for asparagus beds has been found by experience to be 4½ feet, and the least depth for the intermediate trenches 2 feet. The beds are either planted with seedlings one year or two years old, buried six inches beneath the surface, and standing about a foot apart, or sown at once and the seedlings afterwards thinned to such a distance; the latter method is the most simple and the most effectual.

In this country it is frequently forced, but seldom with much success; the heads being usually small and stringy, without sufficient succulence. For this purpose an asparagus bed is dug up, and the plants transferred to a place heated with dung, where they come up in a fortnight or three weeks; but as the roots are always much injured by the operation of transplanting, the little success that attends this method is easily accounted for. In many parts of the north of Europe, especially about Riga, a far better mode is adopted. The forcing takes place in the asparagus beds themselves without disturbing the roots; the trenches are filled with hot dung, and the beds are also covered with the same material about six inches deep; if the weather is very severe, the beds are also covered with frames, but this is rarely necessary in England. Treated thus, asparagus is as fine as if it waited till May to make its appearance. But when this method is practised the heads cannot be cut down at the natural time in the same season. In order to recover from the effect of forcing, they must be allowed to grow as freely as possible during all the succeeding summer, so that they may form a new supply of food for the support of the heads the succeeding spring. Where it is wished to have exceedingly large heads of forced asparagus, pieces of bamboo, or any other hollow tubes, should be put over the shoots when they first make their appearance. The latter will thus acquire a length of as much as eighteen inches without losing their tenderness.

ASPARAMIDE. [ASPARAGIN.]

ASPARTIC ACID. [ASPARAGIN.]

ASPECT, an astronomical term, now entirely disused, applied to the various positions of the planets with respect to one another, as seen from the earth. The terms *conjunction* and *opposition* are the only two out of five names of aspects which have been retained; the remainder being called sextile, quartile, and trine. At *conjunction* two planets have the same longitude; when 60° apart, the aspect is *sextile;* when 90°, *quartile;* when 120°, *trine;* when 180° apart, or opposite, they are in *opposition*. The following are the characters which are used.

Name of Aspect.	Character.	Diff. of Longitude.
Conjunction	☌	0°
Sextile	⚹	60°
Quartile	□	90°
Trine	△	120°
Opposition	☍	180°

ASPERTANNIC ACID. An acid said to be found in sweet-scented woodruff (*Asperula odorata*). Its existence is doubtful.

ASPHALT. A solid bituminous or resinous substance found on the shores of the Dead Sea, in Trinidad, and in other localities. It is doubtless of vegetable origin, and is probably produced by volcanic action upon coal-bearing strata. It is generally black, and more or less lustrous, like pitch, with which, in fact, asphalt possesses much similarity. Oil of turpentine dissolves out of it a black substance, which is insoluble in alcohol and ether, and to which Boussingault has given the name *Asphaltin*; its composition is expressed by the formula $C_{20}H_{16}O_3$.

ASPHALTE. The use of street-pavements formed of asphaltic or bituminous compounds, and especially of that commonly known as the asphalte, or asphaltic mastic of Seyssel, was introduced into this country by Mr. Claridge, under a patent obtained in 1837. The progress which such pavements have made in public favour within the last few years has been less than was at first anticipated. While however comparatively little has been done in the application of asphalte to street-pavements, it has been brought somewhat more extensively into use for foot-pavements in less exposed situations, such as the platforms of railway-stations, for flooring, roofing, and protecting buildings in various ways from injury by damp.

The principal ingredient of the Seyssel asphalte is a dark brown bituminous limestone, found near the Jura Mountains. This stone is broken to powder and mixed with mineral tar and sea-grit; and the whole is exposed for several hours to a strong heat in large cauldrons, until the ingredients, which are continually stirred by machinery, are perfectly united. The mastic is then run into moulds about eighteen inches square and six inches deep, so as to form it into cakes or blocks weighing from 122 lbs. to 130 lbs. each. In this state the asphalte is delivered for use, and portable furnaces and cauldrons are provided for re-melting it upon the spot by fires of wood or coke. In this operation 1 lb. of mineral tar is first put into the cauldron or boiler, to which, as soon as melted, 56 lbs. of mastic, broken into pieces of not more than 1 lb. each, are added, the whole being stirred together. The cauldron is then covered over, and a brisk fire kept up for a quarter of an hour, after which 56 lbs. more of mastic are added and stirred in. The cauldron is again covered for a few minutes, and further quantities of tar and mastic are added, in the proportion of 1 lb. of the former to 112 lbs. of the latter, until the cauldron is full, and the whole is completely melted and fit for use. For some purposes the proportion of the ingredients is different from that above-named.

In laying foot and carriage pavements with asphalte, there is a necessity for securing a firm, solid foundation, which, whenever the ground is soft, must be accomplished by ramming, or by removing the soft earth, and substituting a coarse concrete of gravel and pounded lime-stone.

The modes of applying asphalte to the pavement of cellars and basements for the purpose of excluding damp, vary according to circumstances. Where water is liable to rise under the floor, a brick invert, laid in asphalte as a cement, should be adopted, as the simple pavement laid on concrete will not prove effectual. Damp may be effectually prevented from rising in walls by forming the whole of one horizontal joint a little above the ground level with mastic in lieu of mortar; and skirtings of asphalte, which are formed by pouring the mastic into iron moulds applied to the wall, and assisting its descent with the spatula, may in some cases be applied with advantage. In covering upright surfaces asphalte is not so applicable as in other cases, since it will not bear exposure to the heat of the sun, and will not adhere well to a damp, dirty, or soft surface.

Roofs, especially if of flat pitch, may be advantageously covered with fine asphalte, laid upon a thin coat of fine concrete, supported by a rough boarding of dry wood.

The thickness of asphalte used for pavements varies from half an inch to about an inch and a quarter, the former being sufficient for common floors and court-yards not intended for carriages, and from three-quarters to an inch being the least allowed for carriage pavements; from half an inch to five-eighths is sufficient for roofs and the covering of arches to prevent the filtration of water, and for the lining of tanks and ponds; and about half that thickness is sufficient for covering the ground-line of brick-work, to prevent the rising of damp.

All attempts to employ asphaltic pavements for the foot-ways or carriage-ways of the London streets have failed; the traffic subjects them to a wear and tear greater than they are fitted to bear. Considerable outlay was incurred in the trials made by the various parishes and paving commissioners; so complete has been the failure, however, that at the present time (1859) scarcely an example of asphaltic foot and carriage pavement can be met with in the metropolis.

A useful recent application of asphalte is, as one component of the 'patent asphalted felt,' employed for roofing, sheathing, and other purposes. Its inventors claim for it the properties of impermeability by rain, non-conduction of heat, resistance to vermin, lightness, economy, and durability. Besides roofing and sheathing, it is intended to be applied for lining granaries and stores, clothing or 'jacketing' steam pipes and boilers, and forming a basis or ground for paper-hangings on damp walls. The felt is formed of any refuse fibrous material saturated with melted asphalte.

The so-called asphalte used in the construction of pavement, is chiefly pitch—the residual product of the distillation of coal-tar.

ASPHALTIN. [Asphalt.]

ASPHYXIA, a Greek word (ἀσφυξία) which signifies a cessation of the pulsation, originally expressed any state of disease in which there was a suspension or loss of the heart's action, and a consequent failure of the pulse; but the term is now used to denote a condition of the system in which there is a cessation of muscular movement, an arrest of the circulation, and an accumulation of blood in the veins. The state of asphyxia is that in which the respiratory actions are either temporarily suspended, or have wholly ceased; a state necessarily inducing such a change in the nature of the blood as is incompatible with the continuance of life. The blood which circulates in the two great systems of blood-vessels, veins and arteries, is essentially different [Blood, Nat. Hist. Div.]; that in the veins is incapable of supporting life; that in the arteries is the proper nutrient and excitent of the system. The object of respiration is to convert venous into arterial blood. Of all the conditions necessary to the action of the vital organs, that of receiving a due supply of arterial blood is the most indispensable. If a ligature be placed around the trachea (windpipe) of an animal, so as completely to prevent the access of air to the lung, and if at the same time the carotid artery be opened, that is, one of the great arteries which springs from the arch of the aorta [Heart, Nat. Hist. Div.], and which, passing along the neck to the head, is the main channel through which the brain receives its supply of arterial blood, it is found that in a definite time the blood flowing in this artery has ceased to be arterial, and has become venous. Taking the average of a great number of experiments performed on dogs, for the express purpose of ascertaining this fact, it is found that, in about three-quarters of a minute after the complete exclusion of air from the lung, the blood in the carotid artery begins to lose its vermilion colour. After a minute and a quarter, it has become obviously dark; in the space of a minute and a half, no difference whatever can be perceived between the blood that flows from this artery and ordinary venous blood; in this space of time, therefore, the system of an animal from whose lung air is excluded, is brought completely under the influence of venous blood.

While the blood is thus changing from arterial to venous, the function of the brain is greatly affected. Sensibility diminishes as the blood darkens; and when it has become quite dark, the power of sensation is wholly abolished, and the animal lies in a state of profound coma.

The influence of the circulation of venous blood upon the muscular system is no less powerful than that upon the the nervous, for the muscle can no more perform its function without the stimulus of arterial blood than the brain. When, in consequence of the exclusion of air from the lung, venous blood is sent out to the system, the heart is always the first muscle that feels the effect of this abstraction of its accustomed stimulus; because venous instead of arterial blood is instantly brought into direct contact with the surface of its left cavities [Heart, Nat. Hist. Div.], and because venous instead of arterial blood is sent by its nutrient arteries (the coronary, which are the first branches given off by the aorta) into its very substance; and this blood, as has been already stated, is incapable of affording it the requisite nourishment and excitement. Accordingly the action of the heart is always greatly affected from the very first moment that an animal is brought under this condition. At first, its contractions are somewhat accelerated, probably on account of the violent struggles of the animal, and in consequence of the emotion of fear; but in a few seconds its action begins to be arrested, and it becomes rapidly less and less frequent until it sinks to a point surprisingly low. When in a state of health and unexcited, the pulse of a dog is 130 in a minute; but in two minutes after the exclusion of air from its lung, it sinks to 25, and it often falls still lower. Immediately before death it invariably becomes again accelerated, sometimes rising to its natural standard; but what it then gains in velocity it loses in strength, and in all cases within three minutes after the complete exclusion of air from the lung, the action of the heart has become feeble; this feebleness gradually but rapidly increases, until at the end of the fourth minute it is seldom that the action is at all perceptible by the finger. But though the heart be the first to feel the effect of the abstraction from the system of its usual stimulus, yet the blood which is transmitted to all the other muscles of the body is alike incapable of exciting them to contraction: the muscles of respiration suffer with the rest, so that the respiratory movements, that is, the alternate enlargement and diminution of the cavity of the chest, indispensable to the entrance and exit of fresh currents of air, cease. Not only is the muscular system thus affected, but the capillary system has at last its action suspended, and no more blood passes from the arteries to the veins, and the venous system is greatly congested.

As the circulation fails and the pulse sinks, the muscles termed *sphincter*, that is, muscles placed at the mouths of certain cavities in order to close their passage, that their contents may be retained for a given time, are commonly relaxed; the rectum and the urinary bladder evacuate their contents; often violent convulsions now come on, and immediately before the extinction of life the fæces and urine are expelled with great force.

The phenomena attendant on the state of asphyxia, and which are characteristic of it, are now sufficiently manifest. It is impossible to raise the thorax so as to draw in air, that is, to inspire; nevertheless, violent though vain efforts are made to accomplish this object; but although no air can be introduced into the lung, yet a small portion can be expelled from it, so that the lung is ultimately brought to the extreme state of expiration. Complete exclusion of the air is rapidly followed by the abolition of sensation, this by the diminution and the ultimate cessation of the heart's action, together with the diminution and ultimate cessation of the respiratory movements; and when these changes have terminated in death, the body remains warm for a very long period; the aspect of the countenance is peculiar; the face is swollen; it is either of a reddish violet hue or of a livid colour, and the eyes are clear, bright, and preternaturally prominent. Shakspere's description of this state is physiologically correct:

> "But, see! his face is black and full of blood;
> His eye-balls farther out than when he lived,
> Staring full ghastly, like a strangled man.
> His hair uprear'd; his nostrils stretch'd with struggling;
> His hands abroad display'd, as one that grasp'd
> And tugg'd for life, and was by strength subdued."

As the animal heat is longer retained than is usual in death from other causes, so the coming on of the stiffness consequent on death is longer protracted; but when it has once come on, it is retained for a proportionally longer period.

The morbid appearances in the internal organs observable on dissection are, *in the brain*, turgescence of the blood-vessels, especially of the veins, which are gorged with blood; the blood itself is preternaturally fluid and of an unusually dark colour. No diseased appearance is commonly found in the cavities of the brain, nor is its substance materially changed from the healthy state. *In the respiratory organs*, the mucous or lining membrane of the larynx, trachea, and bronchi are unusually red; the bronchial divisions are of a violet or reddish-brown tint; the lungs are of a blackish-brown colour, and when cut into, large drops of a thick fluid and very black blood ooze out. *In the organs of circulation*, the heart is the organ chiefly affected. Its veins are gorged with dark blood; dark-coloured blood is found both in its right and in its left cavities, but it is invariably accumulated in a larger proportion in its right than in its left cavities; generally there is at least one-third more in the right than in the left. *In the abdominal organs*, the liver, the spleen, and the kidneys are gorged with dark and fluid blood. Thus the blood in all the organs of the system is always unnaturally fluid in consistence and dark in colour.

CAUSES. From what has been stated it is obvious that, whatever is capable of preventing the admission of air to the lungs, or of arresting the chemical action of the air upon the blood, or causing the accumulation of carbonic acid in the blood, is capable of producing the state of asphyxia.

I. Various circumstances are capable of acting in the first mode: 1. Whatever affords a mechanical obstruction to the action of the respiratory muscles, as a heavy weight resting upon the chest. 2. Whatever affords a mechanical obstruction to the due expansion of the lungs, while the respiratory muscles still act with the requisite energy, as the accumulation of fluid in the cavity of the chest, or the diminution of the cavity of the chest by the enlargement or displacement of the abdominal viscera. 3. Whatever affords a mechanical obstruction to the entrance of the air into the lung, as the application of a ligature around the windpipe, causing strangulation; the submersion of the body in water, or drowning; the introduction of foreign bodies into the larynx, trachea, or its divisions, the bronchi; exposure to a too rarefied atmosphere, or to irrespirable gases, such as nitrogen, hydrogen, carburetted hydrogen, carbonic acid gas, &c.

II. The circumstances which are capable of producing the state of asphyxia, by arresting the chemical action of the air upon the blood, are either what may be termed mechanical or vital. The mechanical are those which act in the mode just adverted to, namely, by preventing the entrance of air into the lung, as suspension, submersion, and so on. The vital are those which act chiefly through the medium of the nervous system. If injury be done to the organic nerves which supply the lungs, or if from any cause the nerves of this class fail to supply the lungs with the nervous influence which it is their office to afford, the requisite changes in the blood do not take place. Such an injurious effect upon this class of nerves may be brought about gradually and progressively by the long-continued action of intense cold upon the system, or may be produced instantaneously by a stroke of lightning. The like cause may also act through the nervous system upon the respiratory muscles, stopping the action of what may be termed the mechanical portion of the respiratory apparatus, namely, the alternate enlargement and diminution of the thoracic cavity. Injury done to the other great division of the nervous system, the sentient; injury or division of the eighth pair of nerves; injury or pressure upon the upper portion of the spinal cord (the *medulla oblongata*); injury or pressure upon the spinal cord itself, and especially upon that portion of it which is placed in the neck, whether from fracture or from dislocation of the bones of the spinal column, may destroy the contractility of the respiratory muscles, and thus stop the respiratory movements. It often happens that both sets of causes are combined; the contractility of the muscles of respiration being destroyed by the operation of the same causes which abolish the nervous energy of the lungs.

There are certain varieties of asphyxia which, on account of their practical importance, being states of continual occurrence from accident and otherwise, require a separate consideration. The more important of these are drowning, hanging, strangulation, and suffocation. [RESPIRATION, NAT. HIST. DIV.]

ASPIRATE, or more properly asperate, a name given to one of the divisions of consonants. Grammarians have generally avoided any formal definition of the principle which characterises this or the other classes of letters; they have generally deemed it sufficient to enumerate those letters which belong to each class, and to assign names to these classes without giving any reason for the selection. The subject is confessedly one of difficulty, and it is therefore with much doubt that the following system is proposed.

In the pronunciation of the letters called *tenues*—namely, *k, t, p*,—the moveable organ, whether tongue or lip, comes into the minimum of contact with the organ struck, whether palate, teeth, or lip, and the stroke is rapid. In the pronunciation of the *medials*—*g* (as in *goose*), *d, b*,—the surface of contact is greater, the contact itself closer, and of longer duration. Lastly, in the utterance of the asperated letters, the organs are brought more or less closely together through the whole breadth of the mouth, so that the vibration of air passes through a long narrow fissure. If the pressure or approximation be of slight intensity, and of short duration, the series of asperates, *y, ch* (as at the end of German or Scotch words), *th* as in *thing, ph, w* are produced. If the pressure be closer and more lasting, there result the asperates *gh, th* as in *this*, and *v*. The former series might perhaps deserve to be called asperated *tenues*; the latter, asperated *medials*. The sibilants again seem to have a claim to be admitted under the genus asperate. If this claim be allowed, *s* as in *such, sh* (or *ch* of the French *chemin*), *j* as in the French *jour*, may be called the sibilant *tenues*; and *s* (as in *these*), *ch* (as in the English *church*), *j* (as in the English *journey*), are the corresponding medial sibilants. The letter *h*, which has been omitted in our series, is only a faint *ch* (as pronounced by the Germans). Indeed, if the pedigree of this letter be traced upwards, it will be found to terminate in the Hebrew *cheth*. [ALPHABET.] In the comparison of cognate languages, it is important to bear in mind—first, that the asperated letters are often convertible with one another; and secondly, that they are severally interchangeable with the medials and tenues of the same organ. Thus, 1st, *ch* of the Greek language often corresponds to *h* in the Latin: *cheim* (χειμ-ων, χειμ-ερινος), Gr., *hiem-ps*, Lat., *winter*; *chamai*, Gr., *humi*, Lat., *on-the-ground*; *cha* (χα-σκειν), Gr., *hia-re*, Lat., *to gape*. [GUTTURALS.] 2, *h* in Greek corresponds to *s* in Latin: *hepta*, Gr., *septem*, Lat., *seven*; *hex*, Gr., *sex*, Lat., *six*; *huper*, Gr., *super*, Lat., *above* (*upper*). 3, *th* in ordinary Greek to *ph* or *f* in the Æolic dialect and Latin; *ther*, ord. Gr., *pher*, Æolic Gr., *fera*, Lat., *a wild beast*; *thlib*, ord. Gr., *phlib* in Homer, *press*; *thura*, Gr., *a door*, *fora-s*, Lat., *out-of-doors*; *tharsus* (or *thrasus*), Gr., *fortis*, Lat., *bold*; *thre*, Gr., *fle*, Lat., *bewail*. 4, *th* into *s*, as *sior*, *god*, in the Laconian dialect, instead of *theos*. 5, *th* in ordinary Greek to *ch* in other dialects: *ornith*, ordinary Greek, *ornich*, Doric, *a bird*. Hence in the same language *ith* (ιθ-μα) and *ich* (ιχ-νος) enter into the two forms which signify *a step*; *erch* and *elth* into the two forms of the verb signifying *to go*, ερχομαι, ελθων. Hence too the different forms of the Greek and Latin names for Carthage, *Carchedon*, Gr., *Carthagon*, Lat., in which the second interchange of *d* and *g* compensates for the inverse change of the asperates *ch* and *th*. 6, *f* in Latin corresponds to *h* in Spanish, *faba*, Lat., *haba*, Sp., *a bean*; *fabula-ri*, Lat., *habla-r*, Sp., *to talk*; *fac-ere*, Lat., *hac-er*, Sp., *to do*; *fato* (*fatum*), Lat., *hado*, Sp., *fate*; *formoso* (*formosus*), Lat., *hermoso*, Sp., *beautiful*. For the relation of *sw* and *w* with *h*, see DIGAMMA.

Secondly, the several asperates are, as above stated, interchangeable with the medials and tenues of the same organ. Examples of these changes will readily suggest themselves in every language. The most deserving of attention are perhaps those which exist between the English and German:

initial *k*,	in German,	corresponds to	*ch, sh*	in English.
final *g*	"	"	*w, y*,	"
final *ch*	"	"	silent *gh, ch, k*.	
final *t*	"	"	*th, d*,	"
initial *d*	"	"	*th* in *think*.	
final *d*	"	"	*th* in *the*.	
th	"	"	*d*,	"
initial *z*	"	"	*t*,	"
final *tz, ss*	"	"	*t*,	"
final *b*	"	"	*v, f*,	"
pf	"	"	*p*,	"
final *f*	"	"	*p*,	"
initial *v*	"	"	*f*,	"

(Grimm, 'Deutsche Grammatik;' Becker, 'German Grammar,' English transl. p. 26.)

ASSAMAR ($C_{24}H_{13}O_{13}$). A thick syrup of a reddish yellow colour, and a bitter taste, found amongst the products of the destructive distillation of caramel and sugar. Reichenbach says that toasted bread owes its peculiar bitter taste to this substance.

ASSASSINS, a military and religious order, formed in Persia in the 11th century. It was a ramification of the Ismaelites, who were themselves a branch of the great Mohammedan sect of the Shiites, the supporters of the claims of Ali's posterity to the caliphate. [ALI BEN ABI TALEB, in the BIOG. DIVISION.] But among the Ismaelites there were many who were Mussulmans only in appearance, and whose secret doctrine amounted to this: that no action was either good or bad in itself, and that all religions were the invention of men. These unbelievers were formed into a secret society by one Abdallah, a man of the old Persian race, who had been brought up in the religion of the Magi, and was a hater of the Arabs and of their faith. After several bloody insurrections against the Abbaside caliphs, the Ismaelites succeeded in placing on the throne of Egypt a pretended descendant of Ismael, the seventh Imaum in the line of Ali, from whom the Ismaelites had taken their name. [ISMAELITES.] This descendant, whose name was Obeid Allah Mehdee, was the founder of the Fatimide dynasty, so called from Fatima, Mohammed's daughter. Under the protection of these princes a lodge of the secret doctrine was established at Cairo, and its members spread over a great part of Asia. Their ostensible object was to maintain the claims of the Fatimide caliphs to universal dominion, and to urge the destruction of the caliphs of Bagdad as usurpers. One of the adepts, Hassan ben Sabah, thought of turning these instruments to his own advantage. He was the son of Ali, a rigid Shiite, but living at Rei in Persia, of which the governor was a Soonite, he was forced to conceal his opinions; and further to avoid suspicion, he sent Hassan his son to Nishapoor, to be educated under a celebrated imaum named Mowafek. He here formed an intimacy with Oman Khiam, a poet and astronomer, and with Nizam-al-Moolk, who afterwards became vizir to Alp Arslan, the Seljucide sultan, and his successors. During the reign of Arslan, Hassan lived away from the court; but on the accession of Malek Shah, he applied to his old friend for employment in the government. Nizam-al-Moolk has told his own story, that he introduced Hassan to the sultan, by whom he was highly favoured; but on attempting to supplant his patron he was disgraced and forced to fly. Vowing revenge against the sultan and Al-Moolk, he went to Egypt, where he was received with distinction by the caliph Mostanser, became a zealous adherent of the Ismaelite lodge, and after many vicissitudes and wanderings, obtained possession, by the aid of his brethren, of the hill-fort of Alamoot (or *Vulture's Nest*), situated to the north of Casvin, in Persia, and there (A.D. 1090) established an independent society or order, consisting of seven degrees, with himself at the head as sheikh al jebel, that is, sheikh of the mountain. Under him came three dai al kebir, the grand priors of the order; 3dly, the dais, or initiated masters; 4thly, the refeeks, or companions; 5thly, the fedavees, or devoted; 6thly, the laseeks, aspirants, or novices; 7thly, the prophane, or common people. Hassan drew out for the dais, or initiated, a catechism consisting of seven heads, among which were—implicit obedience to their chief; secrecy; and lastly, the principle of seeking the allegorical, and not the plain sense in the Koran, by which means the text could be distorted into anything the interpreter pleased. This did away effectually with all fixed rules of morality or faith. But this secret knowledge was confined to a few; the rest were bound to a strict observance of the letter of the Koran. The most effectual class in the order were the fedavees—youths often purchased or stolen from their parents when children, and brought up under a particular system of education, calculated to impress upon their minds the omnipotence of the sheikh, and the criminality as well as utter impossibility of evading his orders, which were like the mandates of heaven itself. These fedavees were clothed in white, with red bonnets and girdles, and armed with sharp daggers; but they assumed all sorts of disguises when sent on a mission. Marco Polo gives a curious romantic account of the garden at Alamoot, to which the fedavee, designed for an important mission, was carried in a state of temporary stupor produced by powerful opiates, and where, on awakening, he found everything that could excite and gratify his senses. He was made to believe that this was a foretaste of the paradise of the prophet, reserved for his faithful and devoted servants, and thus became willing to encounter death, even under the most appalling forms, in order to secure a permanent seat in the abode of bliss. Marco Polo's narrative is confirmed by Arabian writers, and Von Hammer inclines to believe it true in the main; others attribute the visions in the garden to the effects of the intoxicating preparation administered to the fedavees. The name of *hashish*, which is that of an opiate made from hemp-leaves, is supposed to have been the origin of the word 'Assassins;' others derive the latter from Hassan ben Sabah, the founder of the order. The word becoming familiar to the crusaders, was by them carried to Europe, where it was used as synonymous with that of *sicarius*, or hired murderer; but the Italians have adopted it to signify a robber on the high road, without necessarily implying the crime of murder.

The Assassins, either by force or treachery, gained possession of many other castles and hill-forts in Persia. The sultan Melak Shah attacked them, the doctors of the law excommunicated them; but the fedavees carried secret death among their enemies; the sultan's minister, Nizam-al-Moolk, was stabbed, and his master soon after died suddenly, it was supposed by poison. The Assassins spread into Syria, where they acquired strongholds in the mountains near Tripoli; and the sultan of the Seljucides was glad to come to an agreement by granting them several districts. Hassan ben Sabah, having extended his order over great part of the Mohammedan world, died at Alamoot in 1124, after thirty-five years' reign. He bequeathed his authority to Keah Buzoorg Oomeid, one of the dais of the order. Buzoorg renewed the war with the Seljucides, and Aboo-'l-Wefa, his dai al kebir in Syria, entered into a temporary alliance with Baldwin II., king of Jerusalem, through the agency of Hugo de Payens, grand master of the Templars, against their common enemies the Seljucide Turks. After this, the Assassins were sometimes on friendly terms, but oftener at variance, with the Christian princes of Syria and Palestine, as well as with their Mohammedan neighbours. To accomplish their object they never scrupled to resort to assassination. In 1126 the prince of Mosul was stabbed as he entered the mosque by Assassins disguised as dervises; soon after, a caliph of Bagdad was killed likewise, and also a sultan of Cairo, notwithstanding his Fatimide descent. In 1138 Keah Mohammed succeeded his father. In 1151 Raymond, count of Tripoli, was stabbed by the Assassins; it was suspected, at the instigation of his wife. At this time the Syrian branch of the Assassins had acquired a large extension of power, and became in a manner independent of the Persian one. A son of Mohammed's, Hassan, proclaimed himself to be the promised Imaum, and gained numerous followers; but his father cast him into prison, and put 250 of his adherents to death. Hassan then renounced his pretensions, but on succeeding his father in 1163, he assembled all the people in Alamoot, proclaimed that they were the true elect, and absolved them from all the obligations of the law of Islam. After a succession of enormities that seem almost like madness, he was assassinated by his brother-in-law. His son, however, succeeded him as Mohammed II., and took a bloody revenge for his father's murder. After a reign of thirty-five years, Mohammed was succeeded by his son Jelial-ed-deen, in 1173. Jellal-ed-deen was a man of more sense than his predecessors; he restored the religion, made his peace with the caliph, sent his harem on the great pilgrimage to Mekka, and received the appellation of New Mussulman. After a short but peaceful reign, he was poisoned by some of his kindred, and was succeeded by his son Ala-ed-deen when only nine years of age, who being murdered, the office of sheikh al jebel devolved upon Rukn-ed-deen, Ala-ed-deen's son. By this time the caliph of Bagdad had applied to the great Mongol conqueror, Mangoo Khan, who sent his brother Hulakoo to exterminate the murderous sect. Alamoot was taken, and Rukn-ed-deen was made prisoner and ultimately put to death. The fortress Kirdcoo resisted for three years, but at last all the haunts of the Assassins were taken, and the inmates were massacred without distinction, A.D. 1256.

The Syrian or western branch of the Assassins, however, continued to exist for some years later under their dai al kebir. Massyad, not far from Beyroot, was their principal stronghold. The history of this branch is the most familiar to Europeans, being much interwoven with that of the crusaders and of the great sultan Sala-ed-deen. The latter was several times in danger from the daggers of the Assassins. The Dai al Kebir Sinan, a man who had a reputation for sanctity, sent in 1173 an embassy to Almeric, the Christian king of Jerusalem, offering, in his name and that of his people, to embrace Christianity, on condition that the Templars, who were their neighbours, should remit the annual tribute of two thousand gold ducats which they had imposed on them, and live in future in peace and good neighbourhood towards them. Almeric was delighted with the offer, and dismissed the envoy with honour. The envoy, however, on his return to his territory, was killed by a party of Templars, led by Gaultier du Mesnil. After this the Assassins resorted again to their daggers, which they had laid aside for many years. Among other victims, Conrad, marquis of Tyre and Montferrat, was murdered by two fedavees in the market-place of Tyre, 1192. The reasons for this murder, which some have ascribed to Richard of England, have been the subject of a long controversy, which Von Hammer does not succeed in elucidating. The Assassins kept the Christians of Tripoli in perpetual fear. They levied contributions on the Christian princes for the safety of their lives; and they even demanded it of St. Louis, King of France, on his passing through Acre on his return from the Damietta expedition: Louis, however, indignantly refused. At last the Syrian Assassins were conquered, and their stronghold taken, by Beibars, the Mamluke sultan of Egypt, fourteen years after the destruction of the eastern branch by the Mongols. Many, however, found refuge in the mountains of Syria, or became mixed with the Yezeed Koords; and some of the tenets of the order are believed to linger still among them. The Syrian Ismaelites are divided into two sects, who live in a number of small villages round Massyad. The Persian Ismaelites dwell chiefly around Roodbar, in Khorasan, their sheikh living under the protection of the Shah of Persia.

(Von Hammer, '*Geschichte der Assassinen*,' and '*Fundgruben des Orients*;' also Sir John Malcolm's '*History of Persia*.')

ASSAULT and BATTERY. An assault has been commonly defined to be 'an attempt or offer with force and violence to do a corporal hurt to another.' Thus, presenting a gun at a person within the distance to which it will carry, throwing a stone or other missile at him, drawing a sword and waving it, or even holding up a cane or a fist in a threatening manner, are given as instances of assault. An assault does not necessarily imply any corporal injury done to the party assaulted; pointing or snapping a loaded gun at a person behind his back, so that he is not aware of his danger, would be an assault, though no actual injury is sustained. But it has long been settled law, that no words, however insolent and provoking, unaccompanied by an act of violence, can amount to an assault.

A *battery*, which is said to imply an assault, consists of any kind of corporal injury, however small, designedly done to another by an actual contact with his person. Thus, throwing water on another is a battery. The injury need not be done by the immediate hand of the party; nor is it material whether the act is wilful or not, provided it proceeds from a mischievous design. Thus, where a lighted squib was thrown into a market-place, which was tossed about from hand to hand and at last struck a man in the face and put out his eye, it was held to be an assault and battery by the first thrower.

A person who commits an assault or battery is liable to an action by the party injured, and also to a criminal prosecution for a misdemeanor and breach of the peace; but the proceeding by indictment and action for the same assault is always discouraged in practice; and where a defendant is found guilty upon an indictment, and the court is informed that an action has been brought for the same injury, a nominal sentence is usually passed, unless the prosecutor will consent to discontinue his action.

It is not uncommon to permit the prosecutor of an indictment for a common assault to compound the offence with the defendant even after he has been convicted; and upon the declaration of the former that he is satisfied, a nominal punishment only is imposed. This practice, which is called *speaking with the prosecutor*, has been introduced for the purpose of reimbursing the person really injured the expenses of the prosecution, and of compelling the offender to make him some compensation, without the circuity of a civil action. Though sanctioned by long usage, it is a relaxation of the strict rules of the criminal law, and is liable to much objection in principle, as enabling an individual to assume the character of a public prosecutor for the purpose of redressing a private wrong. This objection to the practice has been strongly animadverted upon by Sir William Blackstone, and it is now much less frequent than formerly. ('Commentaries,' Mr. Kerr's ed. vol. iv. p. 430.)

The punishment of persons convicted of common assaults is fine and imprisonment at the discretion of the court, exercised upon the circumstances of each particular case. By a variety of statutes, assaults aggravated with respect to the place where, or the persons on whom, they were committed, were formerly punishable with great severity. ('Blackst. Comm.,' vol. iv. chap. 15.) Most of these statutes were, however, repealed by stat. 9 Geo. IV. c. 31, which authorised an increased punishment upon certain specified cases of aggravated assaults. This last statute has, however, been in its turn repealed, and the enormity of offences against the person made to depend in a great measure on the intent of the offender; see 7 Will. IV., and 1 Vict. c. 85. Some offences not contemplated by this statute are provided for by statutes 9 & 10 Vict. c. 25; 14 & 15 Vict. c. 19; and 16 & 17 Vict. c. 30. Other statutes apply to particular cases, as assaults on officers of a workhouse, on apprentices, &c. See 'Blackst. Comm.' Mr. Kerr's ed. vol. iv. c. 15.

The statute of 33 Henry VIII. c. 12, which punishes assaults in the king's palaces with the loss of the right hand and perpetual imprisonment, was repealed by the 9 Geo. IV. c. 31; but it seems that the penalty of the loss of the right hand attached by the common law to assaults committed in the actual presence of the king, or in his constructive presence in the superior courts of law, still remains. This subject was much discussed in a case which occurred in 1799, when the Earl of Thanet, and several other persons, were convicted of a riotous assault and rescue in a court of Oyer and Terminer and Gaol Delivery at Maidstone. Upon their being brought up for judgment, the court of King's Bench entertained doubts whether it was not imperative upon them to pass the specific sentence of amputation; but the attorney-general entered a *Noli prosequi* as to those parts of the charge upon which the doubts had arisen. (Howell's 'State Trials,' vol. xxvii., p. 822.)

Actions for trivial assaults were formerly among the most frequent subjects of litigation in our courts of justice. An attempt was made to discourage them by 22 & 23 Car. II. c. 9, which has to some extent been re-enacted by stat. 3 & 4 Vict. c. 24, providing that the plaintiff, in case the jury shall find the damages to be under 40*s*., shall recover no costs unless the judge certify that the grievance was wilful and malicious.

Persons guilty of common assaults may be convicted summarily by two magistrates, who are empowered to impose a fine not exceeding 5*l*., with the costs; and in case of non-payment, to commit offenders to prison for two months. A certificate that the complaint was dismissed as trivial, or that the assault complained of was justified, or payment of the fine adjudged, or completion of the term of imprisonment for non-payment thereof, is a bar to all further proceedings, criminal or civil, for the same cause.

ASSAULT is in Scotland an offence usually prosecuted by the public prosecutors attached to the sheriffs' courts, to the police courts established by statute, and to the justice of peace courts, and punishable by imprisonment. It is seldom brought before the supreme criminal court, that is, the high court or the circuit courts (or lords commissioners) of justiciary, unless it be of a highly criminal character; and it is then generally charged as assault with some specific aggravation, as "assault aggravated by being to the effusion of blood," or as "being to the danger of life," or "by being committed against a magistrate," or "by being perpetrated with a lethal weapon," an expression applicable to a sword, hatchet, hammer, or any instrument more formidable than an ordinary walking-stick. The punishment in such cases is more severe, being generally a lengthened imprisonment or penal servitude. Criminal prosecutions for assault, at the instance of private parties, are almost unknown. The party injured may sue for damages, but such actions are not frequent. There is no division, as in England, into 'assault,' and 'assault and battery.' Many of the statutes as to specific assaults, for instance, assaults in pursuance of a combination to raise wages, extend to Scotland.

ASSAYING, a chemical operation, which differs from analysis only in degree. When an analysis is performed, the nature and proportions of all the ingredients of a substance are determined; but in assaying, usually, the quantity of any particular metal only which the ore or mixture under examination may contain is ascertained, without reference to the substances with which it is mixed or alloyed.

The operations of assaying are sometimes conducted entirely in what is called the *dry way*, or by heat; at other times in the *moist way*, or by acids and other reagents; and in some cases both methods are necessarily resorted to in assaying the same ore or mixture of metals.

The use of the term assaying is sometimes restricted to alloys or mixtures of gold and silver; but in the present article we shall point out the methods of assaying the ores of the following metals also—copper, iron, lead, tin, and zinc.

The assaying of silver and gold is effected by a process called *cupellation*. Cupels are small flat crucibles, made by pressing bone ash, moistened with water, into circular steel moulds, and they are dried by exposure to the air. The principle upon which the operation depends is, that all metals with which gold and silver are usually alloyed are convertible into oxides by exposure to atmospheric air at a high temperature, whereas the precious metals remain unacted upon. The oxides are miscible with fused oxide of lead, and are absorbed with the latter into the pores of the cupel.

Silver.—To assay silver by cupellation, it is requisite to obtain lead as free as possible from silver; when it is procured by reducing litharge, it contains only about half a grain of silver in a pound; and this portion may be neglected. The silver to be assayed is flattened and made quite clean; about thirty-six grains are to be weighed and wrapped up in the proper quantity of lead, which depends upon that of the base metal in the alloy; this, if coarse, is harder than standard silver, of a brilliant glassy appearance, and is flattened with difficulty on the anvil; if soft, easily flattened, and of a dead-white colour, a nearer approach to purity is indicated. The quantity of lead must then be apportioned according to the experience of the assayer, and varies from three to fifteen times the weight of alloy to be operated on. It is to be observed, that cupels do not absorb more than their own weight of oxide of lead, and also that, if the quantity of this metal be too large, some of the silver is carried with the oxide into the cupel, and a loss of product is incurred.

The alloy and lead are to be put into a cupel when made very hot in a small earthen oven, called a *muffle*, which is placed in the assay furnace; the mixture soon fuses, is covered with a coat of oxide of lead, becomes flattened, gives off fumes, and considerable motion ensues on its surface. The lead thus gradually oxidises, and the oxide fusing is absorbed by the cupel, and carries with it the baser metals, also oxidised, with which the silver was alloyed. The alloy is at first flat, but becomes gradually convex, and presents continually increasing shining points; when this happens, the cupel is to be brought forward to the mouth of the muffle; the shining points disappear, the silver becomes brilliant, and the operation is complete. Care must be taken to allow the assay to cool very gradually. Its weight will denote the amount of fine silver contained in the quantity of alloy subjected to examination.

The assay of silver by the *humid* or moist way is now more generally adopted than the process of cupellation. Dr. Miller, in his 'Elements of Chemistry,' says, "The results of the process of the assay by cupellation, even in experienced hands, may vary as much as two parts in 1000; this circumstance induced Gay Lussac to contrive a different method, which is now adopted, not only in the French mint, but is employed in the mints of Great Britain and the United States, as well as in almost all the mints of Europe; it admits of an accurate estimate of the value of an alloy to within 0·5 in 1000. This process depends upon the precipitation of the silver in the form of an insoluble chloride, and the measurement of the amount of a standard solution of chloride of sodium which is required to effect the complete precipitation of the silver in a given weight of the alloy. Chloride of silver easily collects into dense flocculi by agitation in a solution which is acidulated with nitric acid, and which contains no excess of soluble chlorides; so that the exact point at which the precipitate ceases to be formed is readily perceived.

"A solution of common salt is prepared of such a strength, that 1000 grains of it are exactly sufficient to precipitate ten grains of pure silver. Ten grains of the alloy for examination are placed in a stoppered bottle, capable of holding about six ounces of water, and by the aid of a gentle heat are dissolved in two drachms of nitric acid, of specific gravity, 1·25; the solution of salt is then placed in a burette (*fig. a*) capable of holding rather more than 1000 grains. The burette, when filled with the solution, is weighed before being used, and the liquid is added to the nitrate of silver in the bottle; when it is supposed that the silver is nearly all precipitated, the liquor is briskly agitated in the bottle, and the precipitate is allowed to subside; a drop or two more of the solution of salt is then added; if a precipitate be produced, the liquid is again agitated, and when clear more of the solution is added, as before, as long as any turbidity is produced by the addition. When a cloud ceases to be formed, the proportion of solution of salt which has been added is ascertained, by weighing the burette a second time. The number of grains of the solution employed indicates the degree of fineness of the alloy."

Fig. a.

Gold.—The assaying of gold is performed, to a certain extent, exactly in the same way as that of silver by the dry way; and if the gold were alloyed only with copper, the process would be as simple as that of silver assaying. Usually, however, gold contains silver, and this cannot be got rid of by cupellation; the *parting* process is therefore had recourse to. This consists in dissolving the silver by dilute nitric acid, which leaves the gold perfectly pure, unless the silver is so small in quantity as to be protected by the gold from the action of the acid, which is very commonly the case. To obviate this difficulty, the gold alloy, supposing it to weigh twelve grains, is to have thirty-six grains of pure silver added to it (hence the name *quartation* given to this process), and to be cupelled with one hundred and eight grains of lead. The button obtained is to be flattened into a plate of about one inch and a half long, and four or five lines broad, returned to the furnace, kept for some time at a red heat, taken out and suffered to cool, and rolled up about the size of a quill. This is to be put in a matrass with about three times its weight of nitric acid, of sp. gr. 1·25, and heated on a sand-bath. By the action of the acid the silver is dissolved, and the *cornets*, as they are termed, of gold, are left of a dull-brown colour, and without any metallic appearance; these are repeatedly washed with distilled water, and heated in small clay crucibles to bright redness. The pieces of gold having thus acquired their usual appearance and properties, are to be weighed, the absolute loss in weight indicating the purity of the alloy subjected to trial.

Iron ores are chiefly of three kinds: the impure protocarbonate, commonly called the argillaceous iron ore; the peroxide, including the specular and hæmatite iron ores; the black or magnetic ore, which is a compound of the protoxide and peroxide. The argillaceous iron ore is that which supplies by far the greatest proportion obtained in Britain; the hæmatite occurs in North Lancashire and many other places; the mines of Elba yield the specular ore; whilst the Swedish iron is obtained principally from the magnetic ore.

Various methods have been proposed for assaying these ores, but the principle is in all of them the same; it is that of separating the oxygen from the iron, by the greater affinity of charcoal for that element at high temperatures. The operation of the charcoal is frequently assisted by the use of a flux to combine with the earthy matter, and to convert it into such a glass as will let the melted metal easily fall through, and form, on cooling, a clean button. A flux composed of lime and bottle glass has been used, or the clay which accompanies the argillaceous iron ore is to be burnt and mixed with an equal weight of lime; 200 grains of the powdered ore may be mixed with an equal weight of this flux and forty grains of powdered charcoal; the mixture, put into a Cornish or Hessian crucible, is to be heated in a wind-furnace or a forge. It is not always easy to apportion the charcoal exactly to the oxide of iron in the ore; when it is either too large or too small, the product of iron is deficient, and this will be denoted by the imperfection of the glass.

In the Supplement to the 'Encyclopædia Britannica,' Mr. Mushet has given the results of using various fluxes with an iron ore that yielded forty-six per cent. of the metal; and it appears that the following mixture of the ore and substances, all of course reduced to powder, gave the largest proportion of iron: ore, 200 grains, lime 100, borax 100, charcoal 40, gave 91 of metal; it is therefore evident that only one-half per cent. of iron remained in the glass.

According to M. Descotils ('Ann. de Chimie,' t. 84, p. 188), the earthy portion of the argillaceous iron ore is frequently such as to form a glass without adding any flux whatever to the charcoal. He used crucibles lined with a mixture of clay and charcoal; and thus, among many other assays, with nearly similar results, an ore which was found by analysis to contain about 37¾ per cent. of iron yielded 36 per cent. of the metal, and the glass was of excellent quality.

Copper ores, with reference to the mode of assaying them, may be divided into two classes—those that contain sulphur, and those that do not. The former class may be subdivided into such as also contain iron pyrites, arsenic, tin, lead, zinc, &c., with a considerable quantity of earthy matter; and such as are composed principally of a mixture of the sulphurets of copper and iron, with but small portions, if any, of other metallic or earthy minerals.

To treat the first subdivision of the sulphureous ores (which constitute a large proportion of all copper ores sold in Great Britain), a flux should be prepared by mixing the following ingredients in the under-mentioned weights:—

2 parts	Fluor spar,
1 ditto	Slaked lime,
1 ditto	Borax,
1 ditto	Red argol (impure tartar),
½ ditto	Nitre,

all finely powdered and well mixed.

The sample of ore being reduced to a coarse powder, take 400* grains of it, and calcine it in a Cornish or Hessian crucible, at a moderate red heat, for fifteen or twenty minutes, stirring it repeatedly with an iron rod flattened at the end. During this operation the ore will increase considerably in bulk, and it should never be continued after this begins to diminish. Having taken out the crucible in order to allow it to cool, fill the furnace† with fuel, and put on the cover to increase the heat. When cool, mix the ore, without taking it out of the crucible, with about 400 grains of the prepared flux, and cover the surface of the mixture with common salt; introduce it into the furnace, and continue it therein, at a white heat, until the whole is well melted, which will be known by the surface of the mass assuming a smooth and quiet aspect. If the furnace is in good condition, this will generally be effected in about twenty minutes. Should the operator have reason to think that the mixture in the crucible has not melted thin, so as to allow the metallic regulus to subside through the slag, he may project upon it a mixture of a scruple each of nitre, borax, and argol; and this may be again repeated if necessary, adding, however, ten grains of flowers of sulphur. When thoroughly melted, pour the contents of the crucible into a hemispherical iron mould, previously warmed and greased; allow it to become solid, and then quench it in water. Separate the button of regulus from the slag with a small hammer; it ought to be round and well defined, of a reddish-brown colour with shades of blue, or else bluish-white. When of the former colour, it contains a little more sulphur than the latter. Should the button of regulus exhibit a brilliant bluish-white surface, the slag should be remelted with two drachms of red argol, and a scruple each of slaked lime and sulphur, which will give a small button of regulus to be added to the former. It may here be remarked, that a button of regulus with a nucleus of metallic copper should always be rejected, and a fresh assay commenced, calcining the ore less. And if, when the slag and button of regulus are quenched in water, it renders the latter immediately turbid and of a dirty orange-yellow colour, it should also be rejected, the ore in this case also having been too much calcined, or too large a quantity of nitre used. On the contrary, if the regulus does not collect in a compact well-defined button, but spreads under the slag a considerable way up the sides of the mould, and of a dull-brown aspect, the ore has not been sufficiently calcined.

The regulus must now be calcined: for which purpose reduce it to powder, and expose it in a clean porcelain crucible to a very dull red heat, constantly stirring it with a flattened iron wire. As the operation proceeds, the heat must be increased and the stirring continued, until the whole of the sulphur is dissipated. Especial care must be taken, particularly at the commencement of the operation, to prevent the regulus from clotting or sticking together, which is caused by excess of heat or want of stirring, and much retards the operation. The same remark applies also to the calcination of ores. It is of vital importance that the whole of the sulphur should be expelled in this operation, and this will be greatly facilitated by projecting gradually about twenty grains of carbonate of ammonia into the crucible towards the end of the operation.

The crucible having been removed from the furnace, and allowed to cool, add to the calcined regulus about a drachm each of borax and red argol, with a scruple of nitre, covering the whole with common salt. Melt the mixture well, and pour it into a mould as before; quench it in water, and knock off the slag (which reserve) from the metallic button. The latter is now termed coarse copper, and requires to be refined; for which purpose return the crucible to the furnace, putting into it the button of copper, upon which, when melted, project about half a drachm of flux (prepared as below), and the like quantity of common salt. Shut up the furnace for about two minutes, or until the flux is well melted, and then pour out into the mould as before. Separate the flux (which reserve) from the button; and if the

* The weight used by assayers of copper ores is 400 Troy grains, marked 100 (technically called *cents*), which is subdivided down to one, and that again to one-eighth. Ore giving a button that weighs ten three-eighths is said to produce ten three-eighths per cent., and so on. The average of all the copper ores smelted in Great Britain is about eight and a half per cent.

† The furnace used for assaying copper ores is a simple air furnace, about seven inches square and fourteen inches deep, communicating with a chimney by a lateral flue five inches wide by two deep. The fuel is coke, broken to pieces about the size of walnuts, the small sifted out. Cornish crucibles are used, and require neither stand nor cover, being kept with the mouth just above the surface of the fuel.

latter does not appear to be fine (or free from alloy), repeat the operation until it is. An unerring mark of fineness is a sinking or concavity in the centre of the upper surface of the 'assay,' or button; but so long as the upper surface is convex, it is not fine. If the button, when fine, instead of having a smooth brilliant surface, of a yellowish-red colour, exhibits a roughish surface, of a dark-red colour, and having firmly attached to it bits of a dark-red slag, the refining process has been pushed too far. The button being fine, take the slag which was reserved from melting the calcined regulus, together with the flux and slag from the refining process, and mix these with three drachms of red argol and a very little charcoal powder, and melt well in the crucible in which the refining is performed. This will give a small metallic button, which refine as before.

The flux above alluded to, which is used for refining, is prepared by burning together a mixture of three parts nitre, two parts red argol, and one part of common salt. This is best done by putting the ingredients into a large iron mortar, and stirring them with a red-hot poker until combustion ceases. The mass should be reduced to powder before it is quite cold, and preserved in a well-stopped bottle, or it will deliquesce. About half a drachm of this flux and of common salt are usually taken, and this will generally be a sufficient quantity; but as much should be used as will perfectly cover the button when it is poured into the mould, otherwise the metal will oxidise, which of course is to be avoided.

The ores of the second subdivision of sulphurets are best assayed by calcining them perfectly in the first instance, so that the first melting shall give a metallic button, instead of a regulus or sulphuret. To effect this, when the one has been calcined until the whole of the sulphur is driven off, it should be melted with a drachm each of slaked lime and fluor spar, the same quantity of borax and red argol, with a little nitre; and then proceeded with precisely as directed for calcined regulus.

Copper ores not containing sulphur, or only in very small quantity, may be calcined for a short time (a few minutes is sufficient), and melted as directed in the last section, except that the quantity of lime and fluor spar may be reduced, and some scales of iron from a smith's forge added.

Lead.—The principal ore of lead is the sulphuret, commonly called galena; but the carbonate, or white lead ore, is sometimes found in considerable quantity.

To assay the former ore: take 400 grains coarsely powdered, mix it with 100 grains of black flux, and 50 grains of cream of tartar; put the mixture into a Cornish or Hessian crucible that will hold double the quantity, plunge to the bottom of it the ends of six or eight pieces of No. 10 iron wire, and cover it with carbonate of soda to the depth of half an inch. Expose it to a bright-red heat for about ten minutes, or until the matter in the crucible has ceased to boil, and is become smooth; then withdraw the pieces of iron wire, and allow the contents of the crucible to cool. On breaking the crucible, the button of lead will be found at the bottom.

If the ore is much mixed with iron pyrites or earthy matter, a little fluor spar and borax should be added to the other ingredients.

The carbonate is best assayed by melting it with half its weight of black flux and a little cream of tartar, covering the mixture as before with carbonate of soda.

Tin.—The ores of tin are principally of two kinds, the oxide and the sulphuret; the latter is, however, very rare.

To assay the oxide of tin, or black tin, as it is commonly called, it requires only simple fusion with half its weight of black flux, one-eighth borax and the like of cream of tartar, covering the mixture in the crucible to the depth of half an inch with carbonate of soda.

The sulphuret, or pyritous tin ore.—Let 400 grains be reduced to powder and carefully calcined, with occasional additions of small portions of charcoal powder, constantly stirring it with an iron rod, and so managing the fire as to prevent the ore from clotting. This operation should be continued until the ore ceases to emit either sulphureous or arsenical vapours. When thoroughly calcined, file off from the stirring-rod any portion of the ore that may adhere to it, adding it, of course, to that in the crucible. Add likewise 40 grains of lime, 20 grains of fluor spar, 150 grains of black flux, with a small quantity of nitre, borax, and cream of tartar; when these are well mixed, cover with carbonate of soda, and when melted quite smooth, allow the crucible to cool, when the tin will be found at the bottom.

Zinc.—The ores of zinc are of two kinds, the carbonate, or calamine, and the sulphuret, or blende.

There is perhaps no mode of directly assaying the ores of this metal, so as to obtain their metallic contents. That generally given in books of chemistry and metallurgy, namely, distillation of the roasted ore mixed with charcoal in an earthen retort, will be found universally to fail, either entirely or partially. Even in the treatment of these ores in the large way, the quantity of metal obtained seldom exceeds one-half the quantity which they contain: the loss arises partly from the escape of uncondensed metallic vapour, and partly from unreduced oxide.

The best mode of making comparative assays of the ores of zinc is as follows: If the ore is the carbonate, or calamine as it is usually termed, reduce it to pieces of the size of hazel-nuts, weigh thirty-two ounces, avoirdupois, and expose it under a muffle, or in a large crucible, to a moderate red heat, until the pieces are red-hot throughout. When cold reduce the ore, which will have become very friable, to a fine powder; reweigh it and note its weight, mix it with its own bulk and one-half more of powdered charcoal, and press it down moderately tight into a Stourbridge-clay crucible, which it should not fill nearer than two inches to the top. Then take a piece of moistened and tempered clay, in which a little charcoal powder and sand have been mixed, roll it out to one-eighth of an inch thick, and cut out of it a round cake to fit into the crucible upon the mixture of calamine and charcoal, giving it a little concavity on its upper surface. Then weigh as much granulated copper as is equal to two-thirds of the *calcined* calamine, spread it upon the disc of clay in the crucible, cover it with charcoal powder, and lute a clay cover to the crucible. Set the crucible in an air furnace, and expose it to a bright-red heat for three hours, and then increase the heat to a yellowish-white for another hour; then take out the crucible and allow it to cool, collect the brass which will have formed on the clay disc and weigh it; if its weight equals that of the *calcined* calamine, the latter may be considered of good quality for commercial purposes. The arrangement may be varied by mixing the granulated copper with the calamine and charcoal, instead of putting it on the clay disc; but when the operation is finished, it will be more trouble to collect the grains of brass.

This is an operation that requires considerable nicety in the management of the fire; for if too hot, the metallic zinc is vaporised faster than the copper can combine with it; and, on the other hand, if not hot enough, the oxide will not be reduced. Attention to a few trials will give the requisite judgment.

The sulphuret, or blende, is assayed in the same way, except as to calcination.

Blende must first be reduced to a fine powder and carefully calcined upon the floor of a muffle so heated as to exclude any carbonaceous smoke or flame, stirring it constantly with an iron rod until it ceases to give any indication of sulphur. The powdered blende should not lie above one-fourth of an inch thick on the muffle, and the heat should be very gradually raised from a dull to a bright-cherry red. When perfectly calcined, it must be treated in the same way as calcined calamine.

Zinc ores can only, however, be accurately assayed by the humid process. Mitchell recommends the following methods of conducting this operation: The calcined ore "is dissolved in excess of hydrochloric acid, evaporated to dryness, and redissolved by water. Some silica remains which has not been dissolved, and which may be collected on a filter. An excess of ammonia is now poured into the solution, and the precipitate separated by filtration from the solution, which latter contains all the oxide of zinc. The solution may now be boiled with an excess of carbonate of soda, until all the ammonia has been expelled, the precipitated carbonate of zinc collected on a filter, washed, dried, ignited, and weighed; four-fifths of its weight corresponds to metallic zinc.

"The analysis of *blende* may be conducted by treating it with gently warmed strong nitric acid; decant the solution with care, and boil with aqua regia; collect the residue on a filter, and wash. The solution may be treated exactly as in the analysis of calaminiferous ore: with ammonia, and carbonate of soda.

"Brass may be analysed by solution in nitro-hydrochloric acid, evaporation to dryness, treating with hydrochloric acid, diluting with water, and precipitating its contained copper by means of a rod of iron, collecting, washing, drying, and weighing the precipitated metal: the loss is zinc.

"This is only applicable, however, where the brass contains only copper and zinc; it sometimes, however, contains lead."

ASSEMBLY, GENERAL, SCOTLAND. [GENERAL ASSEMBLY.]

ASSEMBLY, NATIONAL. [NATIONAL ASSEMBLY.]

ASSEMBLY OF DIVINES. [WESTMINSTER ASSEMBLY.]

ASSENT, ROYAL. When a bill has passed through all its stages in both houses of parliament, if it is a bill of supply, it is sent back to the charge of the officers of the House of Commons, in which it had of course originated; but if not a bill of supply, it remains in the House of Lords. The royal assent is always given in the House of Lords, the Commons, however, being also present at the bar, to which they are summoned by the Black Rod. The sovereign may either be present in person, or may signify the royal assent by letters patent communicated to the two houses by commissioners. Power to do this is given by 33 Henry VIII. c. 21. The commissioners are usually three or four of the great officers of state, and sit in their robes on a bench placed between the woolsack and the throne. The sovereign, when the royal assent is given in person, is seated on the throne robed and crowned. The bills that have been left in the House of Lords lie on the table; the bills of supply are brought up from the Commons by the Speaker, who, in presenting them, especially at the end of a session, usually accompanies the act with a short speech. In these addresses it is usual to recommend that the money which has been so liberally supplied by the faithful Commons should be judiciously and economically expended; and a considerable sensation has been sometimes made by the emphasis and solemnity with which this advice has been enforced upon the royal ear. The royal assent to each bill is announced by the clerk of parliament. Having read the title, he says, if it is a bill of supply, "Le roi (or la reine) remercie ses loyal subjects, accepte leur benevolence, et ainsi le veut;" if any other public bill, "Le roi (or la reine) le veut;" if a private bill, "Soit fait comme il est desiré." What is called an act of grace, that is, an act by which the royal favour or bounty is extended to any party, must be signed by the sovereign before it is laid before parliament, where it is only read once in each house, and where, although it may be rejected, it cannot be amended. To such an act there is no further expression of the royal assent, but, having read its title, the clerk of the parliament says, "Les Prelats, Seigneurs, et Commons, en le present parliament assemblés, au nom de touts vos autres subjects, remercient tres humblement votre majesté, et prient a Dieu vous donner en santé bone vie et longue."

When the royal assent is refused to a bill, the form of announcement is "Le roi (or la reine) s'avisera." It is probable that in former times these words were intended to mean what they express, namely, that the sovereign would take the matter into consideration, and merely postponed his decision for the present. There has been no instance of the rejection by the crown of any bill, certainly not of any public bill, which had passed through parliament, for many years. It is commonly stated, even in books of good authority, that the last instance was the rejection of the bill for triennial parliaments by William III. in 1693. Tindal, in his continuation of Rapin, says, "The king let the bill lie on the table for some time, so that men's eyes and expectations were much fixed on the issue of it; but in conclusion he refused to pass it, so the session ended in an ill humour. The rejecting a bill, though an unquestionable right of the crown, has been so seldom practised, that the two houses are apt to think it a hardship when there is a bill denied." But another instance occurred towards the close of the same year, which was more remarkable, in consequence of its being followed by certain proceedings in parliament, which was sitting at the time. This was the rejection of the bill commonly called the Place Bill, the object of which was to exclude all holders of offices of trust and profit under the crown from the House of Commons. It was presented to the king along with the land tax bill; and the day after he had assented to the one and rejected the other, the House of Commons, having resolved itself into a grand committee on the state of the nation, passed the following resolution:—"That whoever advised the king not to give the royal assent to the act which was to redress a grievance, and take off a scandal upon the proceedings of the Commons in parliament, is an enemy to their majesties and the kingdom; and that a representation be made to the king, to lay before him how few instances have been in former reigns of denying the royal assent to bills for redress of grievances; and the grief of the Commons for his not having given the royal assent to several public bills, and in particular to this bill, which tends so much to the clearing the reputation of this house, after their having so freely voted to supply the public occasions." An address conformable to the resolution was accordingly presented, to which the king returned a polite answer, confining himself to the confidence that ought to be preserved between himself and the parliament, but taking no notice of what was said about the rejection of the bill. When the Commons returned from the royal presence, it was moved in the house "That application be made to his majesty for a further answer;" but the motion was negatived by a majority of 229 to 28.

Mr. Hatsell, in the second volume of his 'Precedents' (ed. 1818), quotes other instances of subsequent date to this; the latest being the rejection of a Scotch militia bill in 1707. In former times the refusal of the royal assent was a common occurrence. Queen Elizabeth once at the end of a session, out of ninety-one bills which were presented to her, rejected forty-eight.

It is the royal assent which makes a bill an act of parliament, and gives it the force of a law. As by a legal fiction the laws passed throughout a whole session of parliament are considered as forming properly only one statute (of which what are popularly called the separate acts are only so many chapters), it used to be a matter of doubt whether the royal assent, at whatever period of the session it might be given, did not make the act operative from the beginning of the session, when no day was particularly mentioned in the body of it as that on which it should come into effect. In order to settle this point, it was enacted by 33 Geo. III. c. 13, that the clerk of parliament should for the future endorse on every bill the day on which it received the royal assent, and that from that day, if there was not in it any specification to the contrary, its operation should commence.

It appears that the several forms of words now in use are not, as has been sometimes stated, exactly the same that have been employed in this ceremony from the first institution of parliaments. For instance, it is recorded that Henry VII. gave his assent to the bill of attainder passed in the first year of his reign (1485) against the partizans of Richard III. in the more emphatic terms, "Le roy le voet, en toutz pointz." On some occasions, of earlier date, the assent is stated to have been given in English. Thus, to a bill of attainder passed against Sir William Oldhall in 1453 (31 Henry VI.), the clerk is recorded in the Rolls of Parliament to have announced his majesty's assent as follows: "The king volle that it be hadde and doon in maner and forme as it is desired." And in 1459, in the case of an act of attainder against the Duke of York, the Earls of Salisbury, Warwick, and others, the same king gave his assent in the following form: "The king agreeth to this act, so that by virtue thereof he be not put from his prerogative to shew such mercy and grace as shall please his highness, according to his regalitie and dignitie, to any person or persons, whose names be expressed in this act, or to any other that might be hurt by the same."

In the time of the Commonwealth, an English form was substituted for those in Norman-French, which had been previously and are now in use. On the 1st October, 1656, the House of Commons resolved "that when the Lord Protector shall pass a bill, the form of words to be used shall be these, 'The Lord Protector doth consent.'" In 1706, also, a bill passed the House of Lords, and was read a second time in the House of Commons, for abolishing the use of the French tongue in all proceedings in parliament and courts of justice, in which it was directed, "that instead of 'Le roy le veult,' these words be used, 'The king answers Be it so;' instead of 'Soit fait come il est desiré,' these words be substituted, 'Be it as is prayed;' where these words, 'Le roi remercie ses bons sujets, accepte leur benevolence, et ainsi le veult,' have been used, it shall hereafter be, 'The king thanks his good subjects, accepts their benevolence, and answers Be it so;' instead of 'Le roi s'avisera,' these words, 'The king will consider of it,' be used." "Why this bill was rejected by the Commons," says Hatsell, "or why its provisions with respect to proceedings in parliament were not adopted in an act which afterwards passed in the year 1731, 'That all proceedings in courts of justice should be in English,' I never heard any reason assigned." For further information on this subject, see Hatsell's 'Precedents,' vol. ii. pp. 338—351, ed. 1818.

ASSESSMENT OF DAMAGES takes place on a writ of inquiry before the sheriff or his deputy, and a jury of the county where an action is laid, in cases where the defendant suffers judgment by default. In such cases, the defendant having admitted his liability for the debt or damage sued for, the only question is as to the amount; and the jury are summoned merely to assess the damages, and not as on trials where issue is joined to try the issue *as well as* to assess the damages (*tam ad triandum quam ad inquirendum*). The verdict may be set aside on motion to the court where the action is brought, in case the jury are improperly returned, or the sheriff has misdirected them in point of law, or the damages are excessive. [WRIT OF INQUIRY; DAMAGES.]

ASSESSMENT OF TAXES. [TAX, TAXATION.]

ASSETS (from the Norman French *assetz*, sufficient) is the real and personal property of a party deceased, which, either in the hands of his heir or devisee, or of his executor or administrator, is chargeable with the payment of his debts and legacies. Assets are either *personal* or *real*. The former, embracing goods, chattels, debts, &c., devolve on the executor or administrator; and the latter (including all real estate) descend to his heir-at-law, or are devised to his devisee. Assets are also distinguishable into *legal*, or such as render the executor or heir liable to a suit at common law on the part of a creditor; and *equitable*, or such as can only be rendered available by a suit in a court of equity, and are subject to distribution and marshalling among creditors and legatees, according to the peculiar equitable rules of that court.

1. As to *personal legal assets*. These include all goods, chattels, and moveables, which belonged to the deceased in *action* or *possession* at the time of his death, and which actually come to the executor's or administrator's hands; and also all things which come to the executors or administrators at any time *in lieu* of them. Thus, a lease made to executors, in pursuance of a covenant to grant a lease to the testator in his life; goods delivered to executors under a contract to deliver them to a testator; damages recovered by an executor for breach of a contract made with the testator, are *personal legal assets*. So the young of sheep or cattle of the testator born after his death; the profits made by his executor in carrying on his trade; the value of his mortgaged chattels, redeemed by the executor after his death, are assets of this description.

The locality of the property, in general, does not affect the question whether it is assets or not; it being a maxim that "assets in any part of the world are assets in every part of the world." Therefore, stock in foreign funds, or a leasehold for years in Ireland, must, in the case of a deficiency of assets in this country, be sold by the executor to satisfy the creditors. By the 5th Geo. II. c. 7, s. 4, houses, lands, negroes, &c., in the plantations of the West Indies, were rendered personal assets, devolving on the executor for satisfaction of debts. And the 9th Geo. IV. c. 33, produced the same operation on all real estates of British subjects (not being Mohammedans or Gentoos), situate in India within the civil jurisdiction of the British supreme courts at Fort William (Calcutta), Fort St. George (Madras), and Bombay.

As the law protects an executor or administrator from any personal charge so long as he acts rightfully, the assets which render him chargeable to a creditor are, of course, only such as *come to his hands*, and not necessarily all those of which the deceased may die possessed. It was said by Wentworth, a considerable authority on this subject, that if the testator at his death has sheep in Cumberland, bullocks in Wales, fat oxen in Bucks, money, household stuff, and plate in London, and the executor dwells at Coventry, namely, far from all these places, the executor has such an actual possession immediately on the testator's death, that he may maintain trespass against any one taking them away, and therefore it is doubtful whether these goods must not be considered to have actually come to his hands so as to be assets rendering him chargeable for payment of debts. But it seems now to be the better and more just rule, that if such property should be abstracted by any stranger, either before it has been actually possessed by the executor or afterwards, so that it be without any fault of the executor, he will only be liable to account for the damages which he may actually recover against such stranger, notwithstanding such damages may be less than the actual value of the goods. And upon the same principle, goods stolen from the possession of the executor, without blame on his part, will not be considered assets, unless indeed he have neglected an opportunity of selling them for a good price. As to all such personal property of the testator as is merely in *action*, namely, debts and rights of suit, it only in general becomes assets when reduced into possession by the executor; but if he release any such claims, or take a bond for them to himself personally, they then become assets with which he is chargeable. As nothing but what is of pecuniary value is assets, if the deceased were entitled to the next presentation to a living, and died without presenting, the right in the hands of the executor would not be assets, because not legally saleable. It follows from the very definition of *assets*, that they do not embrace property which the testator possesses merely as a trustee, without having any personal beneficial interest therein; and upon the same principle, the executor cannot employ as general personal assets property which is in the testator's hands clothed with a specific trust or appropriation; for instance, bills or notes remitted to the testator to meet acceptances for any particular purpose; nor money received by the executor himself under a specific trust to apply it in payment of his testator's debts.

2. *Personal equitable assets* are such as can only be made available by the help of a court of equity, and which consequently cannot be given in evidence against an executor on his *plene administravit* in a court of law. The distinction between the two classes is most important, and consists not merely in the mode of obtaining payment out of them by a creditor, but also in the scheme of their distribution for payment of debts. While legal assets must be applied in payment of debts, according to certain rules of priority (namely, 1. Funeral charges, &c.—2. Debts to the crown—3. Judgments—4. Recognisances, &c.—5. Rent and specialty debts, as mortgages, bonds, &c.—6. Simple contract debts—7. Legacies), equitable assets are distributable among all creditors equally, the only distinction recognised in courts of equity being that *debts* are to be preferred to *legacies*. Equitable assets embrace money produced by sale of the testator's real estate, whether his interest in such estate were legal or equitable, and whether it be expressly devised to be sold for payment of debts or not; and the equity of redemption of a mortgage is equitable and not legal assets. So also is any fund over which a man has a general power of appointment, which he exercises; in which case the property will be equitably subject to the claims of his creditors, in preference to those of his legatees or appointees.

3. *Real assets* comprise all such lands, tenements, &c., as descend to the heir at law of the deceased, and which at common law rendered him chargeable with specialty debts binding the heir. They embrace many things not strictly of a real nature. Thus an annuity, though a personal thing, is, if granted to a man and his heirs for ever, real assets, which descend to the heir; and this is also the case with things accessory to real estate, such as chimney-pieces, wainscots, doors, and other fixtures; and even deer in a park, hares and rabbits in a warren, fish in a private pond or fishery, are held to participate in the nature of real estate, and to descend to the heir as real assets. By the statute 29 Car. II. c. 3, estates *pur auter vie*, limited to the grantee and his heirs, or his heirs, executors, and administrators, during the life of a third party, are declared to be real assets in the hands of the heir. Terms of years being personal chattels, are in general personal assets in the hands of the executor or administrator; terms created or assigned over *to attend the inheritance* (according to the mode formerly used by conveyancers of protecting the inheritance from judgments and personal charges of the owner) followed the nature of the inheritance.

At common law, it was strictly only the real estate *descended* to the heir which was liable to any of his debts, and this only to debts by bond or specialty, in which the heir was specifically named. If, therefore, the debtor, after the Statute of Wills, 12 Henry VIII. c. 1, *devised* away his lands, his creditors were entirely defrauded of their debts. To remedy this evil, the 3rd Will. and Mary, c. 14, s. 2, rendered such devises void as against creditors by bond or specialty in which the heir was bound, and enabled all such creditors to sue the devisee of the land jointly with the heir at law. And this act having been construed to apply to the case of creditors on *bond* only, has been wisely repealed, and the same provisions extended by the 1st Will. IV. c. 47, to creditors, not only on bonds, but on covenants, and all other specialties. But it is not merely all classes of *specialty* creditors that have now a remedy against the real assets of the debtor: the creditors by simple contract obtained such a remedy by the 47th Geo. III. st. 2, c. 74 (re-enacted by 1 Will. IV. c. 47); but this was confined to cases where the debtor, at the time of his death, was a *trader;* and none of the above provisions applied to copyhold estates. But now, by the comprehensive enactment of 3 & 4 Will. IV. c. 104, all the real estate of the debtor, whether *freehold*, *customary*, or *copyhold*, which he shall not, by his last will, have charged with payment of his debts, is rendered assets, to be administered in courts of equity for payment of his debts, as well those due on *simple contract* as on *specialty;* provided that in the administration of assets in courts of equity creditors by specialty in which the heir is bound shall be preferred to creditors by simple contract, or by specialty, in which the heirs are not bound. It is to be observed that this important enactment confines the remedy of simple contract creditors against the real estate to a court of equity, and does not enable a simple contract creditor to sue the heir or devisee at law.

We have hitherto treated of assets merely as regards the rights and claims of the creditor against the executors and administrators, and heirs and devisees of the debtor, in respect of assets personal or real come to their respective hands. It remains to notice the doctrine of the *exoneration of the real estate*, that is, the apportionment of the debtor's liabilities in a court of equity between the two funds of the deceased, the real and the personal estate, and also the *marshalling of assets*, in order to produce a full satisfaction of all creditors. Although a creditor by specialty has, where the deceased leaves both personal and real estate, his choice of remedies either against the one or the other, so that if he sue the heir at law he cannot be met by a plea that the deceased has left personal assets, yet it is a settled rule that the personal estate in the hands of the executor or administrator is the primary and natural fund for the payment of the debts of the deceased, of whatever description. If the creditor, therefore, proceeds against the real estate, descended or devised, the heir or devisee who has sustained the loss shall be allowed to stand in the place of the specialty creditor, and reimburse himself out of the personal estate in the hands of the executor; provided, of course, that such reimbursement will not prejudice any *creditor* of the deceased: and where the exoneration of the real estate is in favour of the *heir*, it must not disappoint the claim of any legatee, except the residuary legatee, nor the wife's claim to paraphernalia. But a devisee stands in a different situation from the heir; and if he is compelled to pay a bond debt of the devisor, it seems he is entitled to reimbursement out of the personal assets, to the disappointment of general legacies, and even (as it would appear) of specific legacies.

To entitle the heir or devisee to this exoneration out of the personal estate, the debt must be the *proper* debt of the deceased; for if it was a debt charged on the estate when the deceased purchased it, or a debt incurred for money borrowed to pay off then existing charges (whether debts or legacies), the land is then the proper fund for its discharge, and the heir or devisee must take the land *cum onere*, and cannot throw the burden on the personal funds. The rule is the same with respect to both debts and legacies, namely, that the personal estate is the primary and natural fund out of which they are to be paid, and that the real estate is only to be resorted to in aid of the personalty; and even though debts and legacies are, by the will, effectually charged on the real estate, this is only taken for a declaration by the testator that the real estate shall be liable in case of a deficiency of personal assets. But though it requires more than a mere charge of the real estate to exempt the personalty, still a testator is not debarred, if his intention be sufficiently expressed, from effecting such an exemption. As to the mode of expression in a will requisite to operate this effect, the cases have been very numerous and contradictory, and evidence *dehors* the will has been, in some of them (as it is now held, improperly), resorted to. In earlier cases it was held that *express* words were requisite; but it is now settled that the personal assets will be exempted, if there appear, from the whole testamentary disposition taken together, sufficient to convince a *judicial* mind that the testator meant not merely to charge the real estate, but so to charge it as to exempt the personalty.

Marshalling assets is that operation by a court of equity, by which claimants entitled to claim against both the real and personal estate of the deceased are compelled so to elect as not to defeat the claim of other claimants who have only one of these funds to resort to. It is a general rule of equity that if A. have two funds to resort to for his debt, B., having a claim on only one of these funds, may compel A. to have recourse to the other, provided it be necessary for the satisfaction of both. The doctrine and practice of marshalling assets as between creditors by *simple contract* and creditors by *specialty*, seems to be in a great degree superseded by the effect of the statute 3 & 4 Will. IV. c. 104 (before stated), by which the former have acquired a claim against the freehold and copyhold as well as against the personal property of the deceased debtor. But the same rule of equity exists also in favour of *legatees*, and therefore if a creditor by bond, in which the heir is named, exhaust the personal estate instead of resorting to the heir, so as to leave nothing for payment of legacies, a legatee shall stand in the place of such bond creditor against the real assets *descended* to the heir. But if the real estate were devised to a stranger, it would be otherwise, for in that case it would not be equitable that a general legatee (nor as it seems a specific legatee) should obtain his legacy by throwing the specialty debts upon the *specific devisee* of the land. The principle of course applies as between a legatee and a simple contract creditor, where the latter has a claim upon the real assets, which the former has not; as where the testator's estate is generally devised charged with debts but not with legacies. [EXECUTORS, LEGACIES WILLS AND TESTAMENTS.]

(Williams's *Treatise on the Law of Executors and Administrators;* Bacon's *Abridgment* (7th ed.), tit. *Executors and Administrators, Legacies Mortgage.*)

ASSIDIANS (חֲסִידִים Chasidim, Ἀσιδαῖοι, 1 Maccab. vii. 13. Chasidaer, *the pious*), from the root חָסַד, or rather from חָסֵד, a term used to denote either a very good or a very bad action, but more frequently the former. They formed a sect among the Jews, distinguished by their more than common attention to the ceremonials of their religion. They paid more than the usual tribute to the temple, and swore by it, for which our Saviour reproved the Pharisees (Matt. xxiii. 16), who sprang from them, as the Essenes issued from the Pharisees. It was a name given to the zealous defenders of the unity of the Deity and the belief of their ancestors, against the attempts of Antiochus Epiphanes and his successors to force the Jews into idolatry. The Assidians, or Chasidim, of those days, found a leader in Mattathias, who gave the signal for armed resistance against the Syrian tyrants, by killing the commander of the king's troops at the idolatrous altar in Modim, near Joppa. Mattathias headed the Chasidim during four years against the Græcomania of those days. These four years are not included by Josephus in the 126 years of the Asmonean dynasty, which he commences from the time at which Judas Maccabi assumed the chief command.

Later Jews called those persons Chasidim who secluded themselves from worldly occupations and pleasures, to devote their life solely to religious exercises and bodily chastisements, in the hope either of expiating their own sins or those of others, or of hastening the coming of the Messiah. These Chasidim studied the kabala, and endeavoured by their mortification of the flesh to abstract the spirit from the body, and thus have liberty to enter into communion with God and angels. They fasted frequently, and asserted that they had visions.

Solomon Maimon informs his readers in his 'Memoirs' (Berlin 1792), that some of the Chasidim died in consequence of their austerities, and that others became deranged; he also states that not a few rendered their spiritual profession subservient to their temporal aggrandisement.

About the middle of the 18th century a new sect of Chasidim arose among the Jews, who invented a more comfortable method of ascetic practice. They taught that the union of man with God was effected by contemplation, and that in order to fix the mind on God it is necessary to quicken sensation by the enjoyment of permitted indulgences. They asserted that mortification of the flesh disturbs that mental tranquillity which is necessary for the contemplation of God. These Chasidim considered that union with God subsists in common religionists only during seasons of prayer, and they taught that prayer should be performed with the greatest exertion and concentration of the mental faculties, in order to unite the praying spirit so intimately with God as to obtain power over all sublunary and celestial beings, and thus to realise all desires. The tsadik is always in communion with God.

After this sect became numerous, some of its members were considered representatives of God, and their words regarded as oracles. The influence of these representatives was based solely upon their appearance of sanctity, and not upon their mental superiority. They therefore endeavoured to bring science into disrepute.

The history of the modern Chasidim is briefly this: Israel Baalschem, that is, בַּעַל־שֵׁם. *The Lord of the name*, that is, Θεουργὸς, *Theurgos*, whom Maimon erroneously calls Joel, lived A.D. 1740, in the town of Vlussy, in the circle of Czarkow, in Poland. His partisans assert that his birth was predicted to his father by the prophet Elijah, and that his mother was a hundred years old at the time of his birth, and his father still more advanced in years. While yet in his youth, they relate that he overcame some evil spirits, or demons. Baalschem went afterwards to Medziboze, in Podolia, whence he propagated his doctrines, which are contained in a volume written by himself, and edited by his grandson, under the title ספר המרות. His testament has been published under the title צואת ריבש. His birth and miracles are described by his disciple, R. Bär Linez, in a volume entitled שבחי הבעשט, 'The Habitations of Besht.' The fifth edition was published in 1815. The word בעשט, *Besht*, is formed from the initials of בעל שם טוב, *The Lord of the good name*, or *the Lord of the name of God*.

From the word Besht, the modern Chasidim have been called Beshtians. The orthodox Rabbins opposed in vain the spread of the Chasidim or Beshtians by anathema and excommunications. Baalschem based his doctrines upon the cabalistic book of Zohar, recommending a contemplative, inactive life, and frequent bathing in spring water.

The Beshtians soon spread over Wallachia, Moldavia, Hungary, and Gallizia, in which countries they are still numerous; but their principles are not admitted among the Jews in Germany, France, and Italy. This sect a long time concealed their doctrines, and propagated their opinions rather by manuscript copies of their writings than by printed publications; but since 1817 there have been many works published by their own teachers, which, though they often contain many excellent instructions and exhortations for the leading of a moral life and refraining from evil, are too frequently ornamented with marvellous tales, miraculous cures, and mystical interpretations. Several of the tsadiks, however, have shown themselves enlightened men in their writings, and endeavoured to abolish the observance of some of the old and useless ceremonials.

After the death of Baalschem, A.D. 1760, R. Bär, of Madezicy, R. Mendel Przemislaw, and R. Melash of Lyzans, endeavoured to govern the sect; not as combined triumvirs, but by each assuming the government of his own circle, under the title of *tsadik, just* or *pious*. The title of tsadik was formerly applied to Baalschem by way of distinction, but after his death each of his three most distinguished disciples endeavoured by its assumption to vindicate his own prerogative of conversing with spirits. In conversation the disciples of Baalschem are satisfied with the title of *Abbe*, or teacher.

At the present time, every shrewd individual, well read in the Talmud and in cabalistical writers, may by hypocrisy obtain the dignity of a tsadik, even if his morals are suspected. But the descendants of Besht have more facility in obtaining this dignity, because they are a kind of hereditary nobility among the Beshtians, the richest of whom feel themselves honoured by a degree of affinity with a tsadik. Besht himself taught that by honouring the descendants of the tsadik men might induce God to send the Messiah, and that the son of a tsadik is sanctified from his conception by the holy thoughts of his father, and may be called a son of God and נועם המלך.

The tsadik has no certain salary, but is supported by voluntary gifts, for which he grants his advice to the Chasidim in all transactions of life. Whenever his advice seems to be unproductive of good, the cause is thought to be in the sinfulness of the receiver, and not in the inappropriateness of the counsel. He visits yearly their district; and in the month of October his flock visit him. In times of need or distress, also, the graves of the tsadiks are visited.

The doctrines of the Chasidim may be classed under the following three heads:—

I. אֱמוּנַת חֲכָמִים וְהִתְקַשְּׁרוּת לַצַּדִּיק *faithfulness to wise men and attachment to the tsadik.*

II. דְּבֵקוּת לַשְּׁכִינָה *cleaving to the Shechinah.*

III. עזות *courage.*

This courage may even become insolence and effrontery, so that the Chasid may contradict the principles of truth, justice, equity, moderation, and decency, whenever these principles are in collision with the will of the tsadik and that of his sect.

In modern times the Chasidim have left off the use of prayer-books according to the German and Polish ritual, and have adopted the Spanish and Oriental ritual, with which they have mixed many cabalistic elements.

It is the duty of the Chasid to shout during prayer, to clap his hands loudly together, or to beat the wall with his hands, to jump about, and to move the body as in convulsions. Whoever shouts during prayer with all his might, shakes his whole body, and claps his hands, averts the wrath of God and strengthens his own memory. The Chasid must not be prevented by the ridicule of others from obeying in this respect the precepts of the tsadik.

The Chasidim do not like to assemble in the common synagogues. In every place where ten Chasidim reside they have a room called klossel (clausa) for prayer and conversation both sacred and profane. The Chasidim bathe frequently.

(*Geschichte der Lehren und Meinungen aller bestandenen und noch bestehenden religiosen Secten der Juden, und der Geheimlehre oder Kabbalah*, von Peter Beer, Brünn, 1823; Meyer's *Grosse Conversations Lexikon*, 1844, art. *Chäsidim*.)

ASSIENTO TREATY. [TREATIES, CHRONOLOGICAL TABLE OF.]

ASSIGNAT. One of the earliest financial measures of the Constituent Assembly, in the first French revolution, was to appropriate to national purposes the landed property of the clergy, which, upon the proposition of Mirabeau, was by a large majority declared to be at the disposition of the state. (Thiers, 'Histoire de la Révolution Française.') Shortly afterwards, the Assembly, desirous to profit by this measure, decreed the sale of lands belonging to the crown and the clergy, to the amount of 400 millions of francs, or about sixteen millions sterling. To sell at once so large a portion of the surface of France, without lowering the price of land by overloading the market to such an unexampled extent (Thiers), and moreover in a time of mistrust, insecurity, rapid political change, and almost of civil war, was an object of no very easy attainment. It was first proposed that the lands should be transferred to the municipalities, which, not being provided with ready money, might give the state a bond or security for the price, and the state would pay its creditors with these securities, which could, in process of time, be realised, as the municipalities were able successively to sell, at an advantageous price, the lands thus made over to them. The holders of the securities would thus have a claim not on the government, but on the municipal bodies, which would be compellable by process of law to pay; and the creditor might moreover extinguish the debt by buying the lands when put up to sale, and by offering the security in payment. But it might happen that the holder of such securities would be unable to realise them, and might not be willing to purchase any of the lands of the state; in order therefore to obviate this objection to the securities in question, it was proposed that they should be transferable and be made a legal tender.

There was also another motive for the adoption of this latter expedient. In consequence of the want of confidence and stagnation of trade which prevailed in France at this time, money had become extremely scarce, and much of the current coin had been withdrawn from circulation. The king and queen had been forced to send their plate to the mint. (Thiers, vol. i. p. 100.) Under these circumstances, it was determined to issue a paper money, based on the security of the unsold lands belonging to the state. The notes thus issued (each of which was for 100 francs, equal to 4*l.*) were called *assignats*, as representing land which might be transferred or *assigned* to the holder; and all notes which came back in this manner to the government in payment for national lands were to be cancelled. They moreover bore an interest by the day, like English exchequer bills. The object of this measure was, therefore, to obtain the full value of the confiscated lands of the clergy (which in the actual state of France was impossible), and to supply the deficiency of coin in the circulation (arising from a feeling of insecurity) by a forced issue of inconvertible paper money, which, as was predicted by M. de Talleyrand, the bishop of Autun, would inevitably be depreciated, and cause misery and ruin to the holders of it. (Thiers, vol. i. pp. 233–37, and note xviii. p. 382). The first issue of assignats was to the amount of 400 millions, bearing interest. Shortly afterwards, 800 millions in addition were issued, but without the liability to pay interest (ib. p. 256). The last of these issues was made in September 1790. But, as in the beginning of the following year, the Legislative Assembly sequestered the property of all the emigrants, a numerous and wealthy class, for the benefit of the state (Thiers, vol. ii. p. 51), it was thought that the amount of the national securities having been increased, the issues might be safely increased likewise. Accordingly, in September 1792, although 2500 millions had been already issued, a fresh issue to the amount of 200 millions was ordered by the Convention. (Thiers, vol. iii. p. 151.) Towards the end of this year, the double effects of the general insecurity of property and person, and of the depreciation of assignats caused by their over-issue, was felt in the high price of corn, and the unwillingness of the farmers to supply the markets with provisions. Wholly mistaking the causes of this evil, the violent revolutionary party clamoured for an assize, or fixed maximum of prices, and severe penalties against *accapareurs*, or engrossers, in order to check the avarice and unjust gains of the rich farmers. The Convention, however, though pressed both by factious violence and open insurrection, refused at this time to regulate prices by law. (Thiers, vol. iii. pp. 311–17.) Prices however, as was natural, still continued to rise; and although corn and other necessaries of life were to be had, their value, as represented in the depreciated paper currency, had been nearly doubled. The washerwomen of Paris came to the Convention, to complain that the price of soap, which had formerly been fourteen sous, had now risen to thirty. On the other hand, the wages of labour had not risen in a corresponding degree (see Senior on 'Some Effects of Government Paper,' p. 81); so that the evils arising from the depreciation of the assignats greatly aggravated the poverty and scarcity which would, under any circumstances, have been consequent on the troubles and insecurity of a revolution. The labouring classes accused the rich, the engrossers, and the aristocrats, of the evils which they were suffering, and demanded the imposition of a maximum of prices. Not only however in the Convention did the most violent democrats declare loudly against a maximum, but even in the more popular assembly of the Commune, and the still more democratic club of the Jacobins, was this measure condemned, frequently amidst the yells and hisses of the galleries. As the Convention refused to give way, Marat, in his newspaper, recommended the pillage of the shops as a means of lowering prices—a measure immediately adopted by the mob of Paris, who began by insisting to have goods at certain fixed prices, and ended by taking the goods without paying for them. (Thiers, vol. iv. pp. 38–52.) These and other tumults were however appeased, partly by the interference of the military, and partly by the earnest remonstrances of the authorities. But the evil still went on increasing; corn diminished in quantity and increased in price; the national lands, on account of the uncertainty of their title and the instability of the government, were not sold, and thus the number of assignats was not contracted, and they were continually more and more depreciated.

At length the Convention, thinking that the depreciation might be stopped by laws, made it penal to exchange coin for paper, or to agree to give a higher price if reckoned in paper than if reckoned in coin. Still the over-issue had its natural effects: in June 1793, one franc in silver was worth three francs in paper; in August it was worth six. Prices rose still higher; all creditors, annuitants, and mortgagees were defrauded of five-sixths of their legal rights; and the wages of the labourers were equal in value only to a part of their former earnings. The Convention, unable any longer to resist, in May 1793 passed a decree which compelled all farmers to declare the quantity of corn in their possession, to take it to the markets, and sell it there only, at a price to be fixed by each commune, according to the prices of the first four months of 1793. No one was to buy more corn than would suffice for a month's consumption, and an infraction of the law was punished by forfeiture of the property bought and a fine of 300 to 1000 francs. The truth of the declaration might be ascertained by domiciliary visits. The commune of Paris also regulated the selling of bread; no person could receive bread at a baker's shop without a certificate obtained from a revolutionary committee, and the quantity was proportioned to the number of the family. A rope was moreover fixed to the door of each baker's shop, so that, as the purchasers successively came, they might lay hold of it, and be served in their just order. Many people in this way waited during the whole night; but the tumults and disturbances were so great that they could often only be appeased by force, nor were they at all diminished by a regulation, that the last comers should be served first. A similar maximum of prices was soon established for all other necessaries, such as meat, wine, vegetables, wood, salt, leather, linen, woollen and cotton goods, &c.; and any person who refused to sell them at the legal price was punished with death. Other measures were added to lower the prices of commodities. Every dealer was compelled to declare the amount of his stock; and any one who gave up trade, after having been engaged in it for a year, was imprisoned as a suspected person. A new method of regulating prices was likewise devised, by which a fixed sum was assumed for the cost of production, and certain percentages were added for the expense of carriage, and for the profit of wholesale and retail dealers. The excessive issue of paper had likewise produced its natural consequence, over speculation, even in times so unfavourable for commercial undertakings. Numerous companies were established, of which the shares soon rose to more than double or treble their original value. These shares being transferable, served in some measure as a paper currency, upon which, the Convention thinking that they contributed still further to discredit the assignats, suppressed all companies whose shares were transferable or negociable. The power of establishing such companies was reserved to the government alone.

In August 1793 there were in circulation 3776 millions of assignats; and by a forced loan of 1000 millions, and by the collection of a year's taxes, this amount was subsequently reduced to less than two-thirds: the confidence, moreover, inspired by the recent successes of the republic against its foreign and domestic enemies, tended to increase the value of the securities on which the paper-money ultimately reposed: so that towards the end of 1793 the assignats are stated to have been at par. This effect is attributed by M. Thiers, in his 'History of the French Revolution' (vol. v. p. 407), to the severe penal laws against the use of coin: nevertheless we suspect that those who made this statement were deceived by false appearances, and that neither at this nor any other time, nor even at their first issue, did the real value of assignats agree with their nominal value. (Thiers, vol. v. pp. 145-62, 196-208, 399-413.) However, this restoration of the paper-currency, whether real or apparent, was of very short duration, as the wants of the government led to a fresh issue of assignats; so that in June 1794 the quantity in circulation was 6536 millions. By this time the law of the maximum had become even more oppressive than at first, and it was found necessary to withdraw certain commodities from its operation. Nevertheless, the commission of provisions, which had attempted to perform the part of a commissariat for the whole population of France, began to interfere in a more arbitrary manner with the voluntary dealings of buyers and sellers, and to regulate not only the quantity of bread, but also the quantity of meat and wood which each person was to receive. (Thiers, vol. vi. pp. 146-51, 307-14.) Other arbitrary measures connected with the supply of the army, as compulsory requisitions of food and horses, and the levying of large bodies of men, had contributed to paralyse all industry. Thus not only had all commerce and all manufactures ceased, but even the land was in many places untilled. After the fall of Robespierre, the Thermidorian party (as it was called), which then gained the ascendancy, being guided by less violent principles, and being somewhat more enlightened on matters of political economy than their predecessors, induced the Convention to relax a little of its former policy, and succeeded in first excepting all foreign imports from the maximum, and afterwards in abolishing it altogether. The transition to a natural system was, however, attended with great difficulty and danger, as the necessary consequence of the change was a sudden and immense rise of the avowed prices; and trade having been so long prevented from acting for itself, did not at once resume its former habits; so that Paris, in the middle of winter, was almost in danger of starvation, and wood was scarcely more abundant than bread. As at this time the power of the revolutionary government to retain possession of the lands which it had confiscated, and to give a permanently good title to purchasers, was not doubted, it is evident that a fear lest the national lands might not ultimately prove a valuable security did not now tend to discredit the assignats: their depreciation was solely owing to their over-issue, as compared with the wants of the country, and their inconvertibility with the precious metals. The government, however, began now to find that, although it might for some time gain by issuing inconvertible paper in payment of its own obligations, yet when the depreciated paper came to return upon it in the shape of taxes, it obtained in fact a very small portion of the sum nominally paid. Consequently they argued that, as successive issues depreciated the currency in a regular ratio (which, however, is very far from being the case), it would be expedient to require a larger sum to be paid for taxes, according to the amount of paper in circulation. It was therefore decreed that, taking a currency of 2000 millions as the standard, a fourth should be added for every 500 millions added to the circulation. Thus, if a sum of 2000 francs was due to the government, it would become 2500 francs when the currency was 2500 millions, 3000 francs when it was 3000 millions, and so on. This rule, however, was only applied to the taxes due to the government, and was not extended to payments made by the government, as to public creditors or public functionaries. Nor did it comprehend any private dealings between individuals. (Thiers, vol. vii.) Iniquitous as this regulation was, as employed solely in favour of the government, it would nevertheless have been ineffective if its operation had been more widely extended; for the assignats, instead of being depreciated only a fifth, had now fallen to the 150th part of their nominal value. The taxes being levied in part only in commodities, and being chiefly paid in paper, produced scarcely anything to the government, which had, however, undertaken the task of feeding the city of Paris. Had it not in fact furnished something more solid than depreciated assignats to the fundholders and public functionaries, they must have died of starvation. Many, indeed, notwithstanding the scanty and precarious supplies furnished by the government, were threatened with the horrors of famine; and numbers of persons threw themselves every evening into the Seine, in order to save themselves from this extremity. (Storch, 'Economie Polit.,' vol. iv. p. 168.)

To such a state of utter pauperism had the nation been reduced by the mismanagement of its finances and the ruin of public credit by the excessive issues of paper, that when the five directors went to the Luxembourg in October 1795, there was not a single piece of furniture in the office. The doorkeeper lent them a rickety table, a sheet of letter-paper, and an inkstand, in order to enable them to write their first message to announce to the two councils of state that the Directory was established. There was not a single piece of coin in the treasury. The assignats necessary for the ensuing day were printed in the night, and issued in the morning wet from the press. Even before the entry of the directors into office, the sum in circulation amounted to 19,000 millions: a sum unheard of in the annals of financial profligacy. One of their first measures, however, in order to procure silver, was to issue 3000 millions in addition, which produced not much more than 100 million francs.

In this formidable state of things, the next measure adopted was worthy of the violent and short-sighted administration from which it emanated. A forced loan of 600 millions was raised from the richest classes, to be paid either in coin, or in assignats at the *hundredth* part of their nominal value. So that if the current paper was 20,000 millions, a payment of 200 millions would be sufficient to extinguish the whole. The government, however, refused to sanction this principle as against itself; for in paying the public creditor, it gave the assignat the *tenth* part of its nominal value. The land-tax and the duties in farm were required to be paid half in kind and half in assignats; the custom-duties, half in corn and half in assignats. In the mean time, until the funds produced by this loan, which was enforced with great severity, could be at the disposition of the state, the government went on issuing assignats, till they had absolutely lost all value, and had become waste paper. It therefore anticipated its resources by issuing promissory notes payable in specie, when the forced loan should be collected, and with difficulty prevailed on bankers to discount them to the amount of 60 millions. At this time the Directory gave up the task of supplying Paris with bread, and allowed the bakers' shops to be opened as before: an exception being made in favour of the indigent, and of fundholders and public functionaries whose annual incomes were not more than 5000 francs. The payment of the loan, however, went on slowly, the produce of the government bills was exhausted, and fresh funds were required. Again the resource of assignats was resorted to, and in two months the currency had been raised to 36,000 millions, by the issue of 20,000 millions, which even to the government were not worth the 200th part of their nominal value.

By this time some new financial expedient became necessary. It was expected that, by payments of taxes and of the forced loan to the government, the paper in circulation would soon be reduced to 24,000 millions. It was therefore determined to make a new issue of paper, under the name of *mandats*, to the amount of 2400 millions. Of this sum 800 millions were to be employed in extinguishing 24,000 millions of assignats, which were to be taken at a thirtieth part of their legal value: 600 millions were to be allotted to the public service, and the remainder retained in the public coffers. These mandats were to enable any person who was willing to pay the estimated value of any of the national lands to enter at once into possession; and therefore they furnished a somewhat better security than the assignats, as these could only be offered in payment at sales by auction; and consequently the price of the lands rose in proportion to the depreciation of the paper. The estimate of the lands having been made in 1790, was not true in 1795, at which time they had in some cases lost a half, in others two-thirds or three-fourths of their former value. The mandat of 100 francs, however, at its first issue, was worth only fifteen francs in silver; and the new paper was soon so much discredited that it never got into general circulation, and was not able to drive out the coined money which was now almost universally employed in transactions between individuals. The only holders of mandats were speculators, who took them from the government and sold them to purchasers of national lands. By this entire discredit of the government-paper the prosperity of individuals had been in some measure restored, and trade revived a little from its long sleep. The government was destitute of all resource; its agents received nothing but worthless paper, and refused any longer to do their duties. The armies of the interior were in a state of extreme misery; while those of Germany and Italy were maintained only from the countries where they were quartered. The military hospitals were shut, the gens-d'armes were not paid or equipped, and the high roads were infested with bands of robbers, who sometimes even ventured into the towns.

In a short time the government were forced to abandon the mandats, as they had abandoned the assignats, and to declare that they should be received in payment of taxes and national lands only at their real value. Having fallen to near a seventieth of their ostensible value, they were, in the course of 1796, returned to the government in payment of taxes and for the purchase of lands; and with them ended the revolutionary system of paper-money, which probably produced more wide-spreading misery, more sudden changes from comfort to poverty, more iniquity in transactions both between individuals and the government, more loss to all persons engaged in every department of industry and trade, more discontent, disturbance, profligacy, and outrage, than the massacres in September, the war in La Vendée, the proscriptions in the provinces, and all the sanguinary violence of the Reign of Terror.

From the extinction of the mandats to the present time the legal currency of France has been exclusively metallic. (Thiers, vol. viii. pp. 85-9, 103-19, 158-62, 177, 183-91, 334-44, 423-4; Storch, 'Cours d'Econ. Pol.,' vol. iv. p. 164.)

ASSIGNEE OF BANKRUPT. [Bankruptcy.]

ASSIGNEE OF BILL OF LADING. [Bill of Lading.]

ASSIGNEE OF INSOLVENT DEBTOR'S ESTATE. [Insolvent Debtor.]

ASSIGNEE OF A LEASE is the party to whom the *whole* interest of the lessee is transferred by assignment, which assignment may be made without the privity or consent of the lessor, unless the lessee is expressly restrained by the lease from assigning over. The assignee becomes liable to the lessor, from the date of the assignment, for the payment of the rent and performance of the covenants in the lease; but such liability is limited to breaches of covenant during the existence of the assignee's interest, and may be got rid of by assigning over all his interest, and this even to an insolvent; for his liability, arising only from *privity of estate*, that is, from the actual enjoyment of the premises leased, ceases with such enjoyment; whereas the lessee remains liable to the rent and covenants during the whole term. It results also from the circumstance of the assignee's liability arising from *privity of estate*, that he is not liable to mere personal covenants which the lessee may have made with the lessor (as, for example, to build on premises not demised, or to pay a sum of money in gross), but only to such covenants as run with the land, as for instance, covenants to pay rent, to repair, to reside on the demised premises, to leave part of the land in pasture, to insure premises situate within the weekly bills of mortality, to build a new mill on the site of an old one, &c. [Covenant.] The assignee, in order to become liable to the covenants, must take the whole estate and interest of the lessee; for if the smallest portion is reserved, he is merely an under-lessee, and not responsible to the original lessor. The interest of the assignee must also be a legal, not merely an equitable interest; and therefore if the lessee devise the premises leased to trustees in trust for A B, A B will not be chargeable as the assignee of the lessee's interest. The interest must also be an interest in lands or tenements; for if a lease is made of chattels (as for instance, of sheep or cows, which sometimes happens), and the lessee covenant for himself and his assigns to re-deliver them, the assignee is not liable to the owner on this covenant; for there is no privity between the assignee and the owner, such privity only existing where the subject of the demise is real estate. Wilmot, C. J., says, in *Bally* v. *Wells*, "The covenant in this case is not collateral; but the parties, that is, the lessor and assignee, are total strangers to each other, without any line or thread to unite and tie them together, and to constitute that privity which must subsist between debtor and creditor to support an action."—(Wilmot, 345.) The assignee may acquire his interest by operation of law as well as by an actual assignment from the lessee, and therefore a tenant by *elegit*, who has purchased a lease under an executor, is liable as assignee to the lessor in respect of his privity of estate. [As to the liability of assignees of bankrupt on the leases of the bankrupt, see Bankrupt.]

ASSIGNMENT, a deed or instrument of transfer, the operative words of which are usually 'assign, transfer, and set over,' and which passes both real and personal property. Estates for life and estates for years are the principal real interests which are passed by an assignment; and by the statute of Frauds and Perjuries (29 Car. II.) the assignment of such estate is required to be in writing. An assignment differs from a lease, in being a transfer of the entire interest of the lessor; whereas a lease is carved out of a greater estate, creates the relation of landlord and tenant, and reserves to the lessor a reversion after its expiration. If, however, a deed in effect passes the whole interest of the tenant, it operates as an assignment, though it be in form a lease, and though it reserve a rent. As if A having a term of twenty years in land, grants to B the whole twenty years, reserving a rent: in such case B is assignee of the whole term and interest, and not under-lessee to A; and A, for want of having any reversion, cannot distrain for the rent (a distress being only enforceable where the landlord has a reversion expectant on the determination of the tenancy). A, in such case, can only sue B for the rent as for money due upon a contract. In all under-leases, therefore, it is necessary that part (a day will suffice) of the original term should remain in the lessor. See Sheppard's 'Touchstone,' 266; Blackst. 'Comm.' vol. ii. p. 324 (Mr. Kerr's ed.); Bacon's 'Abr.' (7th edit.) tit. *Assignment.* [BILL OF SALE.]

An Assignment of Goods, Chattels, &c., is frequently made by bill of sale, as to which, see BILL OF SALE. As to all goods and chattels *in possession,* no objection ever existed to their transfer and assignment by deed or writing: but with respect to things *in action* (as debts, contracts, right of entry, and suit), according to an ancient rule of the common law, now considerably modified, they could not be assigned over by the party to whom they were due, since the assignment gave to a third party a right of action against the debtor, and thus led to the offence of maintenance—that is, the abetting and supporting of suits in the king's courts by others than the actual parties to them. In the courts of common law this rule exists (with some exceptions) at the present day. Thus, if the obligee in a bond assign over the bond to a third party, the assignee cannot sue on the bond at common law in his own name; but such an assignment generally contains (and ought always to do so) a power of attorney from the obligee to the assignee, to sue in the obligee's name on the bond. Courts of equity have always protected such assignments, and regarded the assignee, for valuable consideration, as the actual owner of the bond; and the courts of common law so far recognise the right of the assignee, that if the obligor, *after notice* of the assignment, pay the money on the bond to the obligee, the courts will not permit him to plead such payment to an action brought by the assignee in the obligee's name on the bond. In order to constitute a good equitable assignment of a bond, or chose in action, writing is not necessary. A personal trust or confidence cannot be assigned over, however able the assignee may be to execute it; and therefore all trust deeds and settlements contain express provisos for the retiring of trustees, and for fresh appointments, with the consent of the *cestui que trusts.* Neither the future whole-pay nor the future half-pay of an officer are capable of being assigned, it being considered contrary to public policy that a stipend given to a man for his public services should be transferred to another man not capable of performing them. The exceptions to the rule that *choses in action* are not assignable at law are many. The king might at all times become the assignee of a *chose in action;* and after such an assignment was entitled to have execution against the body, lands, and goods of the debtor. But this prerogative, having been abused by the king's debtors, was restrained by stat. 7 Jac. I. c. 15, by a privy seal, in 12 James I., and by rule of court of 15 Car. I.; and the practice of actually assigning debts to the king by his debtors has long become obsolete. Bills of exchange are assignable by indorsement, in virtue of the custom of merchants [BILL OF EXCHANGE]; and promissory notes, by virtue of the 3 & 4 Ann. cap. 9. Bail bonds are assignable by the sheriff to plaintiff in the suit under 4 Ann. c. 16, s. 20. [BAIL.] Replevin bonds, by the 11 Geo. II. c. 19. [BANKRUPT; BOND; CHOSE IN ACTION; INSOLVENT DEBTORS; REPLEVIN.]

ASSIZE. This word has been introduced into our legal phraseology from the French *assis,* and is ultimately derived from the Latin verb *assideo,* to sit by, or, as Lord Coke translates it, to sit together. The word *assido* is also to be found in legal records, and has in law-latin a different meaning from *assideo,* signifying to assess, fix, or ordain. Thus in the *postea,* or formal record of a verdict in a civil action, it is said that the jury find for the plaintiff, *et assidunt damna ad decem solide;* 'and they assess the damages at ten shillings;' and then the judgment of the court is given for the damages 'per juratoris in formâ prædictâ assessa.' It is possible that the word assize, in cases where it signifies an ordinance, decree, or assessment, may be derived from this word. This etymology is not, however, given by Du Cange, Spelman, or any learned writer on this subject; though it obviously leads much more distinctly to several meanings of the word assize than the derivation from *assideo.* With reference to English law, the word assize has been called by Littleton *nomen æquivocum,* on account of its application to a great variety of objects, in many of which neither the etymology of the word nor its original meaning can be readily traced. Thus, 1. The term is used to signify an ordinance or decree made either immediately by the king, or by virtue of some delegation of the royal authority. The Assizes of Jerusalem are a well-known code of feudal jurisprudence framed for the kingdom of Jerusalem, formed in 1099, under Godfrey of Bouillon. In this sense, Fleta speaks of 'the laws, customs, and *assizes* of the realm,' and the ordinances made by the great council of nobles and prelates assembled by Henry II. in 1164 and commonly known as the 'Constitutions of Clarendon,' are called by Hoveden '*Assisæ* Henrici Regis factæ apud Clarendonum.' In like manner the assizes of the forest were rules and regulations made by the courts to which the management of the royal forests belonged.

2. Analogous to these were the assizes or ordinances regulating the price of bread, ale, fuel, and other common necessaries of life; called in Latin *assisæ venalium.* The earliest express notice of any regulation of this kind in England is in the reign of John (1203), when a proclamation was made enforcing the observance of the assize of bread; but it is probable that there were more ancient ordinances of the same kind. In very early times these *assisæ venalium* appear to have been merely royal ordinances, and their arrangement and superintendence were under the direction of the clerk of the market of the king's household. But at a subsequent period many statutes were passed regulating the assize of articles of common consumption; the earliest of these is the assize of bread and ale, *assisa panis et cervisiæ,* commonly called the stat. of 51 Henry III., though its precise date is somewhat doubtful. The provisions of the act with regard to ale, establishing a scale of prices varying with the price of wheat, were altered in some measure by 23 Henry VIII. c. 4, which left a discretionary power with the justices of the peace of fixing the price of ale within their jurisdiction [ALE]; but the assize of bread was imposed by this Act, and enforced from time to time by orders of the privy council until the reign of Queen Anne. In cities and towns corporate the power of regulating the assize of bread and ale was frequently given by charter to the local authorities, and the interference of the clerk of the King's household was often expressly excluded. Books of assize were formerly published, under authority of the privy council, by the clerk of the market of the king's household, and there is one still in existence which was printed in the reign of Henry VIII. The stat. 8 Anne, c. 19, repealed the 51 Henry III. and imposed a new assize of bread, making various other regulations respecting it. Several subsequent Acts have been passed on the subject; but by the 55 Geo. III. c. 99, the practice was expressly abolished in London and its neighbourhood, and in other places it has fallen into disuse. There was also an assize of wood and coal (34 & 35 Henry VIII. c. 3); and so late as the reign of Queen Anne, we find an Act (9 Anne, c. 20) enforcing former regulations for the assize of billet. Besides these, various other articles—wine, fish, tiles, cloths, &c., have at different times been subject to assize. The object of these regulations was the prevention of fraud and monopoly; and it is not surprising that in the early stages of legislation it should have appeared to be one of the first duties of government to secure to its subjects the prime necessaries of life at a reasonable and uniform rate. But subsequent experience and more enlightened views have shown, that to attempt to fix by law the prices of commodities, is not only useless and mischievous, but in most cases impracticable; and that when government has established an uniform scale of weights and measures, and, so far as it can be done, an uniform measure of value, the rest may safely be left to competition, and to the mutual bargaining which takes place between the buyer and the seller.

3. The word assize is also used to denote the peculiar kind of jury by whom the writ of right was formerly tried, who were called the grand assize. The trial by the *grand assize* is said to have been devised by Chief Justice Glanville, in the reign of Henry II., and was a great improvement upon the trial by judicial combat, which it in a great degree superseded. Instead of being left to the senseless and barbarous determination by battle, which had previously been the only mode of deciding a writ of right, the alternative of a trial by the grand assize was offered to the tenant or defendant. Upon his choosing this mode of trial, a writ issued to the sheriff directing him to return four knights, by whom twelve others were to be elected, and the whole sixteen composed the jury, or grand assize by whom the matter of right was tried. The stat. 3 & 4 Will. IV. c. 27, has abolished this mode of trial, the cumbrous machinery of which was entirely unfit for the habits of modern society. [JURY.] The jury in criminal cases in Scotland, which is fifteen in number, are still technically called the assize.

4. The common and popular use of the term assize, at the present day in England, is to denote the sessions of the judges of the superior courts, holden periodically in each county for the purpose of administering civil and criminal justice. These assemblies no doubt originally derived their denomination from the business which was at first exclusively imposed upon them, namely, the trial of writs of assize. According to the common law, assizes could only be taken (that is, writs of assize could only be tried) by the judges sitting in term at Westminster, or before the justices in eyre at their septennial circuits. This course was productive of great delay to suitors, and much vexation and expense to the juries, or grand assize, who might have to travel from Cornwall or Northumberland, to appear in court at Westminster. To remedy this grievance, it was provided by Magna Charta, in 1225, that the judges should visit each county once in every year, to take assizes of novel disseisin and mort d'ancestor. From this provision the name of justices of assize was derived; and by several later Acts of parliament various authorities have been given to them by that denomination. The 13 Edward I. c. 3, (stat. of Westminster the second,) enacted that the justices of assize for each shire should be two sworn judges, associating to themselves one or two discreet knights of the county; and they are directed to take the assizes not more than three times in every year. By the same statute, authority is given them to determine inquisitions of trespass and other pleas pleaded in the courts of King's Bench and Common Pleas. From this important Act of parliament the jurisdiction of the judges of assize to try civil causes, other than the writs of assize above mentioned, originally arose; and as, with some modifications, it forms the basis of their civil authority at the present day, it may be desirable to endeavour to explain the complex and argumentative process by which the provisions of the statute are practically effected. Besides the general authority to determine civil issues, it was provided by the statute of Westminster 2, that no inquest in a civil action should be taken by the judges of the superior courts when sitting at Westminster unless the judicial writ

which summoned the jury for such inquest appointed a certain day and place for hearing the parties in the county where the cause of action arose. Thus, if a suit arose in Cornwall, the writ from the superior court must direct the sheriff of that county to return a jury at Westminster for the trial of the inquest in the next term, '*unless before*' (*nisi prius*) the term, namely on a certain day specified in the writ, the justices of assize came into Cornwall. This was sure to happen under the directions of a previous clause in the statute, in the course of the vacation before the ensuing term, and the jury were then summoned before the justices of assize in Cornwall, where the trial took place, and the parties avoided all the trouble and expense of conveying their witnesses and juries to London. The jurisdiction of the judges of *nisi prius* is therefore an annexation to their office of justices of assize; and thus, from the alteration in the state of society since the above laws were made, the principal or substantial part of their jurisdiction has, by the abolition of writs of assize, become merely nominal, while their annexed or incidental authority has grown into an institution of immense practical importance.

For several centuries, until a few years ago, the whole of England was divided into six circuits, to each of which two judges of assize were sent twice a year. Previously to 1830, the Welsh counties and the county palatine of Chester were independent of the superior courts at Westminster, and their peculiar judges and assizes were appointed by the crown under the provisions of several statutes. This separation of jurisdiction being found inconvenient, the statute 1 William IV. c. 70 increased the number of judges of the superior courts, and enacted that, in future, assizes should be held for the trial and despatch of all matters criminal and civil within the county of Chester and the principality of Wales under commissions issued in the same manner as in the counties of England. Since the passing of this statute, therefore, the assizes throughout the whole of England and Wales (excepting London and Middlesex, where the administration of justice is regulated by custom and Acts of parliament) have been holden twice a year in each county upon a uniform system. In addition to these ordinary assizes, a third assize for the trial of criminals has for the last ten years taken place in the more populous counties.

The judges upon the several circuits derive their civil authority ultimately from the ancient statutes of assize and *nisi prius* in the manner before described; but they have also a commission of assize which is issued for each circuit by the crown under the great seal. This commission pursues the authority originally given by Magna Charta and the statutes of *nisi prius*, and seems to have been nearly in the same form ever since the passing of those statutes. It is directed to two of the judges and to the Queen's counsel (13 & 14 Vict. c. 25), and serjeants, the latter deriving their authority to be judges of assize from the statute 14 Edward III. c. 16, which mentions "the king's serjeant sworn," under which words Lord Coke (2 Inst. 422) says that any serjeant at law is intended, and commands them "to take all the assizes, juries, and certificates, before whatever justices arraigned." Under the direct authority given by these words, the commissioners have in modern times nothing to do, the "assizes, juries, and certificates" mentioned in the commission having only a technical reference to the writs of assize, now wholly discontinued. It is stated in most of the common text books that the judges of assize have also a *commission* of *nisi prius*. This is, however, a mistake, no such commission being known in our law, and the only *authority* of the judges to try civil causes being annexed to their office of justices of assize in the manner above described.

In certain cases, the justices of assize, as such, have by statute a criminal jurisdiction; but the most important part of their criminal authority is derived from other commissions. The first of these is a general commission of Oyer and Terminer for each circuit, which is directed to the lord chancellor, several officers of state, resident noblemen and magistrates, and the queen's counsel and serjeants on their respective circuits; but the judges, queen's counsel, and serjeants, are always of the quorum, so that the other commissioners cannot act without one of them. This commission gives the judges of assize express power to try treason, felony, and a great variety of offences against the law of England, committed within the several counties composing their circuit. [OYER AND TERMINER.]

The judges of assize have also commissions of gaol delivery, which in their legal effect give them several powers, which, as justices of Oyer and Terminer only, they would not possess. They are directed to the judges, the queen's counsel, and serjeants on the circuit, and the clerk of assize and associate. Every description of offence is cognizable under this commission; but the commissioners are not authorised to try any persons except such as are in actual or constructive confinement in the gaol specifically mentioned in their commission. There is a distinct commission under the great seal for the delivery of the prisoners in each particular gaol. [GAOL DELIVERY.]

In addition to the above authorities, the judges on the circuit are also fortified by the commission of the peace. The judges of the three superior courts of common law, for the time being, are always inserted in the commissions of the peace periodically issued for each English county; and consequently they may exercise all the powers and functions communicated by the commissions of the particular counties which compose their respective circuits.

The judges on circuit have also authority to try by a jury of the county to which they are sent, issues joined in the Court of Probate and in the Court for Divorce and Matrimonial Causes. [PROBATE; DIVORCE.]

In practice, the judges of the courts at Westminster choose their circuits by arrangement among themselves on each separate occasion. They are then formally appointed by the crown under the sign manual; and the several commissions are afterwards made out in the Crown Office of the Court of Chancery from a fiat of the lord chancellor.

ASSOCIATION is one of the mental phenomena. It does not rank among the primary powers of the mind, like sensation, perception, and judgment, because it does not form one of the separate steps of all mental operations; nor do its functions consist, like those of memory, in re-embodying past impressions. It acts as an agent to all these powers, though not a power itself. The office which it performs is to connect and arrange rather than to originate ideas. By its influence over the sensations, perceptions, and judgments, it regulates the succession of the thoughts. When one thought is suggested by another, or when a train of past images is summoned by something present, whether spontaneously or by an exertion of memory, the process by which this effort is made is called association. Dr. Brown has designated it "the principle of suggestion:" a term which, if its operations were discriminative and voluntary, would be preferable to the one in present use. But suggestion implies deliberation, choice; whereas, it is the province of association to awaken perceptions, not to perceive; to link the thoughts, not to think; to lead the memory to successive images and trains of ideas, between which there is a bond of connection, not always obvious, but when discovered, traceable to one or other of those affinities, analogies, or contrasts by which the principle of association acts. Mr. Hume was the first writer who traced the influences of our associations to certain principles, which he denominated "resemblance, contiguity in time or place, and cause or effect." "Contrast" has since been added to these, which completes the classification of those sympathies and predilections, seated in the mind and acting with all the force and certainty of established laws.

It is not pretended that there may not be large classes of our associations not referable to any of these principles, such as the names of things, the terms of art, the words by which we designate moral and intellectual qualities and operations; in short, the whole vocabulary of language, in which there is little or no connection either in the way of resemblance, contiguity, cause, effect, or contrast with the objects or ideas represented, although none of them ever fail to summon up the images of the things for which they stand. Anomalies like this, when reducible to certain limits, establish rather than invalidate the laws to which they form an exception. Even the terms of a language, when once connected with their representative objects, offer one of the most remarkable illustrations of simple association. In the word *flower*, for instance, there is nothing to stamp upon the mind any particular image. To one who was ignorant of language it would convey no idea; but let the word be explained, let it once be associated with its representative genus of objects, and it instantly calls up the picture of some beautiful plant in blossom whenever the name is seen or pronounced. The distinction between association and memory is here plainly visible. The knowledge of the term *flower* is an act of memory; the knowledge of the object which it represents implies also an act of memory; but the connection between the name and the object, and still more, between the name and the particular flower that blooms before the mind's eye, are the results of association.

Mr. Hume has annexed to his enunciation of the three principles above enumerated an example illustrative of each. "That these principles," he observes, "serve to connect ideas will not, I believe, be much doubted. A picture naturally leads our thoughts to the original. The mention of one apartment in a building naturally introduces an inquiry or discourse concerning the others. And if we think of a wound, we can scarce forbear reflecting on the pain which follows it." The first of these illustrations is founded upon the law of resemblance; the second, upon the law of contiguity; the third, upon the law of causation. "But," continues he, "that this enumeration is complete, and that there are no other principles of association except these, may be difficult to prove to the satisfaction of the reader, or even to a man's own satisfaction."

To whatever principles or laws we ascribe the association of ideas, it is evident enough that there is not only a bond of connection amongst them, but a bond of order. The greatest irregularity and confusion would obviously prevail in our mental operations, without some regulating principle. That principle is association. It is to mind what the law of attraction is to matter. It draws together ideas connected by common affinities, and repels others that cannot coalesce. When we contemplate the vast number of different impressions made upon the mind in the course of every day, which have to be referred to again, what a confusion would be created, were there not some property in the ideas by which they arrange themselves according to certain invariable laws and relations, designed not only to preserve them, but to promote their restoration at a future period. This reproduction of our thoughts in so perfect a manner, in the order in which they are wanted, comprises one, and not the least remarkable, of the phenomena of association. Most of our ideas are reproduced with facility, but occasionally it is with difficulty they are recovered, owing either to indistinctness in the original impression, or to an imperfection of the associating faculty itself, which is not equally acute in every individual, nor equally active at all times in the same individual.

Sometimes trains of associations *involuntarily* convey the thoughts to subjects foreign to our wishes. They run away, as it were, with our ideas; and, regardless of the unities of time or place, awaken images and recollections which not only startle us by their abruptness, but occasion us at times no little trouble to account for their presence. This mental phenomenon admits of easy explanation. While the volitions of thought are intensely directed to a particular subject, the associations act in subordination to that which is, for the time, "the ruling idea of the mind;" when this mental intensity subsides, and the attention ceases to concentrate the faculties of thought, the mind relapses into that desultory state which is its ordinary mood in the absence of excitement. Hence the attention which fixes the thoughts controls the associations; the relaxation of attention which allows the thoughts to wander, grants the same license to the associations. A striking illustration of this fact is to be found in what are called reveries—a state of mental ennui, in which the mind shrinks from exertion, and resigns itself to the guidance of the associations. In sleep, this emancipation from mental direction is still more complete; in consequence of which, the order and perspicuity of thought, so conspicuous while attention presides over intellectual exertion, are deranged. Strange contradictions and anomalies present themselves, announcing the suspension of that faculty whose office it is to restrain the wild and involuntary action of the associating power.

It should be added, however, that, although our associations roam at large during slumber, and although they may occasionally refuse to come and go at our bidding at other moments, yet they are capable of being controlled and regulated to a very high degree. A habit of attention is the governing power. Attention implies abstraction from desultory thoughts, and the act of mental direction to a particular subject. The influence of this habit keeps the associations under control; the want of it renders our waking thoughts little less incongruous than the dreams of sleep. It is one of the singular properties of association, that it acts upon the moral as strongly as upon the intellectual part of our nature. Not to speak of its influence upon the generous and noble dispositions of the mind, the passions are perverted by an unlicensed association of ideas. Mr. Locke gives an example of this tendency, in reference to the origin of superstitious fear—a weakness less prevalent in the present than in the past generation. He alludes to the vulgar belief in ghosts as spirits of the night. "The ideas of goblins and sprites have really no more to do with darkness than with light; yet let but a foolish maid inculcate these often on the mind of a child, and raise them there together, possibly he shall never be able to separate them again as long as he lives; but darkness shall ever afterwards bring with it those frightful ideas, and they shall be so joined that he can no more bear the one than the other.'

To avoid this and other errors to which the mind is exposed by an undisciplined use of the associating faculty, the greatest pains ought to be taken to render it not only subordinate but obedient to reason; to place it under the guard of attention, and to fill the intellectual storehouse with such ideas as shall only awaken pure and pleasing associations.

In relation to the phenomena of associations, it is worthy of remark, that we are indebted to modern philosophy for the development, if not for the discovery, of them all. The original elucidation of the principle is ascribed to Mr. Locke, who, in one of the later editions of his 'Essay on the Human Understanding,' added a new chapter entitled 'Of the Association of Ideas,' in which the laws of this power are noticed and some of its phenomena explained. Soon after, Dr. Hartley, in his 'Observations on Man,' investigated the principle more thoroughly, and carried its application from simple ideas to the actions and affections, tracing all the intellectual and moral phenomena up to this source. Mr. Hume, in one of his 'Essays,' published almost contemporaneously, showed that the three connecting principles of all ideas are the relations of resemblance, contiguity, and causation, to which some subsequent writer appended a fourth—namely, contrast. In the works of these philosophers is comprised all that is known in reference to the doctrine of association, later writers having done little more than expand or illustrate the views of their predecessors.

ASSONANCE, *assonancia*, in Spanish romantic and dramatic and in several species of lyric poetry, is a peculiar correspondence in sound in the termination of verses, less complete than that of rhyme. In rhyme (called in Spanish *consonancia*) the vowel in the last accented syllable and all the subsequent consonants and vowels are required to be the same as in the co-rhyming verse; but in *assonance*, though the vowels of the last accented syllable and in all subsequent syllables are the same, the consonants may and ought to be different. Thus, *bárbaro*, which has the accent on the antepenultima, is an assonant with *cálamo* and *plátano*. *Búscas*, which is accented on the penultima, is an assonant with *cúran* and *súya*. (So, in English, *hardy*, *manly*, and *carry*, would be assonants; in German, *toben*, *hoffte*, *oder*.) Corazón, which is accented on the last syllable, is assonant with amór, españól, flor, voz.

Assonants are not, like rhymes, exhibited in insulated pairs, but are continued through the whole poem, or, in dramatic compositions, through an entire act or day (*jornada*), without any other change than the alternation of blank verse with the assonants. Thus, the first, third, fifth, seventh lines, &c., of the act are blank verse, and the second, fourth, sixth, and eighth lines, &c., are all assonants to each other; unless indeed the blank line and the assonanted line which follows it be considered as constituting one long line, terminating with an *asonante*, as in the Arabian prototype supposed to be discovered by Sarmiento in some of the metrical parts of the Koran.

But for this constant recurrence of the same assonance through a long succession of alternate lines, the ear would probably be little struck with this faint species of rhyme, even when proceeding from the mouth of a Spaniard, in which the vowels are so fully and broadly sounded, without being contracted by the use of double consonants, which, while they add to the brilliancy of Italian versification, appear to render it less susceptible of this delicate species of embellishment, so peculiarly adapted to the use of the drama, for which rhyme is perhaps too prominent and too ostentatious an ornament.

Calderón, and the other classical dramatists of Spain, always use *asonantes*. The *asonante* of the drama is that in which the accent is on the penultima, the verse consisting of eight syllables.

In lyric poetry, rhyme is more frequently adopted; but the *endecha*, a species of elegy, and some other lyric measures, require the assonant. The following extracts from romances contain lines alternately blank and assonanted, as is always the case in romantic and in dramatic poetry. In the first of these examples the accent is on the penultima; in the second, on the last syllable:—

Salió el gallardo Aliatar
Con cien Moriscos gall*a*rd*o*s
En defensa de Motril
Y socorro de su herm*a*n*o*.

A caballo salió el Moro,
Y otro dia desdich*a*d*o*
En negras andas le vuelven
Por donde salió á cab*a*ll*o*.

Maldeciré mi hermosura,
Y tambien mi moced*a*d,
Maldeciré el triste dia
Que con vos quise cas*a*r.

The next is an example of double assonants:—

Aguárdate, dixo el p*a*v*o*
Al cuervo de l*é*j*o*s.
¿Sabes lo que estoi pens*a*nd*o*?
Que eres negro y f*e*o.

Escucha; tambien rep*a*r*o*,
Le gritó mas r*e*ci*o*,
En que eres un paxarr*a*c*o*
De mui mal agü*e*r*o*. *Yriarte.*

ASSUMPSIT is the technical term denoting one of those specific forms of action which were provided, at a very early period of the history of English law, as the course by which redress for particular injuries must be pursued. It was so called from the past tense of the Latin word *assumo*, barbarously applied to signify 'I undertake;' being taken from the use of this word, describing the defendant's undertaking, in the old Latin pleadings. The form was "that in consideration that the plaintiff had furnished goods to the defendant, the latter undertook, or rather took upon himself (*super se assumpsit*) to pay the former so much money." The action of *indebitatus assumpsit* was used for the recovery of damages occasioned by the breach of a simple contract; being preferred to the more proper action of *debt*, for technical reasons, which have long ceased to operate. *Assumpsit* is maintainable where there has been an express promise to pay money (as in the case of a promissory note), or to do any other act; or in circumstances from which the law implies a contract. An example of the latter occurs in the familiar instance of the delivery of goods by a tradesman to a customer; in which case, though no express promise to that effect has been made, it is an inference of law that the customer has promised to pay for them as much as they are worth; and, accordingly, the plaintiff's declaration, or formal relation of his cause of action, would state the debt generally, and also an *actual* promise to pay it. This would be called an *assumpsit* on a *quantum valebant*. If the consideration were the personal services of the plaintiff, given for the benefit of the employer, the latter is supposed to promise to pay as much as the plaintiff 'reasonably deserved to have;' and then the action is called an *assumpsit* upon a *quantum meruit*. So also the character and relative situations of parties will often raise a legal liability, from which an *assumpsit* or undertaking will be implied in the absence of any express contract. Thus, an innkeeper is bound to secure the goods of his guests; the law consequently supposes him to promise to do so; and therefore if the goods are lost or injured, he is liable to an action of *assumpsit* for the damage which the owner has sustained. In like manner, it is the duty of surgeons and attorneys to use proper care and skill in the service of those who employ them, and being supposed to promise to do so, they are liable to be called upon in an action of *assumpsit* to make compensation in damages for any negligence or want of skill.

(Blackst.' Comm.' Mr. Kerr's ed. viii. pp. 165—173, and 368.)

ASSURANCE. Of late years it has become usual with writers on life contingencies to speak of *assurances* upon lives, instead of *insurances*, reserving the latter term for contingencies not depending on life, as against fire, losses at sea, &c. [INSURANCE, ANNUITIES, &c.]

ASSYRIAN ARCHITECTURE. The architecture of Assyria, including that of Babylon, will be treated of under NINEVEH, ARCHITECTURE OF.

ASTARTE, Achtoret or Ashtaroth, sometimes called Syria Dea, the Syrian Goddess, one of the deities of Phœnicia, of whose attributes and character we are unable to give a detailed account from the scantiness of the information transmitted respecting her; but who is generally regarded as corresponding with the APHRODITE of the Greeks. The author of the treatise 'De Deâ Syriâ,' usually ascribed to Lucian, says, that Astarte is the same as the Greek Selene (moon); but Cicero ('Nat. Deor.' iii. 23) considers her as the fourth Venus, the wife of Adonis; and if so Lucian says she had temples at Byblis and Lebanus, but he distinguishes her from Astarte. The Romans introduced her as Astarte, making her sometimes the same as Juno, and at others as Diana or Venus. A Roman altar was discovered in 1749, at Corbridge in Northumberland, with a Greek inscription, stating that it was dedicated by Pulcher to Astarte; two engravings of it were given in the 'Archæologia,' vol. ii. pl. 4, vol. iii. pl. 17. Herodian (v. 15) tells us that the Africans call her Urania, which, however, is a Greek name, and the Phœnicians, Astroarche (queen of stars). By others she is thought to be the Here (Juno) of the Greeks, but we think the opinion of Cicero is most consistent with the few facts we know respecting her, and that she was nothing else than the planet Venus, whom the Phœnicians worshipped as Astarte. She is frequently mentioned in the Holy Scriptures in connection with Baal, as seducing the Israelites from their duty. (Judges, ii. 13; 1 Sam. vii. 3, 4, xii. 10 where she is called Ashtaroth in the authorised translation.) Astarte had a magnificent temple at Sidon, where she seems to have been the principal divinity. Solomon is said (1 Kings, xi. 5) to have "gone after Ashtoreth, the goddess of the Zidonians." In Judges, iii. 7, Israel is said to have "served Baalim and the groves," and Ashtaroth is supposed to have been the idol of the groves. Jahn says that whenever the worship of, or in, groves is mentioned in the Old Testament, the moon or Ashtaroth is meant, and hence the order to cut down the groves in Exod. xxxiv. 13, and Deut. vii. 8. Some mythologists speak of Hierapolis in Syria as the central point of her worship, but they have confounded her with Derceto, who was the Dagon of the Philistines. The island of Cyprus received her religious rites from Phœnicia, and this divinity became known there as Aphrodite. The rose and the lotus were sacred to her, and, among animals, the lion, the horse, the boar, the lobster, and the pigeon. The temple of Venus at Ascalon, mentioned by Herodotus (I. 105), was, there can be little doubt, a temple of Ashtaroth; in 1 Sam. xxxi. 10, Saul's armour is stated to have been placed by the Philistines in the house of Ashtaroth.

(Selden, *De Diis Syriis*, 244; Höck, *Creta*, Göttingen, 1823; Münter, *Der Tempel der Himmlischen Göttinn zu Paphos*, Kopenhag, 1824.)

ASTERISM, *a collection of stars*, formerly used for *constellation*, but now appropriated to signify any small cluster, which it is either desirable to distinguish from the rest of the constellation in which it lies, or which is not a part of any particular constellation.

ASTEROIDS. This term is usually applied to the group of small planets revolving between Mars and Jupiter, which have been discovered during the course of the present century, and more especially within the last few years. Any person who attentively considers the relative magnitudes of the orbits of the older planets, will have no difficulty in perceiving that there exists a comparatively wider gap between the orbits of Mars and Jupiter than in the case of any other two consecutive planets. Kepler, who did not fail to remark this anomalous fact, found that it offered an insurmountable obstacle to the success of his researches, while engaged, during the early period of his career, in attempting to connect together the mean distances of the planets from the sun by some general law. He finally hazarded the bold conjecture that a planet really existed between the orbits of Mars and Jupiter, and that the circumstance of its not being visible was due to its extreme smallness. This idea of Kepler's was supported by many eminent German philosophers and astronomers of the last century, including Kant and Lambert, and it acquired an accession of plausibility from the discovery of an empiric formula, usually known as Bode's law of the planetary distances, but which is, in reality, due not to Bode, but to Titius of Würtemberg. Supposing the mean distance of the earth from the sun to be represented by unity, this formula leads to the following numerical results with respect to the mean distances of the planets from the same body. We exclude from this list the planets Uranus and Neptune, which had not been discovered at the time to which our remarks refer.

Name of Planet.			Mean Distance from the Sun.
Mercury	4 + 0	=	4
Venus	4 + 3	=	7
The Earth	4 + 6	=	10
Mars	4 + 12	=	16
Hypothetic planet	4 + 24	=	28
Jupiter	4 + 48	=	52
Saturn	4 + 96	=	100

The law of these numbers is obvious. Now, if we express in terms of the same unit the real mean distances of the planets which were known to exist, we obtain the following results:

Name of Planet.	Mean Distance from the Sun.
Mercury	3·87
Venus	7·23
The Earth	10·00
Mars	15·23
* * * * * *	* * *
Jupiter	52·03
Saturn	95·39

A comparison of the two foregoing tables serves to exhibit the close agreement which presented itself between the actual and hypothetical distances of the planets. It also plainly indicates the necessity which existed for the discovery of an additional planet between Mars and Jupiter, in order that the system of planetary distances should acquire the character of a complete expression of Bode's law.

The discovery of Uranus in 1781, served still further to increase the probability of the existence of such a planet. According to Bode's law the mean distance (see the first of the two foregoing tables) of the next planet beyond Saturn would be $4 + 192 = 196$. The real distance was found to be 191·83.

At length the period arrived which was to be signalised by the discovery of the long suspected planet. On the night of January 1, 1801, Piazzi, the celebrated Italian astronomer, in the course of his labours at the Palermo Observatory, determined the position of a small star in the constellation Taurus, which he found, a few days afterwards, to have a retrograde motion in the zodiac. His impression was that the moveable body was in reality a comet, although it exhibited none of the usual features of such bodies, and for some time after its discovery he refrained from communicating to astronomers its apparent position, in all probability with the view of being himself enabled in the first instance to deduce from them the elements of its orbit. He continued to observe the strange body from night to night down to the 11th of February, when his further labours were interrupted by an illness. In the meantime he had transmitted to Oriani, Bode, and Lalande, some results of his observations, but before they reached either of those astronomers it was found that the moveable body had approached too near the sun to admit of obtaining any further determinations of its position. It plainly appeared, however, from a discussion of Piazzi's observations, that the object discovered was in reality a planet revolving in the region between Mars and Jupiter, in accordance with Bode's law. Gauss, who had just entered on his brilliant career as a theoretical astronomer, having obtained possession of Piazzi's observations, determined the elliptic elements of the planet's orbit by a method of his own invention, and calculated an ephemeris of its motion, for the purpose of aiding in its re-discovery. In the month of September the planet, according to Gauss's calculations, had sufficiently emerged from the rays of the sun to hold out a hope of its detection; and an active search for it was forthwith instituted at various observatories throughout Europe. This was a much more troublesome operation than a similar search would be in the present day, when so many excellent charts are available to the observer. On the 7th of December, von Zach, who then held the appointment of Director of the Observatory at Seeberg, obtained a trace of the planet, but a continuance of cloudy weather prevented him from verifying his observation until the 31st of the same month, when he obtained a complete assurance of his re-discovery of the body. Olbers, the celebrated astronomer also re-discovered it, independently, on the following evening at Bremen. Piazzi, the discoverer upon whom devolved the right of naming the planet, bestowed on it the appellation of Ceres Ferdinandea, but the latter epithet, proposed by him as a compliment to his sovereign and patron, speedily fell into disuse, and the appropriate name of Ceres, in allusion to the titular deity of Sicily, was alone retained.

Pallas, the second of the group of minor planets, was discovered by Olbers, on the 28th of March, 1802. Its orbit was calculated by Gauss, who found its mean distance from the sun to be 2·670, agreeing very nearly with the mean distance of Ceres. The inclination of its orbit to the ecliptic was, however, still greater than in the cases of the last-mentioned planet, amounting to so much as 34° 49′. It was also remarkable for the great eccentricity of its orbit, which was equal to 0·24764, exceeding in this respect any of the planets hitherto discovered.

From the circumstance of two planets of very small magnitude having been discovered with nearly equal mean distances from the sun, and with inclinations greatly exceeding those of the older planets, Olbers was led to entertain the curious notion that the two bodies might be in reality fragments of some larger planet which had suffered an explosion from some internal convulsion, and he suggested that many more of such fragments might be found revolving in the same region. He remarked further that, if this hypothesis were true, the orbits of the various fragments might obviously have very different inclinations with respect to each other and to the ecliptic, but that they would all have two common points of intersection in opposite regions of the heavens. These two points were found, in the case of the two newly-discovered planets, to be situate in the constellations of Virgo and the Whale. He accordingly proposed, with a view to the discovery of further fragments of the planet, that a careful examination should be undertaken, and henceforward uninterruptedly maintained, of the regions in those two constellations which included the common points of intersection of the orbits of the two bodies. In the meantime, his views received additional support from the discovery of a third planet, Juno, by Harding, at Lilienthal, on the 2nd of September, 1804. The new planet was discovered in the constellation Pisces, near the region in the Whale through which Olbers had maintained that the fragments of the shattered planet would necessarily pass.

Olbers continued with unwearied perseverance to explore the two opposite regions of the heavens in which he expected to discover further fragments of his supposed shattered planet. At length, on the 28th of March, 1807, his efforts were rewarded by the discovery of another planet, Vesta, in the north wing of the constellation Virgo, one of the regions of the heavens in which he expected to effect such a discovery. The mean distance, as determined by the calculations of Gauss, plainly indicated that it belonged to the group of new planets between Mars and Jupiter. In accordance with his hypothesis, Olbers continued for several years after his discovery of Vesta to search for further fragments of the shattered planet, confining his attention to the two opposite regions through which he expected that they would in each instance necessarily pass in the course of their revolution around the sun, but no new triumph rewarded his labours. Subsequent discoveries have not served to confirm the somewhat fanciful idea upon which his system of observation was founded.

The new planets were found to be excessively small, exhibiting hardly an appreciable apparent magnitude even when viewed in the most powerful telescopes. Sir William Herschel having measured the apparent diameter of Ceres under favourable circumstances, found that at the mean distance of the sun from the earth it would subtend an angle of $0''\cdot35$, whence it was easy to infer that the absolute diameter of the planet amounted to 161 miles. In a similar way he found that the absolute diameter of Pallas was not more than 110 miles.

In consequence of the strong resemblance which the new planets bore to each other, both in size and in the forms and positions of their orbits, and the contrast which they offered in these respects to the older planets, Herschel proposed that they should be called *Asteroids* rather than planets. This mode of designation was favourably received, and is now generally applied to those bodies.

With the exception of Olbers himself, it does not appear that any contemporary astronomer was induced to undertake a systematic exploration of the heavens in search of new asteroids. The want of good star-charts rendered all operations of this kind exceedingly laborious during the early period of the present century. In the year 1825, however, a circumstance occurred which was destined to exercise an important influence on the progress of such researches. This consisted in a proposal on the part of the Berlin Academy to construct a series of star-charts, on which should be laid down all the stars to the ninth magnitude inclusive, comprised in the region of the heavens which extends to a distance of 15° on each side of the equator. It was arranged that the zone in question should be divided into twenty-four parts, corresponding to the twenty-four hours of right ascension; and astronomers of all countries were invited to unite in carrying this project into effect, each co-operating astronomer undertaking the execution of one hour of right ascension. The views of the Berlin Academy met with a favourable response from astronomers, and although only a short time has elapsed since they were carried into complete effect by the construction of the last of the twenty-four charts constituting the zone, still the publication of the individual charts from time to time was productive of important results.

The utility of star-maps in searching for new planets is obvious enough. The observer compares his map with the corresponding region of the heavens. If a star should appear in the heavens which is not inserted in the map it may be presumed to be a planet which has wandered into the region of the map since the epoch of its construction. On the other hand if one of the stars in the map should be missing in the heavens, it may be reasonably supposed that the object is in reality a planet which was laid down as a fixed star at the time of the construction of the map, and has subsequently travelled entirely out of the region to which the map corresponds. The observer, aided by this clue, then proceeds to explore the heavens in the immediate vicinity of the region of the map with the hope of discovering the missing object.

It is plain from the foregoing remarks that trustworthy star-charts are indispensable in searching for new planets. The Berlin charts were obviously very valuable for this purpose, since they included stars of a magnitude considerably inferior to that exhibited by the newly discovered asteroids. It was probably from a consideration of the advantages offered by these charts in the exploration of the heavens, that M. Hencke, an amateur astronomer, residing at Driesen in Germany, was induced in the year 1830, to undertake a search for further asteroids. After devoting fifteen years to a persevering scrutiny of the heavens his labours were finally rewarded by the discovery of a fifth asteroid, Astræa, on the 8th of December, 1845; and two years afterwards, on the 1st of July, 1847, by the discovery of a sixth asteroid, Hebe.

Henceforward the progress of discovery has continued without interruption down to the present time. The aggregate number of asteroids ascertained to exist at the time when this sheet is passing through the press (1859, March 15), amounts to fifty-six. It is usual to characterise each asteroid by the number, enclosed in a circle, indicative of its rank in the order of discovery. The following is a complete list of the various discoveries.

Planet.	Date of Discovery.	Name of Discoverer.	Place of Discovery.
1 Ceres	1801, January 1	Piazzi	Palermo
2 Pallas	1802, March 28	Olbers	Bremen
3 Juno	1804, September 1	Harding	Lilienthal
4 Vesta	1807, March 29	Olbers	Bremen
5 Astræa	1845, December 8	Hencke	Driesen
6 Hebe	1847, July 1	Hencke	Driesen
7 Iris	1847, August 13	Hind	London
8 Flora	1847, October 18	Hind	London
9 Metis	1848, April 25	Graham	Markree
10 Hygeia	1849, April 12	De Gasparis	Naples
11 Parthenope	1850, May 11	De Gasparis	Naples
12 Victoria	1850, September 13	Hind	London
13 Egeria	1850, November 2	De Gasparis	Naples
14 Irene *	1851, May 19	Hind	London
15 Eunomia	1851, July 29	De Gasparis	Naples
16 Psyche	1852, March 17	De Gasparis	Naples
17 Thetis	1852, April 17	Luther	Bilk
18 Melpomene	1852, June 24	Hind	London
19 Fortuna	1852, August 22	Hind	London
20 Massalia †	1852, September 19	De Gasparis	Naples
21 Lutetia	1852, November 15	Goldschmidt	Paris
22 Calliope	1852, November 16	Hind	London
23 Thalia	1852, December 15	Hind	London
24 Themis	1853, April 5	De Gasparis	Naples
25 Phocea	1853, April 6	Chacornac	Marseilles
26 Proserpine	1853, May 5	Luther	Bilk
27 Euterpe	1853, November 8	Hind	London
28 Bellona	1854, March 1	Luther	Bilk
29 Amphitrite ‡	1854, March 1	Marth	London
30 Urania	1854, July 22	Hind	London
31 Euphrosyne	1854, September 1	Ferguson	Washington
32 Pomona	1854, October 26	Goldschmidt	Paris
33 Polyhymnia	1854, October 28	Chacornac	Paris
34 Circe	1855, April 6	Chacornac	Paris
35 Leucothea	1855, April 19	Luther	Bilk
36 Fides	1855, October 5	Luther	Bilk
37 Atalanta	1855, October 5	Goldschmidt	Paris
38 Leda	1856, January 12	Chacornac	Paris
39 Lætitia	1856, February 8	Chacornac	Paris
40 Harmonia	1856, March 31	Goldschmidt	Paris
41 Daphne	1856, May 22	Goldschmidt	Paris
42 Isis	1856, May 23	Pogson	Oxford
43 Ariadne	1857, April 15	Pogson	Oxford
44 Nysa	1857, May 27	Goldschmidt	Paris
45 Eugenia	1857, June 28	Goldschmidt	Paris
46 Hestia	1857, August 16	Pogson	Oxford
47 Aglaia	1857, September 15	Luther	Bilk
48 Doris	1857, September 19	Goldschmidt	Paris
49 Pales	1857, September 19	Goldschmidt	Paris
50 Virginia §	1857, October 4	Ferguson	Washington
51 Nemausa	1858, January 22	Laurent	Marseilles
52 Europa	1858, February 6	Goldschmidt	Paris
53 Calypso	1858, April 4	Luther	Bilk
54 Alexandra	1858, September 10	Goldschmidt	Paris
55 Pandora	1858, September 10	Searle	Albany, U.S.
56 * * *	1857, September 9	Goldschmidt	Paris

In the foregoing list the number prefixed to each asteroid indicates the order of discovery. With respect to the fifty-sixth asteroid (which has not yet been named), there appears to be a deviation from this rule, for according to the date of discovery assigned to it in the second column it ought to rank as the forty-seventh in the list. The origin of this apparent inconsistency is interesting. Upon the discovery of

* Discovered independently, although subsequently in respect of time, by M. de Gasparis.

† Discovered independently by M. Chacornac.

‡ Discovered independently by Mr. Pogson, and also by M. Chacornac.

§ Discovered independently by M. Luther.

Daphne, it was found to have already considerably passed opposition (when it is nearest the earth), and that only a few observations of it could be obtained before it was lost in the sun's rays. From the positions thus determined, the elements of the planet's orbit were calculated by M. Pape of Altona, but in consequence of the small extent of the arc on which they rested, it was feared that considerable difficulty would be experienced in rediscovering the planet upon coming to opposition in the following year. However, guided by an ephemeris founded on M. Pape's elements, M. Goldschmidt discovered an asteroid on the 9th of September, 1857, which he supposed to be Daphne, and under the impression that his surmise was correct, a considerable number of positions of the asteroid were obtained at various observatories throughout Europe. It is only within the last few months that M. Ernest Schubert, a German astronomer, has found that the orbit calculated from the observations of 1857 is totally irreconcilable with the positions of Daphne obtained in the previous year. It was plain, therefore, that the observations of 1856 and 1857, referred to two distinct bodies, and that the object discovered by M. Goldschmidt on the 9th of September, 1857, was in reality not Daphne, but a new asteroid. Since the date just mentioned, however, nine additional asteroids had been discovered, to each of which the proper characteristic number had been prefixed. In order, therefore, not to disturb this arrangement, astronomers have agreed to distinguish the asteroid originally observed on the 9th of September, 1857, by the numerical symbol (56). In the mean time, the asteroid Daphne has not been seen since 1856, the year of its discovery.

The ten asteroids attributed to Mr. Hind in the foregoing list, and also the asteroid discovered by M. Marth, were discovered at the observatory of Mr. Bishop, Regent's Park, a gentleman who, by the munificent patronage which he has extended towards astronomy during a long series of years, has earned for himself an honourable name in the annals of science. It is worthy of remark, that M. Goldschmidt, the discoverer of twelve asteroids, is by profession an historical painter. His discoveries have been all made during his leisure hours in the evening, with a telescope of comparatively moderate dimensions fitted up in an apartment of his private residence.

Allusion has been made to the useful services rendered by the Berlin charts in the discovery of asteroids. Recently they have been superseded in so far as this object is concerned by charts of a more limited range, but which include stars of a smaller magnitude. The construction of such charts has been rendered necessary by the faint aspect of the asteroids discovered in recent years (being generally inferior in brightness to stars of the tenth magnitude). It is of course reasonable to suppose that the brighter asteroids would have been detected in the first instance. Charts for the discovery of further asteroids are in the course of being published at the expense of Mr. Bishop. Similar] charts, constructed by M. Chacornac are also emanating from the Imperial Observatory, Paris.

The theory of the movements of the asteroids is almost entirely due to the German astronomers, more especially Gauss, Encke, and Hansen. Upon the discovery of one of those bodies, the first step is to determine the elements of the orbit from a limited number of observations. For this purpose the method given by Gauss in his immortal work, the 'Theoria Motus,' or a modification of it by Encke ('Berlin Jahrbuch,' 1854), is usually employed. The results thus obtained are subsequently corrected by a discussion of all the observations made during the opposition of the asteroid (on which occasion alone it is generally visible), taking into account the effects of perturbation, more especially those due to Jupiter the principal disturbing body. In consequence of the great magnitude of the eccentricities and inclinations of their orbits, the methods usually employed in computing the perturbations of the older planets, are not generally applicable to the asteroids.* It has accordingly been found necessary to have recourse to what has been called the method of quadratures. In other words, instead of computing the perturbations from general formulæ, involving mean values of the elements as determined by the discussion of a long series of observations, the astronomer calculates their numerical effects for a succession of special epochs, by a process not adapted to mean elements (and therefore not admitting of direct application to any time whether past, present, or future), but to osculating elements corresponding to some given epoch. These elements, being used as the starting point of calculation, are subsequently corrected at the close of each of the intervals into which the period of perturbation is divided.

In more recent times MM. Hansen and Encke have devised methods for obtaining general formulæ of perturbation which are applicable to all the asteroids. Tables of Flora founded on formulæ derived from the development of Professor Encke's method, have been calculated by Dr. Brunnow. Professor Hansen has applied his theory to the asteroid Egeria.

The following synopsis [see cols. 644, 645, and 646] of the elements of all the asteroids hitherto discovered has been derived from the Berlin 'Jahrbuch' for 1861, with the exception of the elements of the fifty-sixth asteroid, which have been taken from No. 1175 of the 'Astronomische Nachrichten.' The longitudes, except in the last instance, are invariably referred to the mean equinoxes of their respective epochs. In the case of the fifty-sixth asteroid, the equinox of reference is that of 1857·O.

Name of Asteroid.	Mean Distance from the Sun, the Earth's Distance being represented by unity.	Time of Revolution in Years.	Mean Daily Motion.	Excentricity.	Longitude of the Perihelion.
(8) Flora	2·2014	3·266	1086"·33	0·15670	32°54'28"
(43) Ariadne	2·2038	3·272	1084 ·52	0·16756	277 14 9
(40) Harmonia	2·2679	3·415	1038 ·90	0·04608	0 55 23
(18) Melpomene	2·2958	3·479	1019 ·97	0·21723	15 14 31
(12) Victoria	2·3344	3·567	994 ·83	0·21890	301 39 25
(27) Euterpe	2·3473	3·596	986 ·63	0·17290	87 39 0
(4) Vesta	2·3607	3·627	978 ·22	0·09012	250 20 33
(30) Urania	2·3642	3·635	976 ·07	0·12718	31 23 25
(51) Nemausa	2·3779	3·667	967 ·64	0·06285	190 12 40
(9) Metis	2·3862	3·686	962 ·61	0·12320	71 9 40
(7) Iris	2·3862	3·686	962 ·51	0·23125	41 29 41
(41) Daphne	2·4003	3·719	954 ·11	0·20249	230 21 30
(25) Phocea	2·4023	3·723	952 ·93	0·25335	302 54 41
(20) Massalia	2·4093	3·740	948 ·77	0·14383	98 36 11
(44) Nysa	2·4242	3·774	940 ·08	0·14933	111 37 52
(6) Hebe	2·4254	3·777	939 ·37	0·20115	15 12 36
(21) Lutetia	2·4354	3·801	933 ·56	0·16204	327 2 45
(42) Isis	2·4401	3·812	930 ·89	0·22566	317 57 23
(19) Fortuna	2·4414	3·815	930 ·16	0·15792	30 22 50
(11) Parthenope	2·4526	3·841	923 ·78	0·09888	316 10 7
(17) Thetis	2·4737	3·890	911 ·98	0·12686	259 22 51
(46) Hestia	2·5178	3·995	888 ·12	0·16184	354 25 29
(29) Amphitrite	2·5548	4·084	868 ·87	0·07238	56 39 6
(13) Egeria	2·5756	4·133	858 ·42	0·08775	119 31 17
(5) Astræa	2·5775	4·136	857 ·95	0·18999	134 35 36
(32) Pomona	2·5831	4·160	852 ·86	0·08240	194 22 43
(56) * * *	2·5835	4·152	852 ·80	0·22702	294 57 50
(14) Irene	2·5895	4·167	851 ·49	0·16525	179 26 55
(53) Calypso	2·6102	4·217	841 ·39	0·21263	91 32 43
(23) Thalia	2·6250	4·253	834 ·29	0·23521	123 11 27
(37) Fides	2·6422	4·295	826 ·17	0·17489	66 4 28
(15) Eunomia	2·6429	4·297	825 ·80	0·18801	27 47 12
(50) Virginia	2·6486	4·310	823 ·14	0·28695	10 0 12
(26) Proserpine	2·6556	4·329	819 ·68	0·08752	235 17 27
(3) Juno	2·6687	4·362	813 ·44	0·25590	54 4 48
(34) Circe	2·6839	4·397	806 ·98	0·10961	149 19 1
(54) Alexandra	2·7076	4·553	796 ·39	0·19941	293 39 13
(45) Eugenia	2·7159	4·476	792 ·78	0·08200	228 51 37
(38) Leda	2·7399	4·535	782 ·32	0·15552	100 44 31
(36) Atalanta	2·7487	4·557	778 ·60	0·29788	42 22 25
(1) Ceres	2·7660	4·600	771 ·30	0·08024	149 26 20
(55) Pandora	2·7692	4·608	769 ·96	0·13895	10 9 23
(2) Pallas	2·7700	4·610	769 ·64	0·23969	122 10 3
(39) Lætitia	2·7710	4·613	769 ·20	0·11081	2 7 12
(28) Bellona	2·7784	4·631	766 ·14	0·15039	122 24 28
(33) Polyhymnia	2·8646	4·848	731 ·83	0·33769	340 41 56
(47) Aglaia	2·8831	4·896	724 ·77	0·12788	314 29 19
(22) Calliope	2·9091	4·962	715 ·11	0·10361	58 7 39
(16) Psyche	2·9263	5·006	708 ·80	0·13575	12 30 57
(35) Leucothea	2·9850	5·157	688 ·01	0·22251	198 37 23
(49) Pales	3·0861	5·421	654 ·47	0·23783	32 50 34
(52) Europa	3·0999	5·458	650 ·11	0·00450	102 12 14
(48) Doris	3·1044	5·470	648 ·67	0·07580	77 37 46
(24) Themis	3·1420	5·570	637 ·09	0·11701	139 7 57
(10) Hygeia	3·1494	5·589	634 ·85	0·10056	227 47 59
(31) Euphrosyne	3·1561	5·607	632 ·80	0·21601	93 51 7

It may be remarked that the researches on the perturbations of the asteroids have led to an important correction of the value of Jupiter's mass. Nicolai of Mannheim (Berlin 'Jahrbuch,' 1826) was first led to conclude by a discussion of fifteen oppositions of Juno, that theory was incapable of representing the results of observation, unless the value of Jupiter's mass was increased by about $\frac{1}{80}$th. The generally admitted value of this important element of physical astronomy ($\frac{1}{1070}$) rested on Pound's measures of the elongations of Jupiter's satellites,

* In the case of Vesta, tables have been calculated by Santini and Daussy from general formulæ representing the effects of perturbation. In the 'Connaissance de Temps' for 1846, Damoiseau has given the general formulæ for the perturbations of Juno and Ceres.

which had not been verified by any subsequent astronomer, although the result was supported by Bouvard, who obtained nearly the same value by an application of Laplace's formulæ for the perturbations of Saturn by Jupiter. On the other hand, the researches of Encke on Vesta, and those of Gauss on Pallas, seemed to indicate that some such alteration as that suggested by Nicolai was necessary. The doubt was cleared up by Mr. Airy, who, upon remeasuring the elongations of Jupiter's satellites, found that the observations of Pound were considerably erroneous. The value of Jupiter's mass thus corrected ($\frac{1}{1048}$) has been found to satisfy the results of observation in so far as the perturbations of the asteroids are concerned, although the theory of Saturn would appear still to leave some room for doubt.

The asteroids must be bodies of very inconsiderable magnitude, for notwithstanding their comparative proximity to the earth, they only in a few instances exceed in brightness stars of the eighth magnitude, even when observed at the times of opposition; while, generally speaking, they fall very far below this standard. The following table expresses the brightness of the various asteroids which come to opposition in the year 1859. The numbers in the third column correspond to the time of opposition as given in the second column.

Name of Asteroid.	Inclination to the Ecliptic.	Longitude of the Ascending Node.	Mean Longitude.	Epoch in Berlin Mean Time.	Name of Calculator.
(8) Flora	5° 53′ 8″	110° 17′ 49″	68° 48′ 32″	1848, January 1	Brünnow
(43) Ariadne	3 27 48	264 29 27	224 5 10	1857, April 17	Weiss
(40) Harmonia	4 15 52	93 30 36	213 54 47	1856, June 2	Powalky
(18) Melpomene	10 9 5	150 1 8	95 6 52	1854, January 0	Schubert
(12) Victoria	8 23 19	235 34 42	7 42 5	1851, January 0	Brünnow
(27) Euterpe	1 35 31	93 44 45	260 43 33	1859, June 14	Günther
(4) Vesta	7 8 17	103 25 34	2 25 23	1859, October 5	Encke
(30) Urania	2 5 57	308 13 46	19 30 24	1858, October 9	Günther
(51) Nemausa	10 14 39	175 37 44	172 45 34	1858, March 2·5	Förster
(9) Metis	5 36 0	68 32 12	209 3 14	1859, April 28·5	Wolfers
(7) Iris	5 27 57	259 47 16	114 59 24	1860, February 9	Schubert
(41) Daphne	15 48 23	180 5 51	202 28 48	1856, June 0·5	Pape
(25) Phocea	21 34 54	214 4 15	75 18 53	1858, December 23	Günther
(20) Massalia	0 41 7	206 42 51	318 35 50	1859, August 2	Günther
(44) Nysa	3 41 41	131 1 17	278 9 28	1858, January 0	Powalky
(6) Hebe	14 46 31	138 36 6	15 4 11	1859, September 30	Luther
(21) Lutetia	3 5 11	80 27 14	41 23 9	1853, January 2	Lesser
(42) Isis	8 35 12	84 27 7	276 59 10	1856, July 1	Seeling
(19) Fortuna	1 32 27	211 30 29	150 1 56	1858, March 9	Powalky
(11) Parthenope	4 36 58	125 3 41	283 56 42	1858, June 27	Luther
(17) Thetis	5 35 41	125 27 13	210 1 24	1856, April 4	Schönfield
(46) Hestia	2 17 34	181 30 8	87 48 23	1859, January 0	Karlinsky
(29) Amphitrite	6 7 50	356 26 52	293 11 24	1859, July 9	Günther
(13) Egeria	16 32 24	43 19 29	11 24 13	1858, September 26	Günther
(5) Astræa	5 19 35	141 24 48	80 56 3	1850, January 0	Zech
(32) Pomona	5 29 5	220 48 11	57 34 47	1855, January 5	Lesser
(56) * * *	7 56 2	194 54 56	330 53 2	1857, September 13·0	Luther
(14) Irene	9 7 5	86 40 15	63 39 50	1857, November 5	Bruhns
(53) Calypso	5 7 37	144 15 30	162 13 58	1858, April 10·5	Oeltzen
(23) Thalia	10 13 53	67 55 58	173 39 42	1854, January 0	Schubert
(36) Fides	3 7 10	8 9 37	42 34 35	1856, January 0	Rümker
(15) Eunomia	11 44 5	293 55 42	149 54 18	1854, January 0.	Schubert
(50) Virginia	2 47 54	173 32 19	31 41 26	1858, January 0	Förster
(26) Proserpine	3 35 40	45 53 19	181 21 21	1857, March 20	Hoek
(3) Juno	13 3 3	171 0 59	206 17 51	1859, April 26·5	Bremiker
(34) Circe	5 26 53	184 51 19	210 3 50	1855, June 23	Powalky
(54) Alexandra	11 47 29	313 50 32	324 1 29	1858, September 20·5	Schultz
(45) Eugenia	6 34 55	148 5 0	294 34 54	1858, January 0·0	Löwy
(38) Leda	6 58 26	296 27 35	112 56 20	1856, January 0·0	Allé
(37) Atalanta	18 42 9	359 8 48	36 19 53	1856, January 0·0	Förster
(1) Ceres	10 36 33	80 49 57	346 38 53	1859, September 6·5	Wolfers
(55) Pandora	7 20 44	10 55 30	16 7 49	1858, November 4·5	Möller
(2) Pallas	34 42 33	172 39 19	318 17 8	1859, August 11	Galle
(39) Lætitia	10 21 0	157 19 39	146 43 50	1856, January 1	Allé
(28) Bellona	9 21 24	144 38 58	94 6 20	1857, December 15	Bruhns
(33) Polyhymnia	1 56 48	9 14 30	23 5 48	1855, January 0·0	Pape
(47) Aglaia	5 0 24	4 29 1	11 17 40	1855, January 8·0	Powalky
(22) Calliope	13 44 52	66 36 55	76 59 1	1853, January 0·0	Hornstein
(16) Psyche	3 4 0	150 32 24	313 1 2	1854, July 14·0	Klinkerfues
(35) Leucothea	8 12 4	356 9 56	89 34 29	1858, December 1·25	Schubert
(49) Pales	3 8 30	290 29 29	31 25 4	1858, February 23	Powalky
(52) Europa	7 24 40	129 57 8	136 25 14	1858, January 0·0	Hornstein
(48) Doris	6 29 43	185 14 7	16 2 28	1858, February 3·0	Powalky
(24) Themis	0 48 53	36 9 13	130 4 35	1858, April 14·0	Krüger
(10) Hygeia	3 47 9	287 38 34	354 47 48	1851, September 17·0	Zech
(31) Euphrosyne	26 25 12	31 25 23	53 49 50	1855, January 0·0	Winnecke

Asteroid.	Time of Opposition.	Brightness.
Victoria	January 5	11·1 Magnitude.
Hestia	„ 7	12·0 „
Pales	„ 17	11·3 „
Daphne?	February —	11·5? „
Harmonia	„ 9	9·3 „
Circe	February 17	10·9 Magnitude
Virginia	„ 19	11·5 „
Isis	„ 25	11·7 „
Astræa	March (beginning)	8·7 „
Calliope	„ 19	9·8 „
Irene	„ 25	8·6 „
Themis	April 17	11·7 „
Juno	„ 26	9·8 „
Bellona	„ 27	10·3 „

Asteroid.	Time of Opposition.	Brightness.
Metis	April 27	9·6 Magnitude
Eunomia	May 10	9·4 „
Flora	„ 15	9·7 „
Europa	„ 17	10·0 „
Fortuna	June 4	10·1 „
Euterpe	„ 13	11·1 „
Calypso	„ 17	12·5 „
Melpomene	July 1	9·2 „
Atalanta	„ 3	11·8 „
Amphitrite	„ 9	9·3 „
Thalia	„ 10	11·8 „
Lutetia	„ „	9·5 „
Psyche	„ 24	9·3 „
Massalia	August 1	9·8 „
Nemausa	(beginning)	10·0 „
Pallas	„ 10	9·2 „
Fides	„ 20	10·8 „
Euphrosyne	„ 25	11·8 „
Ceres	September 6	7·8 „
Vesta	October 4	6·9 „
Hebe	„ 12	7·1 „
Proserpine	November 1	11·0 „
Polyhymnia	(beginning)	10·0 „
Leda	„ 7	10·9 „
Parthenope	December 1	9·6 „
Alexandra	(beginning)	11·0? „
Eugenia	„ 18	12·2 „

The asteroids, Iris, Hygeia, Egeria, Thetis, Phocea, Urania, Pomona, Leucothea, Lætitia, Ariadne, Nysa, Aglaja, Doris, and Pandora do not come to opposition in 1859. The asteroid (56) which is not included in the list from which the foregoing numbers are extracted, may be stated to be about the 10·11th magnitude when it comes to opposition.

Since the asteroids exhibit no appreciable discs by the measurement of which their absolute diameters might be determined, as in the case of the other planets, astronomers have endeavoured to accomplish the same object by means of photometric results, founded on their apparent brightness, combined with an assumption relative to their power of reflecting the solar light. Professor Stampfer, of Vienna, has endeavoured in this way to determine the absolute magnitudes of several of the asteroids. By photometric experiments he found that the planets Mercury, Venus, and Jupiter, possess the same capacity for reflecting the solar light. By extending this principle to the asteroids, the following results have been obtained (Bruhns, 'De Planetis Minoribus,' Berlin, 1856) relative to the absolute magnitude of those bodies.

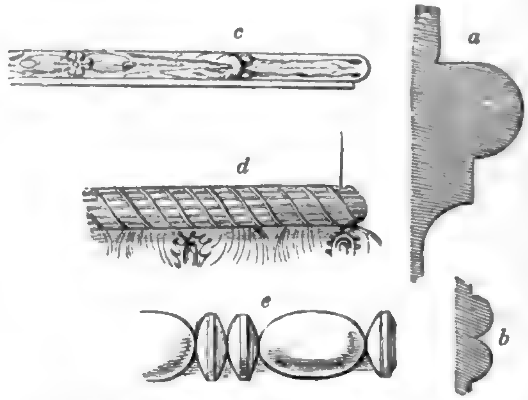
Asteroid.	Diameter in Miles.	Asteroid.	Diameter in Miles.
Ceres	227	Lutetia	40
Pallas	172	Calliope	96
Juno	112	Thalia	42
Vesta	228	Themis	36
Astræa	61	Phocea	31
Hebe	100	Proserpine	47
Iris	96	Euterpe	39
Flora	60	Bellona	59
Metis	76	Amphitrite	83
Hygeia	111	Urania	51
Parthenope	62	Euphrosyne	50
Victoria	41	Pomona	35
Egeria	73	Polyhymnia	38
Irene	68	Circe	29
Eunomia	12	Leucothea	25
Psyche	93	Atalanta	20
Thetis	52	Fides	41
Melpomene	54	Leda	29
Fortuna	61	Lætitia	87
Massalia	68		

No trustworthy conclusion can be arrived at respecting the aggregate number of the asteroids. If, indeed, we suppose them to be all of the average size of those already discovered, we might then be enabled to form some opinion on the subject, for the zone in which they perform their revolutions contains only a definite number of stars of the average apparent magnitude of those bodies. But the more the search for new asteroids is prosecuted and the greater their aggregate number becomes, the smaller the more recently-discovered ones turn out to be, and the obvious inference therefore is, that there probably exist many more of such bodies, which from their minute magnitude have hitherto escaped detection.

But if it is impossible to assign any limit to the number of the asteroids, the result is different when we consider their aggregate mass. In this case it may be ascertained by calculations founded on the theory of gravitation, that if the quantity of matter contained in the totality of those bodies exceeded a certain amount, their attractive force could not fail to produce sensible perturbations in the movements of the neighbouring planets Mars and the earth. M. le Verrier has considered the subject from this point of view. His researches are founded on the twenty-six asteroids which had been hitherto discovered, but the conclusion at which he arrived is equally applicable in the present day. He found that if the aggregate mass of the asteroids was equal to the earth's mass, its attraction would disturb the place of the perihelion of Mars to the extent of 11″ in a century. Now, if there really existed from such a cause a variation in the perihelion of the planet, amounting to even the fourth part of this quantity, it could not escape observation in the present advanced state of practical astronomy. The conclusion therefore is that the aggregate mass of the asteroids does not amount to one-fourth of the earth's mass.

ASTHMA. [BRONCHITIS.]

ASTRAGAL, a moulding used in architecture, and applied principally to the upper ends of the shafts of columns and to their bases. It is also used in the entablatures of the Roman Doric, the Ionic, Corinthian, and Composite orders. The term is derived from the Greek ἀστράγαλος, which signifies the bone on which the tibia rests, and sometimes a vertebra. The form of this moulding is semicircular, projecting from a vertical diameter. The surface is usually worked plain, although there are Roman examples of its being carved to represent leaves, as in the arch of the goldsmiths at Rome, or reeds bound together, as in the pedestal of Trajan's column. The astragal cut into beads is common to Greek and Roman architecture.



Sections of astragal mouldings, and elevations of astragal mouldings carved:—*a*, section of an astragal form the three columns of the temple of Jupiter [Stator], in the Campo Vaccino, at Rome; *b*, astragal used in the base of the Ionic order of the temple of Minerva Polias at Priene; *c*, enriched astragal used in the arch of the goldsmiths at Rome; *d*, enriched astragal of the pedestal of Trajan's column at Rome; *e*, astragal cut into beads.

The apparent use of the astragal is, to bind the parts of columns and entablatures together, for which purpose it is employed both at the top of the shaft where the capital commences, and at the bottom where the base terminates. Many of the parts also of the entablature are bound together with the astragal moulding.

In Egyptian architecture, bands curved after the manner of astragals seem to bind the reeds of which the shaft of the column often appears to be formed. In the choragic monument of Lysicrates at Athens, supposed to be one of the oldest examples of the Corinthian order, it has been conjectured that the hollow between the top of the shaft and the lower part of the capital of the column formerly received a bronze ring of the form of an astragal, by which means, if the conjecture be well founded, the parts, from the contrast of colour, would appear to be more *distinctly bound together*. The most remarkable example of the use of the astragal in Grecian architecture is in the base employed in the Ionic temple of Minerva Polias at Priene; which has been imitated by Mr. Cockerell in the portico in the front of Hanover Chapel, Regent-street. In the temple of Jupiter Olympius, at Athens, the astragal at the top of the column appears to have a channel cut underneath it. (Stuart, vol. iii.) This, however, is very unusual. [COLUMN.]

ASTREA, one of the group of small planets revolving between Mars and Jupiter. [ASTEROIDS.]

ASTRINGENTS (from *astringo*, to constringo, or bring closer together) are agents which contract the fibres of the muscles and blood-vessels, and lessen the flow of fluids, whether it be the secretions of the glands proceeding from their natural orifices in excessive quantity, or the contents of the blood-vessels escaping by their exhalent extremities, or by an unnatural opening (or rupture). They produce this effect, generally by a vital, but sometimes by a chemical action. Their power is manifested first, and often solely, on the part to which they are applied; yet in many instances it is extended by sympathy very rapidly over the whole body, as is observed when the acerb juice of the aloe is brought in contact with the tongue. The sensation then experienced may be considered the best general test of the presence of *astringency*, which cannot be ascribed to any one principle, but is owing to tannin, gallic acid, and hæmatine, in vegetable astringents, and is possessed by acids, and many metallic salts among mineral agents; and is also one of the effects of the application of cold to the body. In vegetables, the astringent principles are found chiefly in the bark (as oak), the root (as rhatany and tormentil), and the wood (as logwood). As wood and bark form parts of *exogenous* trees only, it is only from this section of the vegetable kingdom that any astringent principles can be obtained. [See explanation of the term *exogenous*, under the article AGE OF TREES.] Sir Humphry Davy found that the inner layer of the bark possessed the greatest quantity of the astringent principle: this is the natural consequence of the mode in which the sap descends from the leaves, namely, through this inner layer of bark, whence it occasionally passes into the wood, which will then be found to possess principles similar to those of the bark. Most astringent vegetables are red, owing to the presence of an acid in excess, which is often manifest to the taste, as in rumex or sorrel. In metallic astringents, when super-salts, the excess of acid is also very perceptible to the taste, as in alum, which is a supersulphate of alumina and potassa.

The particular principle to which any substance is indebted for its astringent power, may be ascertained by appropriate tests. When *tannin* exists in plants, its presence may be proved by an insoluble precipitate taking place on the addition of a concentrated solution of gelatin. The precipitate is a compound in definite proportions of tannin and gelatin, being forty-six of tannin and fifty-four of gelatin. Gelatin has therefore been proposed by Sir Humphry Davy as a test of the quantity of tannin in different astringent vegetables. (See 'Philosophical Transactions,' 1803.) But in the practical application of this test there are some sources of fallacy difficult to guard against. (See Papers by Dr. Bostock in Nicholson's 'Journal,' vol. xxiv. 1809, and by Mr. E. B. Stephens, in 'Annals of Philosophy,' New Series, vol. x. p. 401.) Tannin rarely exists alone, though it probably does so in catechu, but mostly along with gallic acid. Extractive is also a frequent accompaniment of tannin, and is of considerable service, assisting its action in the process of tanning. Gallic acid strikes a bluish-black precipitate with all the salts of iron, but a solution of the persulphate is the ordinary test. Hæmatine exists in logwood, along with tannin and extractive. It may be known by combining with oxide of lead without undergoing any change.

The effect of astringents which is due to their chemical action is nearly the same in dead as in living animal matter; their long-continued application to the skin will produce a condition similar to that of a tanned hide. They are therefore sometimes employed to effect this, when internal parts are exposed, to change them from a secreting to a non-secreting surface—such as in irreducible prolapsed uterus. Their use in this way however is very limited, whilst their vital action is extensive and important. The chief effects of astringents are to contract the muscular and vascular tissues, to diminish secretion, and lessen irritability, and in many instances to impart strength or increased tone to an organ or part. Their action is always greatest on the part to which they are applied. When a drop of diluted acetic or sulphuric acid is applied to the skin, whiteness of the part is observed, which soon disappears, and the natural colour, or even a more intensely red one, follows. If this is frequently repeated, the structure of the part is changed; it ceases to secrete, is no longer pliant, but becomes stiff and inflexible. The loss of colour is owing to the diminished calibre of the blood-vessels, which no longer admit the red globules. During the absence of these, the sensibility of the part is less than natural; just as cold and torpid fingers lose their fineness of touch. Nearly similar effects may be supposed to follow the internal administration of astringents, the action of which is greatest on the intestinal canal, and less on parts remote from this; yet it deserves to be remarked, that as the intestinal canal is a mucous membrane, and possesses a muscular structure, parts of a similar structure are more influenced by astringents introduced into the stomach than other parts are: hence, increased secretion from the mucous membrane of the lungs, or from the lining membrane of the bladder, or flow of blood from arteries, is more effectually checked by astringents than increased exhalation from serous surfaces. There is reason to believe that the astringent principle of many plants does not enter into the circulation, but passes along the whole course of the intestinal canal without being absorbed; for Sir Humphry Davy found, that when tannin is present in grasses, as it is in that of *aftermath crops*, it is voided in the dung of the animals which feed upon it. (See Davy, 'Elements of Agricultural Chemistry, Appendix,' p. lxi.) But that of other plants enters the system so rapidly, that the astringency of the *Uva Ursi*, or bear's whortleberry, can be detected in the urine forty-five minutes after it has been swallowed. In the case of those which do not enter into the circulation, any beneficial effect which they exert upon remote organs must be attributed to that sympathy which exists in so great and unquestionable a degree between the stomach and almost every organ of the body. That such vegetable substances, while passing along the intestinal canal, promote the fulfilment of its functions, is obvious, from the effects following the use of food in which astringent principles are absent. Plants possessing astringent powers and bitter principles, such as tormentil and the bog-bean, are very efficacious in preventing the rot in sheep (as has been already stated under ANTHELMINTICS), while watery grasses, among which no astringent plants grow, favour the generation of worms.

The primary sympathetic effect of several of the astringents which ultimately enter into the circulation, is the most valuable in some of the cases in which they are employed, such as dilute sulphuric acid, which often checks hæmorrhage by closing a bleeding vessel, before any of it can be conceived to have been conveyed directly to the bleeding orifice; it checks the flow of blood in the same way as cold suddenly applied to the surface or skin does. The tonic effect of many astringents, after their use for some time, first on the digestive organs, and afterwards upon the whole system, and more especially upon any weak organ, must be admitted, and borne in mind in forming our estimate of their utility in a curative point of view. Without attempting to account for the ultimate cause of the action of astringents, to do which successfully seems impracticable in the present imperfect state of our knowledge, it may be stated, that under their influence a tension of the parts is produced, during which the muscular and vascular structures acquire an increase of power, and secreting surfaces and glands produce less fluid, but more natural secretions. Some indeed lessen the action of the heart, and so stop the flow of blood from dilated or ruptured vessels, such as the preparations of lead, which, though in some degree astringent, ought to be considered at *sedatives*; while others which combine with, and neutralise the unhealthy or excessive secretions, as lime and its carbonate with the secreted fluids of the intestinal canal, are more properly termed *absorbents* than astringents. When astringents are applied directly to the bleeding vessels, such as to external wounds, or to the nostrils or gums, they are termed *styptics*, and in such cases they often act chemically as well as vitally.

Before proceeding to consider the cases in which astringents may be advantageously used, an enumeration of the most common and valuable substances may be given. Of vegetable astringents the chief are *barks*, as of oak and willow, the best kind of the former of which is obtained from the *Quercus robur* of Linnæus (the true British oak) which is synonymous with the *Quercus pedunculata* of Willdenow, while the inferior sort is obtained from the *Quercus sessiflora* of Salisb., which is synonymous with the *Quercus robur* of Willdenow. The best willow-bark is procured from the *Salix pentandra*, or sweet bay-leaved willow, though very excellent bark is yielded by the *Salix Russelliana*, or Bedford willow. Roots, as of tormentil (*Potentilla tormentilla*); bistort (*Polygonum bistorta*); common avens (*Geum urbanum*), which are British plants; and rhatany (*Krameria triandra*), rhubarb (*Rheum palmatum*); pomegranate (*Punica granatum*), which are exotic plants; leaves of arctostaphylos (*Uva ursi*), petals of the *Rosa gallica*, fruits of *Prunus spinosa*, or sloe-thorn (*Punica granatum*), and secreted juices of many plants, as kino, from *Petrocapus marsupium*, and several others; catechu, from *Acacia catechu*, and galls, from *Quercus infectoria*; in all of which the astringent principle is tannin, with more or less of gallic acid; log-wood (*Hæmatoxylon Campechianum*), in which hæmatine as well as tannin possesses an astringent property; and *Ægle Marmelos*, or Indian Bael. Acetic acid must also be classed among the vegetable astringents.

The mineral astringents are—diluted sulphuric acid, and salts of iron, zinc, copper, silver, and the salts of lead. Cold, in whatever way applied, is also a valuable astringent, particularly in the form of ice.

In treating of the employment of astringents as curative agents, it is necessary to distinguish between their action as local, direct, and often chemical, and their action as general, influencing remote organs, their effects upon which are vital rather than chemical; also between their mere astringent power and their tonic power. The beneficial effects of many of the above-named astringents in checking increased secretion, is doubtless often due to their tonic power; for as in a weak state of the system or any particular gland, the secretions are generally profuse in quantity, a return to the healthy proportion and quality can only be insured by increasing the power or tone of the body or gland, which astringents do by bringing the living tissues into a closer or more compact state, and which tonics do by heightening the vitality of the debilitated structures. Hence astringents are beneficially employed in diseases where a laxity of the muscular and vascular tissues exists, accompanied with imperfect discharge of the functions of the secreting organs. The stomach and intestinal canal being the channel by which is conveyed the material necessary for the nourishment and vigour of the system, and for maintaining a capacity to discharge their functions in the other organs of the body, an impaired state of the structure and functions of this canal extends to every other part. The re-establishment of its healthy condition is a primary object in endeavouring to cure many diseases. Of these intermittent and remittent fevers may be taken as an example, since in these there is always great debility of the digestive organs, and of all the parts which have the most intimate sympathy with them, such as the skin. Astringents possessed of a tonic power have, therefore, mostly been resorted to, in order to remove this debility; cinchona-bark, willow-bark, and many others, have been used with this intention. These, however, are to be avoided whenever any acute inflammation exists, which must first be subdued by appropriate means before tonic astringents can be safely or advantageously used. In diseased states of the intestinal canal, in which greatly increased or unhealthy secretions take place, as diarrhœa, dysentery, and cholera, the most careful inquiry should be made into the cause of the disease, that if it has its origin in an inflammatory condition of the mucous membrane of the intestine, or is owing to the presence of any acrid substance, the former may be overcome by antiphlogistic measures, and the latter be removed by purgatives. When the increased flow from the intestines is connected with increased determination towards these parts, owing to the application of cold to the outer surface suppressing the secretion of the skin, which has the greatest sympathy with the internal surface, and which consequently is excited to double action, a preternatural quantity of secreted fluid is produced. The most effectual, as well as only *safe* means of diminishing this, in the early stages of its occurrence, is the employment of diaphoretics, or such medicines as restore the action of the skin; after which, should the discharge continue, mild astringents may be used, of which logwood or tormentil is the best. A preliminary treatment is likewise required in dysentery: in the common cholera a purgative should generally be given before any astringent is administered.

In the bilious cholera of autumn, after the employment of suitable purgatives, nothing seems to act more effectually as an astringent than the infusion of cusparia, or angustura bark, with dilute nitric acid; to which, in some cases, a small portion of laudanum may be added at first, but afterwards omitted. Nor in the slighter cases of epidemic cholera, has more marked benefit followed the use of any means than has resulted from the employment of this combination, which speedily checks the liquid discharges, and restores the circulation and animal heat.

Diarrhœa, or looseness of bowels, proceeding from acid secretions, is best removed by the astringents which combine chemically with these —such as lime, or its carbonate, which are rendered more suitable by uniting them with aromatics, an excellent form of which is supplied by the *mistura cretæ*, or chalk mixture of the pharmacopœia.

The next most important class of diseases in which astringents may be employed are termed hæmorrhages, or a discharge of blood, either from the exhalant extremities of the arteries, when they are gorged or when they are too much relaxed, or from the wounded or ruptured coats of any blood-vessel. The above distinction refers to the differences between active and passive hæmorrhage, or that which takes place when the system is too full of blood and the vessels propel it with great force; the other, which takes place when the power of the vessel is greatly below the natural standard. In the former, astringents cannot safely be employed at the commencement of the flow of blood, but time should be allowed for the vessels to unload themselves; or a vein should be opened, cooling saline medicines administered, cold air admitted freely to the surface of the body, and, under competent medical attendance, opium or laudanum may be given; after which, astringents will either not be required, or if so, may be safely used.

In passive hæmorrhage they may be employed from the commencement; and perhaps, in most cases, a saturated solution of alum in the infusion of roses is to be preferred, though the tincture of the muriate of iron is very eligible when the kidney is the source of the bloody discharge, as acetate of lead is when the lungs are the organs whence the blood flows. So long as lead is kept in the state of an acetate, its administration is perfectly safe: it should therefore always be accompanied with dilute acetic acid.

Bleeding from the nostrils or gums may be checked by the direct application of styptics; such as preparations of zinc or copper. Nitrate of silver will frequently stop the flow of blood from a leech bite; collodion more effectually still. Cold should, in most cases, be employed along with the other means; even alone it is often successful, especially in the form of water poured from a height in uterine hæmorrhage. Ruspini's styptic, which is said to be a solution of gallic acid in alcohol, is sometimes useful, where other means have failed. Matico is very useful.

The application of astringents to more limited examples of loss of tone or increased flow of secreted fluids, need not be extensively noticed here. After acute inflammation of the eye, proper antiphlogistic means having been used, astringent applications are very serviceable, especially those of zinc and nitrate of silver, either in solution or made into an ointment. Scrofulous inflammation of the eye is often benefited by them, if internal means be also used. Salivation, or excessive flow of saliva, occurring either spontaneously or from the use of mercury or other means, is often effectually checked by nitrate of silver, or decoction of the rhus glabrum, or by iodine, or infusion of cloves. Nitrate of silver, by lessening the inflammation which gives rise to them, also frequently removes morbid discharges from other mucous surfaces besides those we have specially noticed; an effect which also often follows the use of diluted chloride of soda. The colliquative sweats of hectic fever are best checked by giving internally dilute sulphuric acid, and sponging the skin with vinegar and water, or by oxide of zinc.

Astringent substances are decomposed by, or decompose, many others, which therefore should not be given at the same time with them; such, for example, as ipecacuanha with most of the vegetable astringents which contain tannin, by which an insoluble tannate of emetina is formed: when kino is united with calumba, a purgative action follows. All astringent vegetables containing tannin, except oak-bark, decompose tartrite of antimony, and are therefore the best antidotes to it, especially tea.

The ancient Egyptians would appear to have been acquainted with the power of astringents in preserving vegetable as well as animal substances, and they seem to have dipped the coarse cloths in which the mummies were enveloped in some astringent liquid, which tanned the skin, and rendered it less subject to change, as well as excluded the air from the interior of the body. The article employed by them with this view is supposed to have been some sort of kino. The same substance is said to be used by the Chinese to dye cotton for their nankeens, but perhaps a peculiar cotton.

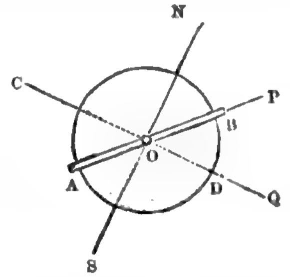
This property of astringents may be usefully applied for the preservation of all kinds of cordage, fishing-lines, and nets, which last much longer if steeped in an infusion of oak-bark. Though inferior in preserving power to the plan of Mr. Kyan, it may be applicable in some cases where his is inadmissible. [ANTISEPTICS.]

For further information on astringents, see Dr. A. T. Thomson's 'Elements of Materia Medica and Therapeutics,' vol. ii., in which much recent valuable matter is brought together.

(For the employment of astringents in the arts, see DYEING AND TANNING; and also 'Library of Entertaining Knowledge'—Vegetable Substances; Materials of Manufactures, p. 178, 1st edition).

ASTROLABE, from two Greek words, signifying *to take the stars*. It has an earlier and a later meaning. As used by Ptolemy, it may stand for any circular instrument used for observations of the stars; but in the 16th and 17th centuries it signified a projection of the sphere upon a plane, being used in the same sense as the word *Planisphere*. To this small projection, which had a graduated rim, sights were added, for the purpose of taking altitudes; and in this state it was the constant companion and badge of office of the astrologer. In later times, before the invention of Hadley's quadrant, a graduated circular rim, with sights attached, called an astrolabe, was used for taking altitudes at sea, as further described in Bion, 'Traité des Instrumens de Mathématique,' Hague, 1723. In the older sense of the word, every one of our modern astronomical instruments is a part of the astrolabe, the principle of which we proceed to describe.

If a solid circle be fixed in any one position, and a tube be fixed upon its centre, round which it may be allowed to move, as in the adjoining diagram; and if the line C D be drawn upon the circle, pointing towards

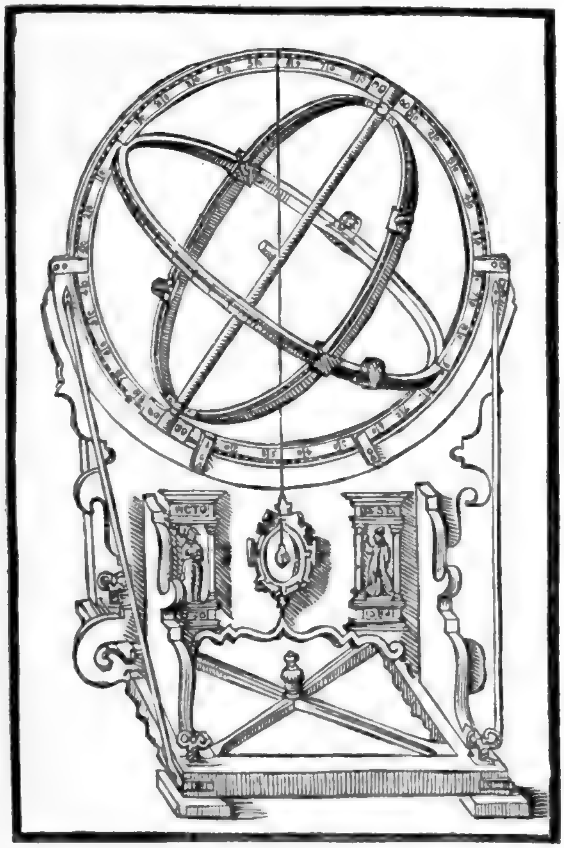


any object Q in the heavens which lies in the plane of the circle, it is obvious that, by turning the tube A B towards any other object P in the plane of the circle, the angle B O D will be the angle subtended by the two objects P and Q at the eye, or their angular distance upon a common globe. This angle may be measured, if the circumference of the circle be graduated. Thus, suppose the plane of the circle to pass through the poles N and S, and C D to point towards the equator; then when the tube points towards the star, N O B its north polar distance, or B O D its declination, may be measured; or if the circle be fixed in the plane of the equator, and C D be made to point towards the vernal equinox at the same moment at which the tube points towards the star, then the angle D O B will be the right ascension of the star.

A collection of circles, such as the *Armillary Sphere*, might therefore, by furnishing each circle with tubes, be made a complete astrolabe. The practical difficulty consists in keeping so many circles exactly in their proper relative positions. The distinction between the astrolabe of the ancients and the circular instruments of the moderns, is as follows:—First, the ancients endeavoured to form an astrolabe of two circles, so as to measure both latitude and longitude, or both right ascension and declination, by the same instrument; while the moderns, in most cases, measure only one of the two. Secondly, the ancient instruments were made to revolve, to find the star, or were furnished with at least one revolving circle, moving round the pole of the equator or ecliptic, according as declination or latitude was to be measured. The moderns for the most part fix their instruments in the meridian and wait for the star. But the *equatorial*, the altitude and azimuth *circle*, and the *theodolite*, are strictly astrolabes, according to the ancient meaning of the term.

Hipparchus is the first we know of who can be reasonably supposed to have made use of an astrolabe. But, at the same time, there are reasons for supposing that Eratosthenes, a century before Hipparchus, made use of a circle fixed in the meridian, for measuring the obliquity of the ecliptic. He is also said to have erected armillary circles at Alexandria. Ptolemy does not mention Hipparchus expressly; but he was in all respects his follower, and therefore, probably, in describing his own instrument, he is only repeating that of his great predecessor. And Nicholas Cabasillas (an ecclesiastic of the 14th century, cited by Delambre) attributes to Hipparchus an instrument consisting of an equator, a meridian, and two tropics. It is impossible, from what we know of Hipparchus, that he could have done without something of the sort. At the same time, between Hipparchus and Ptolemy we have no observations to settle this point.

The description of Ptolemy ('Syntaxis,' book v. ch. i.) is as follows:—Fix two perfectly equal circles at right angles to each other, and let one represent the ecliptic, and the other the solstitial colure. In the poles of the ecliptic place cylinders, projecting within and without beyond the rims of the solstitial colure, and fix on these cylinders as pivots outer and inner circles, which shall revolve freely without and within the first-mentioned circles. These are evidently circles of longitude. Within the innermost, and in its plane, place a lighter circle, sliding by friction, and having two sights diametrically opposite, by which the latitude of any celestial phenomenon may be observed when the instrument is adjusted; that is, when the circle representing the ecliptic is in the plane of the true ecliptic. To effect this, cylindrical pivots are inserted in the solstitial colure in the points corresponding to the poles of the equator, and the whole of the apparatus is suspended within a circle which is placed in the meridian of the place of observation. The ecliptic being divided from its interior to its exterior rim, the outer of the circles of longitude is set to the division corresponding to the longitude of the sun, as given in the solar tables, and the whole



is then turned round the poles of the equator, until the plane of the ecliptic and the plane of the outer circle of longitude pass through the sun. The instrument is then adjusted, the inner circle of longitude and its sliding limb with sights is turned to the moon, and the angle read off upon this circle is the latitude of the moon, while the angle read off on the interior edge of the ecliptic is the longitude.

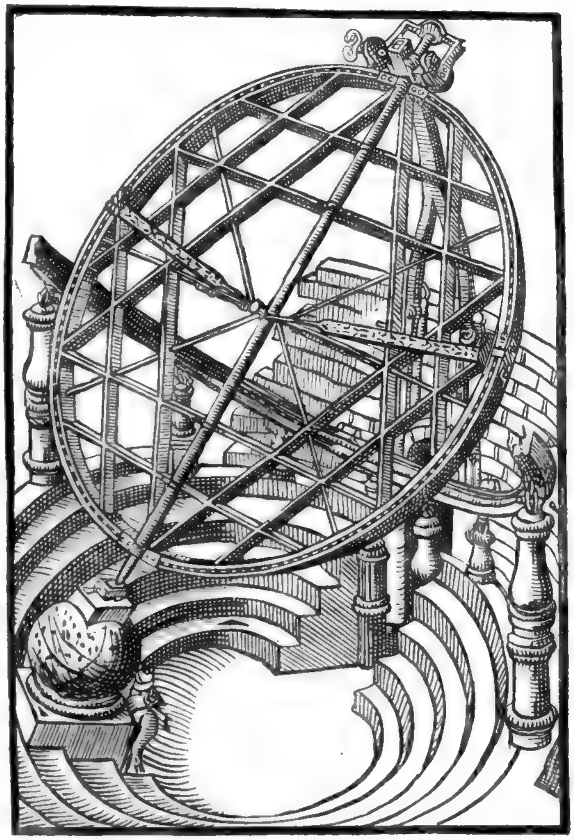
When stars are observed, it is sufficient to make the plane of the outer circle of longitude pass through the moon or any known star after setting that circle to the known longitude of the moon or star. The observation then takes place as before.

No material improvement upon this construction appears to have been made by the Arabs, who in some instances used very large instruments of the kind. A more skilful variety of the astrolabe is here shown, described by Tycho Brahé, from whose 'Astronomiæ Instauratæ Mechanica' the preceding cut is taken.

The outermost circle represents the meridian; the axis passes through the poles, and there is a revolving equator and hour-circle fixed together. The sights on the circles are moveable; but instead of using opposite sights, the small cylinder which projects from the axis is employed. For example, to measure the declination of a star, the hour-circle is moved till it passes through the star, and a sight is then placed so that the star may be seen through it on the edge of the cylindrical pin which projects from the centre of the axis, both on looking above and below the cylinder, the orifice of the sight being made just large enough to admit of this. The angular distance of the sight from the equatorial circle is then the declination of the star. To measure the difference of right ascension of two stars, two observers take two sights on the equator, which they adjust till each sees his star just on the axis, both on one side of it and the other. The angular distance of the sights is then the difference of right ascension of the stars.

The plumb-line shows whether the meridian is exactly vertical, and the screws at the feet are employed to raise or lower either end when necessary.

We give one more step between the ancient and modern instruments, from the same work of Tycho Brahé.



The hour-circle is now disengaged from the equator and independent of it. The polar axis is directly supported, and not made to depend upon the position of the meridian. This is perhaps sufficiently near to the modern equatorial to be considered as the first instrument of the kind.

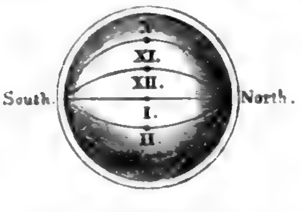
ASTRO'LOGY. If this word were used in a sense analogous with that of *geology* or *theology*, it would mean simply the *science of the stars;* while *astronomy* might mean the science of their order and arrangement. But the term, at least when coupled with the epithet *judicial*, has always signified the discovery of future events by means of the position of the heavenly bodies. The two words astrology (ἀστρολογία) and astronomy (ἀστρονομία) seem to have been used in the same sense by the Greeks, at least till about the Christian era. Cicero ('Offic.' i. 6.) uses the word *astrologia* to express astronomical knowledge.

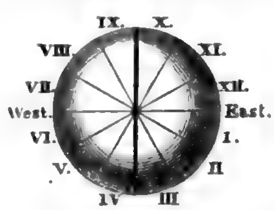
It has long been unusual to produce any arguments against this pretended science; but there are two considerations which make us think it may be useful to show those who are unacquainted with it a few of its details. The first is, that works, seriously professing to inculcate and defend the principles of astrology, have been published within the last twenty years in this country, and are still sold, almost exclusively, by some booksellers: the second, that several of our most popular almanacs do actually give astrological predictions at the present time. This may be a mere matter of amusement with the more enlightened; but we are afraid there are some who play with edge-tools in reading the fooleries of the works alluded to. The love of the marvellous is not under proper regulation, even in the minds of many who do not go the length of supposing astrology credible; and we shall therefore perhaps do good service in showing what the system really is, and what consequences its adoption must lead to.

It must moreover be remembered that our old English writers, particularly the dramatists, cannot be well understood without some information upon the leading terms and principles of this art; which therefore may be as lawfully studied as the history of Jupiter and the Metamorphoses of Ovid.

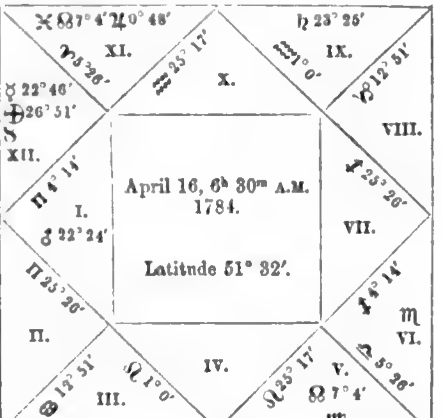
The science which, under the name of astrology, or some term of equivalent meaning, found universal belief among all the nations of antiquity except the Greeks, and also prevailed through the whole world of the middle ages, is based upon the supposition that the heavenly bodies are the instruments by which the Creator regulates the course of events in this world, giving them different powers according to their different positions. This is the description of the more learned astrologers; for we need hardly say, that the ignorant have made the stars themselves the agents, just as the image of the Deity has generally come in time to be regarded by the vulgar as the Deity himself. Looking at the more credible description, it might be philosophical for a newly created being, in possession of rational powers, to suspend his opinion on such a point till he had observed facts enough to affirm or deny the connection asserted to exist between the places of the planets and his own fortunes. That there is nothing repugnant to human nature in the basis of astrology is sufficiently proved by the number of great minds which have been led by it, when properly prepared by education; and the present age must recollect that the arguments which are now held conclusive against astrology get their strength in the minds of most people from no other circumstance than that which formerly was the prop of considerations which were held equally decisive in favour of it, namely, the bias of education. The real arguments against astrology are, first, that it is self-contradictory; secondly, that its predictions are not borne out by facts. To see the first of these, we must describe the leading principles of the art.

In the following globes, the circle projected horizontally represents the horizon, the double circle the meridian, and the other four circles are drawn at equal distances from the meridian and horizon, through the north and south points of the latter, thus dividing the whole





heavens, visible and invisible, into twelve equal parts. These circles are supposed to remain immoveable, while the diurnal revolution of the globe takes place under them. The twelve divisions are called the twelve *houses* of heaven, and are numbered in the order in which they would rise, if the circles accompanied the diurnal revolution. Every heavenly body passes through the twelve houses in twenty-four hours, but is not always in the same house with the same stars, except at the equator. For it is evident that, in order to have two bodies always in the same house, the revolution must take place round the north and south poles of the heavens, which poles are in the horizon only to a spectator on the equator itself. The principal point attended to in each house is the part of the zodiac which occupies it; and the place of any planet in the house is the distance of the body from the cusp, or boundary circle, measured on the zodiac. The following fanciful method of representing the twelve houses was in universal use, and the readers of almanacs must be familiar with it.



The twelve triangles represent the twelve houses of heaven, as marked by the Roman numerals. The time is April 16, 1784, at half past six in the morning. On the boundary of each house is written the part of the ecliptic which is to be found on it. For instance, on the cusp of the twelfth house that is just rising is the point of the ecliptic which is in 4° 14′ of Gemini. The boundary between the ninth and tenth houses is in 1° Aquarius. The whole sign of Scorpio is in the sixth house, the boundaries of which are therefore in Libra and Sagittarius. The planets are placed in their proper positions in the houses; thus Mercury (☿) appears to be in the twelfth house, at 22° 46′ from the boundary of the eleventh and twelfth.

But, on all the preceding points, it must be observed that great authorities differ very much. From among the obscurity and confusion which prevail in old treatises, we are able to collect this much, that some of them draw the boundary lines of the houses in such a way as to cut the ecliptic into twelve equal parts, instead of the prime vertical, as we have done; others draw the boundaries through the poles, instead of the north and south points of the horizon. The future destinies of mankind are rendered very uncertain by such diversity of opinion; but this we have found, that the followers of each system complain just as much of the rest, as if they had some reason to show for their own. For instance, Peletarius, or Pelletier, who introduced algebra into France, and wrote on the horoscope in 1563, expresses himself thus: "Some cut the horizon into equal parts, some a vertical circle, some the equator, some the ecliptic, some a parallel: whence it is not wonderful that a difficult art should be involved in fresh obscurity; for who can possibly see a living likeness in a mirror which is put out of shape in so many ways?" His own system is the equal division of the zodiac; and his argument for it, independently of old authorities, is the incongruity of letting the poles of the ecliptic have nothing to do with a matter which so nearly concerns the zodiac. *Minimeque convenit, zodiaco suos polos esse inutiles in eo negotio quod zodiaco maxime proprium est.* The placing of the signs in the equator he treats as a dream, and seems perfectly satisfied with the preceding reason.

The houses have different powers. The strongest of all is the first, which contains the part of the heaven about to rise: this is called the *ascendant;* and the point of the ecliptic which is just rising is called the *horoscope*. The next house in power is the tenth, which is coming on the meridian, &c. The first is the house of life; the second, of riches; the third, of brethren; the fourth, of parents; the fifth, of children; the sixth, of health; the seventh, of marriage; the eighth, of death; the ninth, of religion; the tenth, of dignities; the eleventh, of friends; the twelfth, of enemies. Each house has one of the heavenly bodies as its lord, who is stronger in his own house than in any other, as is but fit; and of two planets equally strong in other respects, he who is in the strongest house is the stronger. Now conceive all plants, animals, minerals, countries, &c., parcelled out under the different planets, which exercise their influence in abundance of different ways, according to the houses they may happen to be in for the time, and their positions relatively to each other—the result will be as good an idea of the mysteries of astrology as it is worth any body's while to obtain.

We shall now give some examples of the application of the science; and this we do principally, because in the mystical announcements which issue from our press, the darkness of the hints which are given throw a poetical gloom over the subject. This no doubt is interesting, and is not sporting too much with the credulity of the age, or with the chance of detection; but it is a foul libel on the powers of astrology. Thus, in 1815, instead of announcing some such prediction as the following—"Mars in the house of death portends, we are afraid, some new disasters by war or other cause; a personage will strive against the new order of things; but, if we mistake not, the conjunction of Luna and Saturn in the twelfth house bodes him no good,"—instead, we say, of such an unsatisfactory prophecy, a real believer in astrology, such as it was before it fell from its high estate, might have traced Napoleon from Elba to Waterloo, have calculated the very moment of the advance of the Prussians, and described the sword-knot of the captain of the Bellerophon. Thus we have the story of a Jew, in the time of the Caliph Al Mansur, who was able to detect, by means of the heavenly bodies, that certain words just written upon a paper, which he was not allowed to see, were the names of a plant and an animal. But lest any one should imagine that perhaps the later astrologers have given up the attainment of information so minute, and have confined themselves to such general indications as those of our almanacs, which, as they mean nothing, may as reasonably be drawn from the stars as elsewhere, we take the following instances from a work published in 1817, which we will not name, and which we would willingly suppose to have been written in irony, if it were not that its size (2 vols. 4to, with tables) and style are both evidences either of real belief or intentional attempt to deceive.

A man was born June 24, 1758, at eight minutes after ten in the morning, committed a murder, and was by many supposed to be insane. Pending his trial, an astrologer was requested to point out by the stars whether this defence would be established or not. The nativity was cast; that is, the position of the heavens at the aforesaid time was laid down, and the nativity having been *rectified* (a process amounting to giving the prophet a power of making almost any change he pleases), the result was as follows:—

"Mercury being lord of the ascendant, irradiated by a malefic quartile aspect of the planet Mars, and afflicted by an opposition with Jupiter, declares that the native shall be involved in an abyss of troubles and afflictions, even to the hazard of his life."—"The quartile of Mercury and Mars, particularly when Mercury is constituted principal significator, hath implication of high crimes and misdemeanors."—"Upon a further inspection of the figure, we find a baneful quartile aspect of Mars and Jupiter, with a mischievous opposition of Saturn and Mars. To the first of these we are to attribute the dissolute manners of the native."—"Here is unquestionably a favourable trine of the Sun and Saturn; but no great good can result from it, because the Sun is lord of the twelfth house, posited in the tenth, and out of all his essential dignities: at the same time that Saturn is lord of the sixth, located therein, and both the significators are under the dominion of the *evil genii*, vitiating the mind and affections of the native."—"At the time the unhappy native was prompted to commit this barbarous act, the Moon came to an opposition of Mars by direct direction, while she occupied the cusp of the seventh house, which represents the unfortunate woman."—"The Sun I find to be giver of life, posited in the tenth house, the house of justice; Mercury, lord of the ascendant, being in Gemini, *an airy sign*, and the Moon likewise in an airy sign, show the manner of the native's death, that *he would die suspended in the air;* while the opposition of four planets in the radix, and the mundane quartile of the Sun and Mars from the tenth, the house of justice, show the quality of it—namely, that it should be in due course of law, by the hands of the common hangman, and not by suicide."—"I brought up the direction of death with great nicety and precision, and found he would be plunged into eternity when the Sun came to the anaretical point of the midheaven, and met the noxious beams of the Moon and Mars in opposition, which thus constituted is ever productive of a violent death."

We now give the following opinion upon a case of a projected marriage, in which the lady, suspecting an attachment elsewhere on the part of her intended husband, inquires whether it will ever take place. The position of the heavens is supposed to be laid down at the moment of asking the question.

"The Sun is significator of the lady; and Saturn, lord of the seventh house, is significator of the gentleman. It must also be observed, that in this, and all questions relative to matrimony, Mars and the Sun are the natural significators of a woman's marriage; and Venus and the Moon are those of a man's. Now Saturn, the gentleman's significator, is remarkably well posited in the fifth house, and has Venus within his orb, applying to him by conjunction; which is a very powerful indication that his affections are sincere and honourable, and that his mind is fully bent to the marriage state. The Sun, likewise, being in a sextile aspect with Mars, the lady's significator of marriage, plainly shows her inclination to matrimony to be strongly fixed, and her affections to be perfectly sincere.

"The next thing to be considered is, whether there be any frustration or impediting aspect between these significators, and I find the Moon and Venus, the gentleman's significators of marriage, are applying to a quartile aspect with each other. This is an evident proof that the marriage is prolonged by the interference of some other woman of this gentleman's intimate acquaintance, because the aspect is made in a feminine sign; but as the Moon, in separating from Venus, applies to a perfect trine with Mars, the querent's principal significator of marriage, and also to a sextile of the Sun, her natural significator in the figure, it totally removes the evil effects of the malefic aspect, and leaves the path free and unobstructed to the gates of Hymen. This opinion is greatly strengthened by considering the mode in which their significators are severally disposed. Saturn disposes of the Sun, who is posited in the terms of Venus; and Venus, Saturn, and the Moon, are all disposed of by the benevolent planet Jupiter, who is himself disposed of by Mars, the principal significator of this lady's marriage, and who thus triumphs over every obstacle to the celebration of their nuptials. I therefore could not hesitate in declaring to the lady, in the fullest and most satisfactory terms, that the gentleman who courted her had a sincere and tender regard for her; and that, though some circumstances might have happened rather unfavourable to her wishes, yet she might rest perfectly assured that he was the man allotted to be her husband.

"Apparently well satisfied with these declarations, she proceeded to inquire in what length of time this desirable circumstance might come to pass. To gratify her wishes in this particular, I referred again to the figure where the Moon wants upwards of eleven degrees of forming a perfect sextile aspect with the Sun, the lord of the ascendant, and the same to Mars, her significator of marriage, and, therefore, by converting the degrees into time by the rule heretofore given, I fixed her marriage at about the end of three months, assuring her it could not exceed that time."

On looking at the examples we have chosen, we see that they refer to matters which are proverbially under the control of destiny. We therefore take another, which has more connection with the common affairs of life. It consists of directions for dealing in the smaller sorts of cattle, such as sheep, hogs, &c., and will fully explain the risk of such speculations.

"If the lord of the sixth and the lord of the second are in conjunction, in a good house of heaven, the querent may thrive by them (that is, small cattle); or if they be in sextile or trine, the same. The lord of the sixth, casting a friendly aspect to the part of Fortune, or being in good configuration with the depositor thereof, denotes much good to the querent by dealing in small cattle; but if, on the contrary, the lord of the sixth be unfortunate, and in evil aspect with the lord of the ascendant or second, or cast malignant rays to either of their cusps, the querent will lose by dealing in small cattle. If the lord of the sixth be in quartile, or in opposition to the dispositor of the part of Fortune, or the Moon, the querent cannot thrive by dealing in small cattle. The same if the lord of the sixth be afflicted either by Saturn, Mars, or the Dragon's Tail; or be found either retrograde, combust, cadent, or peregrine. The Dragon's Tail and Mars show much loss therein by knaves and thieves, and ill bargains, &c.; and Saturn denotes much damage by the rot or murrain."

That the ancient system of astrology contained the most contradictory assertions may be made evident in very few words. The position of the heavens at the time of birth settled every man's character of body and mind, the various fortunes he would meet with, and his relative positions with regard to friends and enemies. Thus, every one who was born at or very near the same time as Alexander the Great, in the same country, would have a right to expect a somewhat similar career; and twin brothers could never fail to have the same horoscope, and therefore the same success in life; and though the subject of a particular horoscope should travel over the whole world, and thereby come under the influence of positions of the heavens which never could have occurred at his birthplace, yet these would be always ready to tell him (when properly looked at) whether the present moment was favourable or unfavourable to any pursuit he had in view. To take a case that might have occurred: suppose two men had engaged to throw dice against each other for their whole fortunes, and that each went the night before to consult different astrologers in the same town. To them it would not be necessary to tell their names or exhibit their horoscopes; the present position of the heavens would be sufficient for pointing out a favourable hour, and if both astrologers worked by the same rules, as they ought to do, they would both arrive at the same result; that is, the same would be recommended to both inquirers, though one of them must certainly lose.

The astrologers never made any allowance for the precession of the equinoxes. Thus, though the *constellation* Aries is now in the sign Taurus, and the influences of its stars ought to have moved with them, we find that the *astronomical* Aries, or the first thirty degrees of the ecliptic, is used for the constellation. Under the circumstances, this is of little consequence; but such a practice would be fatal to *astronomy.*

That observed facts did stubbornly refuse to fulfil the predictions of the planets need hardly be told. In the 15th century, Stœffler foretold a universal deluge which should take place in 1524, in consequence of three planets being then in conjunction with a watery sign. All Europe was in consternation; and those who could find the means built boats in readiness. Voltaire mentions a doctor of Toulouse who made an ark for himself and his friends. Such a circumstance shows the hold which astrology had upon men's minds, from which, had it been true, it never could have been forced; for although a *new* truth, even when capable of easy verification, is introduced with difficulty, it is altogether absurd to suppose that a science, the correctness of which was of every-day experience, should drop and become exploded, not for want of cultivators, but of believers. The former we have, perhaps, even now, and a few of the latter, though only among the most ignorant of the community. The art is at present under the ban of the law, in order that designing persons may have at least one access stopped to the pockets of the credulous. By the Statute of the 1st of James I., c. 12, sorcery of all species was prohibited, though it does not appear certain that this term included astrology; but by the Vagrant Act, 5 Geo. IV., c. 8, sec. 4, all "persons pretending to tell fortunes, or using any subtle craft, means, or device, by palmistry or otherwise, to deceive and impose upon any of his Majesty's subjects," are rogues and vagabonds—that is, punishable by any magistrate, with three months' imprisonment and hard labour.

The history of judicial astrology, at least up to the middle of the 15th century, is very nearly that of astronomy, since the latter branch of the science, except among the Greeks, was mostly cultivated for the sake of the former. Hence to it, as to alchemy, we owe many really useful discoveries. It is a singular fact, that the first lunar tables which were constructed on the Newtonian theory were intended to be subservient to the calculation of nativities; there is no question that the necessity which the astrologer lay under, of being ready, at any moment, to lay down the positions of the heavenly bodies, produced great numbers of useful tables and observations; and the Greek works which have been preserved by the Arabs were valued principally for the use to which their mathematics could be turned in astrology. The origin of the science is beyond the reach of history, nor is it much worth while to collect all that is known on this point. It certainly came into Europe from the East, where it is mentioned in the earliest records of every nation. The Chinese are said to have placed it on the same footing with agriculture and medicine: the Chaldeans cultivated it sedulously, and the invention is attributed to them by Suidas (cited by Montucla, iv. 372). The Hindoos have long regulated the most important actions of their lives by the stars (see introduction to the 'Lilliwati'); but Mr. Colebrooke has shown ('Hindoo Algebra,' preface, p. 80) that several of their fundamental terms are not Sanscrit, from which he apparently leads us to conclude that he thinks the science neither ancient nor indigenous in India. Among the Egyptians it was of great antiquity; but it is not mentioned in the books of Moses, unless included in magic or sorcery, which is most probable.

The books of Isaiah and Jeremiah allude directly to astrology in several places, as also that of Daniel. During the captivity, the Jews appear to have learnt the art, and from that time probably, but certainly in the earlier centuries of the Christian era, became much addicted to it. Several of the more celebrated writers on astrology under the caliphs were Jews, as Messahalah, Moses ben Maimon, Solomon Iarchus, whose almanacs we have mentioned as among the earliest published, and many others.

In Greece, at least during the classical ages, judicial astrology found no reception; nor do we trace any marks of it even in the earlier astronomical writers of that country. The system was little in harmony with the allegorical mythology which prevailed there; and the oracles afforded perhaps sufficient nourishment to the appetite for the marvellous. But among the Romans astrology was cultivated with avidity from the time of the conquest of Egypt, in spite of several edicts of the senate. In the 2nd century the whole world was astrological, and even Ptolemy was infected. There is a work entitled 'Tetrabiblos' attributed to him, which is entirely devoted to astrology; and though its genuineness has been doubted by some, merely because it is astrological, there appears no sufficient reason to reject it. (See Delambre, 'Hist. Ast. Anc.,' ii. p. 543.)

All the followers of Mohammed are and have been astrologers. The predestinarian doctrines of their system render the transition easy and natural; for, as we have seen, the science of astrology is based upon the notion of the necessity of human actions. The establishment of the Moors in Spain, and the crusades, caused the introduction or the increased cultivation of the art among the descendants of the barbarians who destroyed the Roman empire; probably the former, for we have no distinct traces either of astronomy or astrology among the northern nations. But the predestinarian principle assumed a modified form more consistent with the belief of the Catholic Church. It was said that the stars only incline, but cannot compel; which position, while it left the will free, was a most convenient explanation of any failure in the predictions. The Greek and Roman Christians of the earlier centuries had in many instances received the whole of astrology; in others, the modified belief above mentioned. Origen, though he recognises the stars as rational beings, yet, in his 'Philocalia,' contends that the stars neither incline nor compel, but only prophesy or point out what men will do, without exerting any influence. He then gives a long and curious argument against their compelling power, without explaining how it does not hold equally against their predicting faculty. St. Augustin (cited by Vossius) argues against astrology altogether. The Church, in its public capacity, condemned the art in the first councils of Braga and Toledo, and in the Decretals (cited by Vossius). The doctrine of astrology was among the errors imputed to the Priscillianists. But many zealous Catholics in later time adopted the same opinions, and among them churchmen of the highest rank, such as the Cardinal d'Ailly (died in 1425), who calculated the horoscope of Jesus Christ. The astrology of comets, which is hardly yet out of date, has even been recognised by a pope: in the 15th century, Calixtus III. directed prayers and anathemas against a comet which had either assisted in or predicted the success of the Turks against the Christians.

The establishment of the Copernican system was the death of astrology; and that upon an argument not one bit stronger against it than the preceding systems for it. When it was found that the earth was only one among other planets, it soon came to be reckoned absurd by many that our little globe should be of such consequence as to be the peculiar care of the whole system. But why should the principle of non-interference have been preferred to that of the balance of power? We have lost a charming opportunity of discovering what goes on in other planets.

The last of the astrologers was Morin, best known as the opponent of Gassendi. The latter had in his youth studied and believed in the art, but had afterwards renounced and written against it. The former, who worked for thirty years at a book on astrology, and was besides an opponent of the motion of the earth, predicted his opponent's death repeatedly, but was always wrong. He also foretold the death of Louis XIII., with no better success. Since his death, which took place in 1656, the science has gradually sunk, and we believe has in no case been adopted by any real astronomer.

ASTRONOMY signifies the *laws of the stars*, and is applied generally to all that relates to the motions and theory of the heavenly bodies, as well as of the earth. If we except general terms, such as *science*, there is perhaps no single word which implies so many and different employments of the human intellect. We shall therefore confine ourselves here, to a slight sketch of the annals of the science, and a few general considerations, pointing out at the same time the articles which should be consulted for further details.

The work of the astronomer begins in the observatory, where means are provided for noting the positions of the stars. Of the instruments by which this is done, see the principle and details in the articles INSTRUMENTS (ASTRONOMICAL); CIRCLE; CLOCK; PENDULUM; OBSERVATORY; TRANSIT INSTRUMENT; &c. There are two classes of observations: the first, of known bodies, of which the places are so nearly determined that no question remains except about quantities less than a second of time, or its corresponding quantity, fifteen seconds of space [ANGLE]; and for this class the consideration what phenomena shall be observed is made to rest entirely upon the instruments, those phenomena being preferred, for the observation of which the steadiest instruments can be made. These move only in the meridian, and the star is waited for. The second class of observations, such as those of comets, double stars, and all mere appearances which require an instrument that can be pointed to any part of the heavens or can be made to follow a star, is performed by telescopes, which are made to revolve with the heavens. [EQUATORIAL.]

The second division of astronomical labour is the department of the mathematician only. The observations as they come from the instruments are subject to all the errors of the latter, and no perfect instruments can be constructed. The best circle that can be made is slightly oval; the best pivot that can be turned will not be truly cylindrical. The question now comes, in what manner to compare different species or sets of observations, so that the discordances themselves shall point out the quantity and quality of the instrumental errors; and how from thence to derive the corrections necessary for future observations. Also, how to choose the time and manner of observation, so that any particular error, whether of instruments or theory, shall be least, if the observer be desirous of avoiding it, or greatest, if he wish to detect and measure it. Every-day experience shows that there is no better test of the progress of observation than the discovery of new instrumental errors, provided only the quantities in question become less and less. The angular error which now sets an observer to work to correct his result, is less than the six-hundredth part of that which would have been sufficient to annoy Ptolemy or Hipparchus. And in speaking of an instrument, we may consider the observer himself as a most material part, on the combined power of whose eye, ear, and judgment, the correctness of the observation depends. It is hardly to be expected that, even under precisely the same circumstances, two observers should note the same phenomenon so as to agree within a small fraction of a second; and recent experiments on phenomena noted with both the eye and hand, have demonstrated the existence of small differences between different observers, attributable only to their different habits of perception or physical constitution. On this point see EQUATION (PERSONAL).

When observations have been, as nearly as possible, freed from instrumental errors, the next step would be, if we could imagine a system of astronomy only in its infancy, with instruments as near perfection as our own, to deduce, by combination of mathematical reasoning and calculation, the real places of the stars for some one moment, and the magnitudes and laws of the various motions to which they are subject, whether periodical or permanent, and whether arising out of the motion of the earth, or out of a proper motion of the stars themselves; and for the solar system, to determine the relative motions and positions of the planets and their satellites, which can only be done by the previous measurement of the earth, and subsequent comparison of the results of one observatory with those of another. But these primitive determinations have always been in progress with the instrument, and results have increased in accuracy with the power of observing; so that instead of working afresh for the determination of *elements*, as they are called, almost the whole of modern astronomy is a process of correction of those which have been previously obtained. This greatly facilitates operations [for the reason of which see DIFFERENTIAL CALCULUS; APPROXIMATION]. The measurement of the earth itself, and the determination of its figure, which is the basis of planetary astronomy, so far as ascertaining the actual dimensions of our system is concerned, will be treated as a separate science under the name of GEODESY, though it is a constituent part of astronomy, both as to the methods by which it is carried on, and the objects for which it is undertaken.

The third department of astronomy, being that which requires the most extended knowledge of mathematics and the highest exercise of thought, is that which goes under the name of *physical astronomy*, and consists in the combination of the various phenomena as actually observed, in order to find out what are their physical causes and according to what laws those causes act. It is evident, that without some success in this branch of the science, there can be no power of *prediction*, except what arises from the presumption that preceding phenomena have run their whole possible round, so that nothing *can* happen except a repetition of what *has* happened. To a rough view this seems to be the case, and is so in a great measure; but to the instruments of an observatory there appears no such complete *periodicity*. To this head we should refer such questions as those of REFRACTION; ABERRATION; GRAVITATION. The term physical astronomy is usually applied to investigations connected with the latter only; but both etymology and analogy warrant its extension to the former. Under this, also, we must place all questions connected with the physical constitution of the various planets, so far as that can become known. Of the great increase which the predicting power of astronomy has received since Newton deduced the motions of our system from the simple law of attraction, there is no need to speak; but we shall notice one peculiar use of that principle, by which the results of observation are anticipated, and the first and second of our divisions of astronomy advanced, while at the same time the *experimentum crucis* of the truth of the principle is furnished. There are many small inequalities of the solar system, which, though not likely to show themselves mixed up as they are with so many others, are yet certain to be found, if looked for at the time when their effects are most sensible. The results of theory point out that a certain inequality, whose law and approximate magnitude it gives, should be found in the motion of a certain body, if the Newtonian principle be correct. On being looked for in the manner which the nature of the inequality itself shows to be most advantageous, it is found accordingly, and its *exact* magnitude, as ascertained by observation, is often of use in correcting that obtained from theory. For example, had it not been for methods of this kind, our knowledge of the motions of Jupiter's satellites, which is yet far from mature, would have been in a state of the merest infancy.

If the theory had arrived at a degree of completeness, towards which it has been and is rapidly tending, nothing more would be necessary for the determination of the motions of the solar system than the knowledge of the actual positions, velocities, and directions of the velocities of the bodies composing it, at some one moment, or of any other quantities in which the above were mixed up, and from which they could be obtained by calculation. But up to the present time it has been necessary to use more *data* of observation than the preceding, and it is only in recent years that tables of the moon, from the first-mentioned *data* alone, have been published,

For the details of the actual state of astronomy we must refer the reader to such articles as STARS; SOLAR SYSTEM; &c., and the names of the several planets. We shall now proceed to a sketch of the history, or rather the *annals*, of astronomy, referring for fuller information to the list of works given at the end of this article.

The real history of *written* astronomy, that is, of actually recorded and moderately correct observations in sufficient number to constitute a body of science, commences with Hipparchus, about 160 years before our æra. Prior to his time, it is difficult to do more than speculate upon the few facts which are left to us. That astronomical observation of a certain description began in the very earliest ages, there can be no doubt; but here there could be but one instrument, the horizon, and but one theory, the actual motion of the heavenly bodies round the earth. The earliest observations mentioned are those of the rising and setting of stars, which led to the registration of the different appearances presented by the heavens in the course of a year, to which may be added lunar and solar eclipses and comets. The rapid motion of the moon in the heavens would probably have caused the lunar zodiac to be first marked out, though it is clear that the solar zodiac was of a very early date. Astronomical observation has always been one of the accompaniments of civilisation, both in modern and ancient times; and however much we may conceive ourselves entitled to look down upon the notions of our predecessors, we must not forget that in speaking of any country which possessed an astronomical theory worth so much as laughing at in modern times, we place that country in the list of exceptions to the rule which prevailed through the greater number. If the Chaldean system appear insufficient or the Ptolemaic complicated, these are yet real results of thought, and, to a certain extent, actual representations of fact. Mungo Park mentions an African tribe, whose opinion it was that the inhabitants of the west fried the sun when he got down to them, and after heating him sufficiently for next day's service, took him round by a private passage to the east. If we could collect the astronomy of the whole ancient world, there can be little doubt that the comparatively humble efforts to which we are coming would appear miracles of sense and reflection, among theories not much superior to those of Park's Africans.

The nations who are known to have cultivated astronomy before the Christian era are the Chinese, Indians, Chaldeans, Egyptians, and Greeks. The first made it a matter of politics, the three next of religious observance, and all four applied it to astrology. Among the Greeks only, the science had no reference either to politics, religion, or soothsaying; and here it throve with a vigour which permits us to make the astronomy of Hipparchus and Ptolemy a part of the chain which ends with Newton and Laplace. What we know of the four first-mentioned nations is not sufficiently certain or definite to warrant our drawing very positive conclusions as to the time when they began to study the science; and the question is rendered the more difficult by the pretensions to antiquity which have been advanced in favour of each by well-informed men of modern times. Each nation has its advocates, who maintain that the Chinese, the Indians, the Chaldeans, or the Egyptians, were the first astronomers: which is of itself sufficient to prove that the question is doubtful. Fortunately it is of little consequence; and also the astronomy of the first and two last is of a character and extent which will justify our saying that, be it very ancient or not, there is nothing on the face of it which needs the supposition of any very long time having been expended upon it. The Hindoo astronomy, on the other hand, though certainly more extensive and correct, may have been, for anything that can be shown to the contrary, received from the Arabs of the middle ages. At least such is the opinion of Laplace, Delambre, and several celebrated Anglo-Indians, who have had means of knowing more of the subject than either. But this question is one of difficulty, and ought not to be considered as finally settled.

The Chinese have some annals which were translated by De Mailla, a Jesuit missionary at Pekin, 1777-1785. They claim to go back to the year B.C. 2857; but of astronomical phenomena they record hardly anything, except eclipses of the sun and the appearance of comets, and of the former nothing but the fact and the day of their happening. They state that the astronomers by profession were obliged, on pain of death, to predict every eclipse that occurred, and that, even after such phenomena were found capable of prediction, it was the practice to shout, beat drums, &c., during every eclipse, to frighten away the monster which they supposed to be devouring the sun. The mathematicians, in spite of their responsibility, were forbidden to make any alteration in their theories or methods, without the consent of the emperor. The loss of many methods, asserted to have been formerly practised, is attributed to the burning of all scientific books by one of their princes, B.C. 221. But perhaps the loss was not great; for Gaubil, who recalculated their asserted eclipses, could not verify more than one of a date anterior to the time of Ptolemy; and even that one is doubtful. The fact of the motions of the planets was known to the Chinese, but not the precession of the equinoxes, till about A.D. 400. They had also the Metonic and Calippic periods.

The question with regard to the Hindoos is not whether their astronomy is sufficiently high in its pretensions to make it worth while to inquire into its antiquity, but whether an astronomical system of a very advanced character, which certainly was found among them, is or is not as old as they assert it to be. This system is found in certain tables, called the tables of Tirvalore, which have been brought into Europe by Le Gentil, and in an original work, the 'Surya Siddhanta,' of which an account will be found under VIGA GANITA, in the BIOG. DIV.; and it may be fairly considered as about equal to the European system of the 12th century. The epoch claimed by the tables is B.C. 3102, the beginning of the Cali-yug, or iron age of Hindoo mythology, at which time a conjunction of all the planets is asserted. But this has too figurative a character; and moreover, the elements of the tables are hardly such as would have been derived from observations actually made at that period. That the epoch is fictitious may be readily believed; but the question is, was this fictitious epoch formed by Hindoos from their own observations before the Christian era, or was their system introduced by the Arabs, or by direct communication with the Greeks? On the one hand it is argued that the Indian tables, being in many respects a mean between those of Ptolemy and Albategnius, may have been derived from those two; on the other hand, the remarkable correctness of several points, and the known character of the people in question, whose advances in mathematics cannot be doubted, and whose habits have, throughout recorded history, induced them to repel all connection with foreigners, are urged in favour of the originality of their system. Those who are curious may consult Bailly's 'Hist. de l'Astronomie Indienne,' on the one hand, or Delambre, on the other; but this question has unfortunately been treated with considerable spirit of system on both sides.

The Chaldeans, according to Diodorus, had long observed the risings and settings of the heavenly bodies, as well as eclipses. They had the celebrated Metonic period of nineteen years, and it is supposed that Meton obtained it from them, though this point is doubtful. They had also other periods, the meaning of which has caused discussion. [SAROS, NEROS, SOSOS.] Simplicius, a commentator on Aristotle, and also Porphyry relate that a series of eclipses preserved at Babylon was transmitted by Alexander to Aristotle, and contained the observations of 1903 years preceding the conquest of Babylon by the Macedonians. But Ptolemy gives only a few of them, the earliest of these not reaching higher than B.C. 720. They are of the roughest kind, the times being given only in hours, and the part of the diameter eclipsed within a quarter; but nevertheless they are the earliest trustworthy observations we possess, and led, in the hands of Halley, to the discovery of the acceleration of the moon's mean motion. We find also among the Chaldeans the use of the clepsydra as a clock, of the gnomon as an instrument for measuring solstices, and of the hemispherical dial called by the Greeks σκάφη, for ascertaining the positions of the sun. By the clepsydra they were enabled to divide the ecliptic nearly into twelve equal parts, and are thus said to have invented the zodiac.

The Egyptians have left us no observations, and few astronomical relics, the meaning of which can be made very clear, though it is probable that they were the first instructors of the Greeks. Their year was of 365 days: for their method of correcting it, see SOTHIAC PERIOD. They observed eclipses, but none have come to us; they foretold comets, according to Diodorus; but as this author also mentions at the same time that they foretold future events, it becomes doubtful whether we are to understand that their predictions were successful. The idea attributed to them that Mercury and Venus moved round the sun is not mentioned by Ptolemy; whose silence on this and many other points, writing as he did in Egypt, is remarkable, unless it be admitted at once as a proof of exaggeration in the preceding accounts. The correct manner in which some of the pyramids are said to be placed north and south has always been quoted as a ground of suspicion, that these buildings had some astronomical use. The zodiac has also been attributed to the Egyptians. [DENDERAH, ZODIAC OF.] The only attempt at a measure which we have remaining is one of the diameter of the sun, the meaning of which is obscure; but if what Delambre mentions (without citing his authority) be true, that they measured time by the *distance run by a horse*, as well as by the clepsydra, we need not be surprised that Ptolemy found no assistance from their ancient observations. The story of Thales teaching the Egyptians how to find the height of the pyramids by the shadow, and that in Herodotus, of his being told by them that the sun had twice risen in the west, are, so far as their credit goes, confirmations of the opinion generally formed of Egyptian astronomy.

With regard to the astronomy of the Greeks previously to the earliest extant works, there is little to be said. The Ionian school, founded by Thales B.C. 600, followed in succession by Anaximander, Anaximenes, and Anaxagoras, added little or nothing to practical astronomy. If Thales really predicted the total eclipse of the sun, B.C. 585 [ECLIPSES], he must have succeeded in doing so by means of the Chaldean Saros, or period of 18 years and 10 days, which produces a regular recurrence of solar and lunar eclipses. The opinion of the earth's motion attributed to Anaximander rests on slender foundation. The school of Croton, founded by Pythagoras about the year B.C. 500, and sustained by Philolaus, produced no observers, though it certainly adopted the opinion of the earth's motion. Pythagoras is said to have first taught that Lucifer and Hesperus, or the morning and the evening star, are in reality one and the same planet. The following is a list of ancient philosophers to whom the opinion of the earth's motion has been attributed:—

Pythagoras.	Cleanthes the Samnite.
Philolaus.	Leucippus.
Anaximander.	Ecphantus.
Nicetas of Syracuse.	Heraclides of Pontus.
Seleucus.	Aristarchus of Samos.

Meton, B.C. 432, introduced the Luni-Solar cycle of nineteen years. In conjunction with Euctemon, he observed a solstice at Athens in the year B.C. 424. Calippus, B.C. 330, introduced the improvement of the Metonic cycle, known by his name. Eudoxus of Cnidos, B.C. 370, brought into Greece according to Pliny, the year of 365¼ days, and wrote some works, one of which exists in the poetical version of Aratus.

Pytheas, about the time of Alexander, measured the latitude of Marseille with tolerable accuracy. The work of Aristotle on astronomy is lost; and what is still more to be regretted, that of his disciple Eudemus on the history of astronomy. The poem on the Sphere attributed to Empedocles, B.C. 450, is probably much more modern.

We now come to the period of history, and of the Alexandrian school. This article being for reference only, we shall condense as much as possible the principal discoveries of the succeeding astronomers, in order of time. This could not be done in the chain of surmises mixed with history which we have just finished, since it is important to avoid confounding what is known with what is only supposed.

List of astronomers of the Alexandrian school:—

Aristyllus.	Paulus of Alexandria.
Timocharis.	Theon the Younger.
Eratosthenes.	Hypatia.
Conon.	Pappus.
Hipparchus.	Diodorus.
Sosigenes.	Theophilus.
Theon the Elder.	Cyrillus.
Ptolemy.	

Autolycus, B.C. 300. His books are the earliest which are extant in the Greek language on astronomy. They are two: 1. On the sphere in motion. 2. On the rising and setting of the stars. He appears to have considered the year as exactly 365 days.

Timocharis and *Aristyllus*, B.C. 300 (?), made the observations which afterwards enabled Hipparchus to discover the precession of the equinoxes.

Euclid of Alexandria, B.C. 300. The 'Elements of Euclid' show that the Greeks of his time had no trigonometry. There is another work attributed to him, entitled 'Phenomena,' which is no more than a treatise on the doctrine of the sphere.

Aratus of Cilicia, B.C. 281, has left an astronomical poem, chiefly taken from Eudoxus, and valuable on account of the commentary of Hipparchus.

Many other ancient writers have also written commentaries on the poem of Aratus. The following list of them is given by De Chales:—

Agesianax.	Callistratus Tenedos.
Alexander of Ætolia.	Crates.
Alexander of Ephesus.	The two Didymi.
Antigonus the Grammarian.	Eratosthenes.
Apollonius the Grammarian.	Heliodorus the Stoic.
Apollonius the Geometer.	The two Hermippi.
Aristarchus the Grammarian.	Hipparchus.
Aristarchus of Samos.	Numenius Parmenides.
Aristophanes.	Parmeniscus.
The two Aristylli.	Pyrrhus of Magnesia.
Atalus of Rhodes.	Sminthes Thales.
Bœthius.	Timotheus Zeno.
Callimachus of Cyrene.	

Aristarchus of Samos, B.C. 280. His work on the magnitudes and distances of the sun and moon is the first attempt to measure the relative distances of these two bodies, by observing their angular distance at the time of half moon. To him also is attributed the opinion that the earth revolves round the sun.

Manetho the Egyptian, B.C. 260. His history is lost, but a poem attributed to him remains. It is a description of the heavens, filled with astrology and containing no observations.

Eratosthenes of Cyrene, B.C. 240, is said to have observed with some celebrated astrolabes which he erected at Alexandria, which remained standing till the time of Ptolemy. Various works are attributed to him, for which see his Life, in the BIOG. DIV. He observed (either with a gnomon or with a meridian circle) [ASTROLABE] the obliquity of the ecliptic, and the latitude of Alexandria; and from the latter, and the fact that at Syene the sun was vertical at the summer solstice, he deduced an approximation to the earth's magnitude. His approximation makes a degree to be 700 stadia. A catalogue of stars attributed to him (the oldest extant) is probably spurious, but shows that, in and about his time, the method of referring stars to their latitudes and longitudes was not practised. His value of the obliquity of the ecliptic—11 parts out of 166 of the whole circumference—was adopted by Hipparchus and Ptolemy.

Archimedes of Syracuse, died B.C. 212. He observed solstices, and attempted to measure the sun's diameter. His writings show that trigonometry was as yet unknown.

Hipparchus of Bithynia (?), B.C. 160-125, the greatest of all the Greeks in astronomy. In his youth he wrote a commentary on Aratus. He discovered the precession of the equinoxes, by comparing his own observations with those of Aristyllus and Timocharis, or others of his predecessors. He was the first who employed processes analagous to those of plane and spherical trigonometry, for which he constructed a table of chords. He first used right ascensions and declinations, which he afterwards abandoned in favour of latitudes and longitudes. He suggested the method of referring terrestrial positions to latitude and longitude, and was probably the inventor of the stereographic projection. He determined the mean motion of the sun and of its apogee, the inequality of the sun's motion, and the length of the year, to greater exactness than his predecessors. He found the mean motion of the moon, of her nodes, and of her apogee; her parallax, eccentricity, the equation of her centre, and the inclination of her orbit. His observations also led him to suspect another inequality in the moon's motion, which Ptolemy afterwards discovered (the evection). He calculated eclipses, and used the results in the improvement of the 'Elements.' He made one of the first steps towards a correct representation of phenomena, by supposing the sun to move round the earth in a circle, the earth not being at the centre. His catalogue of the longitudes and latitudes of 1081 stars was the first at all worthy of the name. If Hipparchus had possessed the pendulum and the telescope, fifty years might have enabled his successors to place astronomy in the state in which it stood at the birth of Newton. Considering his means, his observations are perhaps unequalled.

After the death of Hipparchus there is no astronomer of eminence till Ptolemy. Between them we have—

Hypsicles of Alexandria, B.C. 146, wrote the 14th and 15th books of the 'Elements of Euclid,' which contain some astronomical propositions.

Geminus (of Rhodes?) B.C. 70, wrote an introduction to the heavenly phenomena, containing no new discovery. It would seem he was not an observer.

Posidonius about the same time attempted to verify the measure of the earth of Eratosthenes. His writings are all lost, but many of his opinions are preserved in Cleomedes and Strabo. He remarked (though probably he was not the first who did so) the connection of high water with the southing of the moon.

Theodosius of Bithynia, B.C. 50, left a work on spherical geometry, another on climates, and a third on the phenomena of day and night.

Sosigenes of Alexandria, B.C. 50, corrected the calendar under Julius Cæsar.

Hyginus left an astronomical description of the heavens.

Manilius, a Roman, A.D. 10, wrote an astronomical and astrological poem.

Seneca, A.D. 50. His book on natural philosophy contains many pieces of information on astronomical history, but is principally remarkable for the bold opinions of the author on the nature of comets. These he declares to be planets, whose laws he predicted would one day be calculated, and that posterity would wonder how things so simple could have so long escaped notice.

Menelaus, A.D. 80, observed at Rome and Rhodes. He has left three books of spherical trigonometry.

Theon of Smyrna, A.D. 117 (?) observed at Alexandria. He wrote on astronomy, and made a collection of astronomical works. His observations are cited by Ptolemy.

Cleomedes wrote on astronomy. He certainly lived after Posidonius, but whether before or after Ptolemy is uncertain. He is usually considered as having lived under Augustus Cæsar.

We must suppose that there were many real observers between the epochs of Hipparchus and Ptolemy; but from the loss of even their names, and the silence of Ptolemy himself, it is clear that no discovery of any importance was made.

Ptolemy of Alexandria, A.D. 130–150. We must briefly mention his works, his system, and his discoveries. The *μαθηματικὴ σύνταξις*, or *mathematical collection*, afterwards called *μεγάλη σύνταξις*, and by the

Arabs the *Almagest* [ALMAGEST; SYNTAXIS] is the work from which we derive most of our knowledge of the Greek astronomy. We find there a full account of the observations and discoveries of Hipparchus; those of Ptolemy himself; the reasons and elements of his system; various mechanical arguments against the motion of the earth, which show that the first principles of dynamics were utterly unknown; a description of the heavens and the Milky Way, and a catalogue of stars, which we may be nearly certain was that of Hipparchus, reduced to his own time by an assumed value for the precession, but which has been asserted to have been corrected by new observations; a theory of the planetary motions; the length of the year; the instruments he employed, &c.

The Ptolemaic system [for more detail of which see PTOLEMAIC SYSTEM] was an attempt to represent the motions of the planets by supposing them to move uniformly in circles, the centres of which circles themselves moved uniformly in circles round the earth. The angular motions of the planets, as then known, were sufficiently well represented by this system; not so their changes of distance from the earth, as seen in their apparent diameters. This was the universal system of after-times till Copernicus.

The principal discovery of Ptolemy is that of the LUNAR EVECTION (which see), an inequality such as would be caused by an alternate increase and diminution of the eccentricity of the moon's orbit. He also discovered the REFRACTION (which see), and made some tolerably correct experiments to determine its law. He explained the apparent enlargement of the discs of the sun and moon when near the horizon. He extended the projection of the sphere of Hipparchus. He entered into the investigation of every point which Hipparchus had touched; in some instances finding more correct values; in others, altering without amending. He was not an astronomer only, but wrote on geography, music, chronology, mechanics, and, unfortunately, on astrology.

With Ptolemy the originality of the Greek school ends. We must come to the Arabs before we find anything worth particular notice.

Sextus Empiricus, A.D. 173, described and wrote against the Chaldean astrology.

Censorinus, A.D. 238, wrote an astrological work on the day of nativity, containing historical information with regard to astronomy.

Julius Firmicus Maternus, A.D. 370, wrote on astronomy.

Pappus of Alexandria, A.D. 383. His commentary on Ptolemy is nearly all lost.

Theon of Alexandria, A.D. 385, the most celebrated commentator on Ptolemy. He was a good mathematician, but no great astronomer. He has however left some tables, and a method of constructing almanacs.

Hypatia (his daughter), murdered A.D. 415, the first female on record celebrated for her scientific talents. She wrote one book of her father's commentary, and constructed some tables.

Martianus Capella, A.D. 470, in his 'Satyricon,' has some astronomical notions, among which is the following: that Mercury and Venus move round the sun. Cicero and Macrobius give the same idea; but the passage of Martianus is remarkable as being reported to have turned the attention of Copernicus to the system which bears his name.

Thius of Athens, A.D. 500, has left six observations of lunar occultations and solstices: *the only observations recorded between Ptolemy and the Arabs.*

Simplicius, A.D. 546, has left a commentary on, and description of, the astronomical work of Aristotle, which we have mentioned as lost.

Proclus Diadochus (the commentator of Euclid), A.D. 550, wrote a commentary on the astrology of Aristotle, and a description of astronomical phenomena.

Isidore, archbishop of Hispalis (Seville), A.D. 636, wrote a theological work on astronomy.

Bede, A.D. 720, and *Barlaam* the monk, A.D. 1330, are attached to the preceding by Delambre. Both wrote astronomical works of little distinct merit. The last Greek writer on astronomy of the least note is *Michel Psellus*, A.D. 1050.

It is remarkable that, excepting his own commentators, few of the authors who flourished during the period immediately succeeding ever quote Ptolemy. Had it not been for the Arabs, the writings of the latter must have been lost.

The Alexandrian school was destroyed by the Saracens under Omar, A.D. 640; and the rise of astronomy among the eastern Saracens dates from the building of Bagdad by the Caliph Al Mansur, in the year 762. In the reign of this prince translations of the Greek writers were begun; and, with nearly the same instruments and the same theory as Ptolemy, a career of four centuries of observation commenced, during which many astronomical elements, and in particular the obliquity of the ecliptic, and the precession of the equinoxes, were more accurately determined.

In the reign of Al Mamoum, son of Harun al Rashid, himself a diligent observer, great encouragement was given to astronomy. A degree of the meridian was measured, but with what accuracy cannot be known, from our ignorance of the measure employed.

Albategnius, or *Al-Batani*, A.D. 880, discovered the motion of the solar apogee, corrected the value of the precession, the solar eccentricity, and the obliquity of the ecliptic, and published tables. He is the first who made use of sines (instead of chords) and versed sines. He found the length of the year more accurately. He is, beyond all doubt, the only distinguished observer of whom we know anything between Hipparchus and Tycho Brahé.

Alfraganus, or *Al-Fergadi*, and *Thabet ben Korrah*, both about A.D. 950. The first has left a work on astronomy; the second is principally remarkable by his having revived an old notion of the Greeks (not mentioned by Ptolemy, but by Theon) of a variation in the position of the ecliptic, which has been called a *trepidation*. (See 'Hist. Ast.,' Library of Useful Knowledge, p. 33.)

Ebn Yunis, and *Abul-Wefa*, about A.D. 1000. The former, an Egyptian, an observer and mathematician of great merit, has left a work containing tables and observations. He first noted the time of the beginning and end of an eclipse by taking the altitude of a star. His work shows an increasing knowledge of trigonometry. He was the first who employed subsidiary angles. Abul-Wefa first formally used tangents, cotangents, and secants, which Albategnius had overlooked. He gave tables of tangents and cotangents.

Alphetragius of Morocco, 1050, attempted a new explanation of the planetary motions, not worthy of further notice.

Arsachel, a Spanish Moor, 1080, has left some tables [TOLEDO, TABLES OF] of indifferent accuracy. His contemporary, *Alhazen*, wrote on refraction. *Geber*, also a Spaniard (about 1080?), made some improvements in spherical trigonometry. He introduced the use of the cosine.

Abul Hassan, about 1200, has left a catalogue of stars, and some improvements in dialling.

We have Persian tables (of the 11th century?) translated by George Chrysococca, a Greek physician, in the 14th century; but the best known are those of Nasiréddin, published in 1270, under the protection of Hulagu, grandson of Jenghis Khan, and conqueror of Persia. The Persians have a method of intercalating their solar years, which, though complicated, is of surprising accuracy, but when they first began to employ it is unknown. [CALENDAR.]

Ulug Beg, grandson of Timur, 1433. This prince made a large number of observations at Samarcand. His catalogue of stars of the date above-mentioned, was, in its day, the most correct ever published. He also gave tables of geographical latitudes and longitudes. The Emperor Akbar (sixth from Timur, died 1605) also encouraged astronomy, and caused many Hindoo works to be translated into Persian.

In China, *Cocheou-King* 1280, patronised by Kublai, brother of Hulagu, and fifth successor of Jenghis Khan, in the partial conquest which that prince made of China, made a great number of good observations. He introduced spherical trigonometry, and rejected the ancient chronology.

Since the 15th century, astronomy has declined throughout the East. The Chinese received many methods from the Jesuits, but to little purpose. Among the Hindoos, there are very few who can understand the ancient writings. The Turks and Persians have little besides astrology. We now proceed with the chain of European astronomy.

Astronomy was introduced again into Europe by means of the Greek writers, mostly through translations from the Arabic. The first translation of the 'Almagest' was made under the auspices of the Emperor Frederic II., about 1230.

Sacrobosco (an Englishman named *Holywood*), 1220, wrote a work on the sphere taken from Ptolemy, &c. It continued for a long time in great repute. He also wrote on the Calendar. About the same time, *Jordanus* wrote a curious work on the Planisphere.

Alonso X., king of Castile, 1252, with the assistance of Arabs and Jews, formed the first European tables. They differ little from those of Ptolemy. [ALONSINE TABLES.]

Roger Bacon, 1255, wrote on the phenomena of astronomy. (For writers of this period, not worth naming, see Delambre, 'Hist. Ast. Moy.' pp. 258, 444.)

The Cardinal *Cusa*, 1440, wrote on the correction of the Calendar. He is said to have maintained the motion of the earth.

George Purbach, 1460, extended trigonometrical tables, and published a theory of the planets based on that of Ptolemy.

John Müller, called *Regiomontanus* (died 1476), made an abridgment of the 'Almagest,' published more extensive trigonometrical tables, extended various parts of trigonometry, and was an observer, though not, in this respect, superior to some of the Arabs. His almanacs were the first which were worthy of the name, and were in great repute.

The two last-mentioned writers deserve some special notice, though it cannot be said that they made any direct advances either in theory or observation. Their writing, and the facilities afforded by their tables, undoubtedly did much to promote a taste for astronomy.

George of Trebizond, called *Trapezuntius*, who died 1486, first translated the '*Almagest*' *from the Greek* into Latin.

Bianchini, 1495, published tables similar to those of Alonso.

Waltherus (died 1504), a pupil of Regiomontanus, made numerous observations which were often reprinted.

The following names are inserted that the reader may know to what names to refer for the astronomy of the time immediately preceding the promulgation of the system of Copernicus. Except in this point of view, there is but little interest attached to their labours:—

Riccius, 1521, wrote a work on astronomy, containing much historical discussion.

Werner (died 1528), gave a more correct value of the precession.

Stöffler (died about 1531), published almanacs for fifty years; wrote on the astrolabe, &c.

Munster (died 1552), wrote on clocks and dials.

Fracastorius (died 1543), wrote on the heavenly motions.

In 1528, *Fernel*, who died in 1558, gave a very correct measure of a degree of the meridian, from such insufficient observations, that, as Delambre remarks, the correctness must have been accidental.

Phenomena observed to the close of the 15th century :—

1030. A total eclipse of the sun, observed in Norway.

1106. A great comet appeared. Its tail was compared to a beam of fire extending along the heavens.

1140. Occurrence of a total eclipse of the sun which was visible in London. This eclipse is mentioned in the Saxon Chronicle and in the writings of William of Malmesbury.

1264. Apparition of a great comet in the heavens, accompanied by a tail 100° in length.

1402. Two great comets appeared in the heavens in the course of this year.

1433. Occurrence of a total eclipse of the sun which was visible in Scotland.

1456. Apparition of a great comet which spread universal terror throughout Europe. This is known to have been one of the apparitions of Halley's comet.

1468. A great comet visible : observed in Europe and China.

1472. A great comet observed both in Europe and China. In one day it described an arc of 40°.

Copernicus, born 1473, died 1543. Applied himself to astronomy from 1500. In 1530, he had finished his tables of the planets, and his work 'On the Revolutions of the Heavenly Bodies,' containing an explanation of the COPERNICAN SYSTEM, which, it is almost unnecessary to say, was a revival of the opinions of the Pythagorean school on the motion of the earth. It was published in 1543, and its author died immediately afterwards. Copernicus improved the lunar tables, and gave, to a considerable extent, an explanation of celestial phenomena upon his own system. His book is a mixture of his own original and sagacious notions and of the old philosophy; and he was far from being able to answer the mechanical objections of his time. What might have struck so bold a thinker, had he lived to face opposition, cannot be told, but as the history stands, we shall come to the time of Galileo before we find all objections satisfactorily answered.

From this period, at which the preservation of printed works commences, our limits will not permit our giving more than the names of many astronomers. The following is the list of those who are worth mention between Copernicus and the death of Tycho Brahé. The history of this period has been elucidated chiefly by Professor De Morgan. The dates are generally those of death, but where that is not known, the date in brackets is that of the publication of some work.

Copernicus	1543	Vigenera	(1578)
Gassarus	1546	Stadt	1579
Apian	1552	Schreckenfuchsius	1579
Gauricus	(1552)	Bressius	1581
Rheinhold	1553	John of Padua	1582
Piccolomini	1553	Didacus à Stunica	1584
Orontius Fineus	1555	Urstisius	1588
Gemma Frisius	1555	Raimar	1588
Royas	(1555)	Benedict	1590
Dee	(1556)	Schöner	1590
Field	(1556)	Landgrave of Hesse Cassel	1592
Bassantin	1557	Mercator	1594
Recorde	1558	Thomas Digges	(1595)
Carelli	1558	Rothmann	1596
Vinet	1564	Patricius	1597
Leonard Digges	1571	Galucci	(1597)
Ramus	1572	Pini	1598
Maurolicus	1575	Jordanus Brunus	1600
Rheticus	1576	Tycho Brahé	1601
Nonius	1577		

Of these must be mentioned—

Rheinhold, the friend of Copernicus, who formed the PRUTENIC TABLES (which see).

Recorde, the first who wrote on astronomy and the doctrine of the sphere in English.

Rheticus, editor of the 'OPUS PALATINUM,' a large trigonometrical table (which see).

Maurolicus, author and editor of several works and tables. [MAUROLICO, in BIOG. DIV.]

Nonius, inventor of an ingenious method of division of the circle, which has often caused it to be supposed that he anticipated the invention of Vernier.

Mercator (Gerard), who gave the first idea of the projection known by his name.

Jordanus Brunus, who was burnt to death at Rome in consequence of his bold opinions on the system of the universe.

Up to this time, the means of observation had been undergoing gradual improvement, more by attention to the construction of the older instruments, than by the introduction of any new principle. The Copernican theory had its advocates, but was not yet adopted by many. Algebra had been introduced into most parts of Europe, but was not yet in a state to furnish much assistance in trigonometry. Logarithms were not yet invented, nor do we find the *instruments* fixed in the *meridian*, the *telescope*, or the *pendulum clock*. The first *observer*, who made any important additions to the phenomena of the heavens as received from the Arabs, was Tycho Brahé, to whom we now come.

Tycho Brahé, born 1546, began to study astronomy 1560; commenced his observations at Huena, an island, in the Baltic, near Copenhagen, 1582; was driven from thence, 1597; died 1601. He made a catalogue of the fixed stars, more accurate than any which preceded : gave the first table of refractions : discovered the *variation* and *annual equation* (which see) of the moon, the variation of the motion of her nodes, and of the inclination of her orbit. What was essentially as great a service as any of the preceding, he discarded the *trepidation* of the precession, already mentioned, which had more or less infected all tables up to his time; he also ascertained that comets (those of his day, of course) were further removed from the earth than the moon; in fact, that they had no parallax which his instruments could discover, thus refuting the notion that they were atmospheric bodies. He greatly improved and extended the instruments in use as well as all the methods of observation.

Tycho Brahé did not admit the Copernican theory; but substituted for it one of his own, usually known by the name of the *Tychonic system*. This consisted in supposing the sun to move round the earth, but all the other planets to move round the sun, being also carried with it round the earth. This system explains all the appearances as well as that of Copernicus; and we must say (though it is always usual to reproach Tycho for refusing to admit the simple system of Copernicus) that by this means the *then* unanswerable arguments against the Copernican system were avoided. In fact, there is nothing but the *aberration of light* (a comparatively recent discovery), which is demonstrably conclusive in favour of the annual motion of the earth. [ABERRATION; MOTION (APPARENT).] The system of Tycho is said to have been promulgated by some of the ancients, at least with regard to the inferior planets.

The reformation (as it was called) of the calendar took place in 1582, under Pope Gregory XIII. As the views of those who made the change were rather theological than astronomical, we shall only here mention the fact and the disputes it gave rise to; referring for further information to CALENDAR.

From the time of the death of Tycho Brahé, to that of Newton, which forms the next great epoch in the history of astronomy, we can only dwell generally on a few leading discoveries. To enable the reader to search further, we give a table of all the names between the deaths of Tycho Brahé and Newton, which Delambre has thought worthy of any mention, with some few additions. The names mentioned from 1581 to 1727, which are not in this list, will be found in the next. The year of death is given opposite to each name; or where that is not known, the year of some publication is given in brackets. The dates are principally from Weidler, and several from Delambre, compared with those in the first edition of Lalande's Astronomy.

Tycho Brahé	1601	Metius	1635
Bayer	(1603)	Schickhardt	1635
Vieta	1603	Peyresc	1637
Gilbert	1603	Reinerius	1639
Nunez	(1605)	Horrocks	1641
Scaliger, Jo.	1609	Galileo	1642
Clavius	1612	Gascoigne	1644
Pitiscus	1613	Herigonius	(1644)
Calvisius	1615	Langrenus	1644
J. B. Porta	1615	Bartoli	(1644)
Wright	1615	Rheita	(1645)
Fabricius	1616	Fontana	(1646)
Magini	1617	Cavalerius	1647
Napier	1617	Longomontanus	1647
Ursinus	(1619)	Torricelli	1647
Tarde	(1620)	Durret	(1649)
Marius	1624	Argoli	1650
Adr. Romanus	1625	Descartes	1650
Gunter	1626	Scheiner	1650
Snellius	1626	Wing	(1651)
Wendelinus	(1626)	Petavius	1652
Blaeu	(1628)	Crabtree	1652
Vlacq	(1628)	Pascal	1653
Briggs	1630	Gassendi	1655
Malapertius	1630	Licetus	1656
Vernier	(1631)	Morinus	1656
Mœstlinus	1631	Tacquet	1660
Kepler	1631	Street	(1661)
Lansberg	1632	Malvasia	(1662)
Stevinus	1633	Levera	(1663)
Bartschius	1633	Cunitia (Maria)	1664
Byrgius	1633	Deusingius	1666
Norwood	(1633)	Lubienietsky	(1667)
Habrecht	1634	Townley	(1670)

Riccioli	1671	Huyghens	1695
Mutus	(1673)	Richer	1696
Roberval	1675	Hooke	1703
De Billy	1679	Marquis de l'Hopital	1704
Borelli	1679	Duhamel	1706
Doerfel	(1680)	Gregory, Dav.	1708
Picard	1682	Roemer	1710
Lefevre	1683	Cassini, Dom.	1712
Picard	1684	Cotes	1716
Hevelius	1687	Leibnitz	1716
Pound	(1687)	Lahire, Phil.	1718
Greenwood	(1689)	Lahire, Gabriel P.	1719
Seth Ward	1689	Flamsteed	1719
Auzout	1693	Keill	1721
Bouillaud	1694	Wren	1723
Mercator, N.	1694	Wurzelbaur	(1725)
Mouton	1694	Newton	1727
Buot	1695		

As we approach an age in which discoveries proceed rapidly, it would disturb the order of time if we were to enumerate those of individuals together. We shall therefore give the dates in chronological order of the more remarkable phenomena which have appeared, and of the principal accessions to the science, keeping, according to our original plan, only enough to direct the attention of the reader to points worthy of further reference.

1560. Occurrence of a total eclipse of the sun which was observed at Coimbra by Clavius.

1567. Occurrence of an annular eclipse of the sun.

1572. Apparition of a new star in the constellation Cassiopeia. Hagecius determines the apparent positions of the new star of this year by measuring its altitude on the meridian and noting the time of observation.

1573. Thomas Digges proposes to determine the positions of the celestial bodies by the method of corresponding altitudes.

1577. Apparition of a comet, the observations of which enabled Tycho Brahé to demonstrate that cometary bodies revolve in the regions beyond the moon.

1581, or thereabouts, Galileo remarks the isochronism of the pendulum.

1590. An occultation of Mars by Venus witnessed by Mœstlin. (A doubtful observation.)

1596. Kepler's 'Mysterium Cosmographicum,' containing fanciful analogies between the orbits of the planets and the regular solids of geometry.

1598. Occurrence of a total eclipse of the sun which was observed in the north of Europe.

1601. Occurrence of an annular eclipse of the sun observed in Norway.

1603. Bayer's maps, in which the stars are first denoted by letters.

1604. Kepler approximates more nearly to the law of refraction. A new star appears in the constellation Serpentarius.

1607. An apparition of Halley's comet.

1608. Telescopes invented in Holland by Lipperhey, a spectacle maker.

1609. Galileo made a telescope from a general description of a magnifying instrument made by Lipperhey. He used a concave object glass, Lipperhey a convex. Kepler publishes his work on Mars, in which he establishes, from Tycho Brahé's observations, the elliptic form of the orbit, and the proportionality of the areas to the times. These are called *Kepler's first and second laws.*

1610. Galileo announces the discoveries of Jupiter's satellites—of spots on the moon—of nebulæ—of some new appearances in Saturn, afterwards found to proceed from the ring—phases of Venus. He also discovers the diurnal libration of the moon, and that in latitude. Harriot observes the spots on the sun. (This fact has only been known from examination of Harriot's papers in the present century. It appears he got telescopes from Holland.)

1611. Lyncean academy founded. Galileo observes the spots on the sun.

1614. Napier's invention of logarithms.

1616. Prohibition of the theory of Copernicus by the Roman court.

1617. Snellius measures an arc of the meridian at Leyden. This was the first done by *triangulation ;* but astronomical instruments were not yet sufficiently perfect to make this method much better than the old one.

1618. *Kepler* announces *his third law*, that the squares of the periodic times of the planets are in proportion to the cubes of their distances from the sun. Apparition of a great comet with a tail upwards of 100° in length.

1619. Snellius discovers the law of refraction from one medium into another.

1626. Wendelinus determines the diminution of the obliquity of the ecliptic. He also extended Kepler's law to Jupiter's satellites, and ascertained the sun's parallax.

1627. The 'Rudolphine Tables' published by Kepler, from the observations of Tycho Brahé.

1631. Gassendi first observed the transit of Mercury over the sun's disc; he also measured the diameter of the planet. Vernier publishes his invention of the instrument which bears his name.

1633. Norwood measured the meridian from York to London, and gave a more accurate value of the degree than his predecessors. Descartes produced his system of vortices. Galileo is obliged to recant his Copernican opinions by the Inquisition of Rome.

1637. Horrocks suspects the long inequality in the mean motions of Jupiter and Saturn.

1638. Horrocks ascribes the motion of the lunar apsides to the disturbing force of the sun, and adduces the oscillations of the conical pendulum as an illustration of the planetary movements.

1639. Horrocks and Crabtree first observed a transit of Venus over the sun's disc. The former ascertained the diameter of Venus. They were the only two who saw this particular transit.

1640. Gascoigne applied the telescope to the quadrant, and a micrometer to the telescope.

1646. Fontana observes Jupiter's belts.

1647. 'Selenographia' of Hevelius, in which the moon's libration in longitude is announced.

1650. Scheiner constructs a convex object-glass telescope.

1651. A transit of Mercury observed by Shackerley, at Surat in India.

1652. A great comet visible in the heavens.

1654. Huyghens completes the discovery of Saturn's ring.

1655. Huyghens discovers a satellite of Saturn (Titan).

1657. Academia del Cimento founded.

1658. Huyghens made the first pendulum clock.

1659. Huyghens, without being aware of what Gascoigne had done, devises the original form of the micrometer as used on the continent.

1660. Mouton applied the simple pendulum to observations of differences of right ascension, and measured the sun's diameter very correctly by it.

1661. A transit of Mercury observed at Dantzig by Hevelius.

1662. Royal Society of London incorporated. Cassini begins his researches on refraction. Malvasia's improvement of Huyghens' micrometer.

1663. Gregory makes his reflecting telescope.

1664. Hooke detects the rotation of Jupiter.

1665. Cassini determines the time of rotation of Jupiter, and publishes the first Tables of the Satellites. Hooke proposes to measure the distance of the moon from the stars in her vicinity, by means of *a rete or divided scale.*

1666. Cassini determines the rotation of Mars, and makes a first approximation to that of Venus. Academy of Sciences founded at Paris, and observatory first thought of and commenced in the following year. Auzout applied the micrometer to the telescope without any knowledge of Gascoigne. Newton first turned his attention to gravitation.

1667. Auzout and Picard applied the telescope to the mural quadrant, without knowing that Gascoigne had preceded them.

1668. Cassini's second Tables of Jupiter's Satellites. 'Cometographia' of Hevelius. A great comet visible in southern latitudes.

1669. Newton made his first reflecting telescope.

1670. Mouton's first use of interpolations.

1671. Picard and La Hire publish their degree of the meridian, obtained by measuring from Paris to Amiens. Richer, in a voyage to Cayenne, observes the shortening of the seconds' pendulum in approaching the equator. Flamsteed begins observing at Derby. Cassini begins the observations which led to his discovery of the inclination of the lunar equator, and the coincidence of its nodes with those of the orbit. Cassini discovers a satellite of Saturn (Japhet).

1672. Cassini discovers a satellite of Saturn (Rhea).

1673. Huyghens publishes his 'Horologium Oscillatorium,' in which are found the first theorems on central forces and centrifugal force. Flamsteed explains the equation of time. Picard, in the course of his labours at the Royal Observatory of Paris, introduces the practice of determining the positions of the stars by observing their altitude on the meridian and noting the corresponding time.

1674. Hooke revived the idea of attraction, but without assigning any law, or connecting it with any observed facts. Spring watches made under the direction of Huyghens, who was unacquainted with what Hooke had already done in the matter.

1675. Roemer announces his discovery of the velocity of light by means of Jupiter's satellites. Greenwich Observatory founded. D. Cassini discovers the division on Saturn's ring. Roemer recognises the advantages of the transit instrument for determining the right ascensions of the stars.

1676. Flamsteed commences his observations at the Royal Observatory, Greenwich.

1677. A transit of Mercury observed at St. Helena by Halley.

1679. Halley published his Catalogue of Southern Stars, observed at St. Helena. Appearance of the 'Connaissance des Tems.'

1680. Flamsteed gives the law of the annual equation of the moon, and corrects the tables accordingly. A great comet appeared in the heavens. This comet is remarkable for having, on its passage of the perihelion, approached nearer the sun than any other comet recorded in history, with the exception of the great comet of 1843. It is also memorable for having conducted Newton to the important discovery that comets revolve in conic sections around the sun, conformably to Kepler's laws. Clement, a London clockmaker, introduces the use of anchor pallets in clocks.

1681. Doerfel's work on comets.

1682. An apparition of Halley's comet. Newton, who had laid aside his theory of gravitation when he found it not capable of verification by taking the best measures of the earth in use, hears of Picard's more accurate measurement, tries it, and finds a remarkable degree of nearness to the result deduced from his celebrated law.

1683. Cassini and La Hire discontinue till 1700 the arc begun in 1680. A mural quadrant is erected in the plane of the meridian, at the Royal Observatory of Paris. Cassini's earliest researches on the zodiacal light.

1684. Cassini discovers two satellites of Saturn (Tethys and Dione).

1687. Newton publishes the 'Principia.'

1689. Roemer first used the transit instrument; that is, fixed a telescope in the meridian for the purpose of observing transits. Flamsteed commences his course of observations with the mural arc.

1690. Huyghens' theoretical determination of the ellipticity of the earth. Catalogue of Hevelius published.

1693. Cassini's third tables of Jupiter's satellites. Announcement of his discoveries on libration. Halley discovers the acceleration of the moon's mean motion.

1694. Commencement of Newton's correspondence with Flamsteed respecting observations for the improvement of the lunar theory and the establishment of the theory of refraction.

1699. Occurrence of a total eclipse of the sun, visible in the North of Europe.

1700. The Cassinis (D. and J.) extend the arc which the former had begun southward.

1702. La Hire's researches on the theory of refraction.

1704. Roemer commences observing the stars with a meridian circle.

1705. Halley first predicted the return of a comet, namely, that of 1759.

1706. Occurrence of a total eclipse of the sun, which was visible in the south of France.

1711. Berlin Observatory founded.

1714. J. Cassini discovers the inclination of the orbit of Saturn's fifth satellite.

1715. Occurrence of a total eclipse of the sun, which was visible in London. Taylor's researches on the theory of refraction.

1718. Bradley publishes his tables of Jupiter's satellites. J. Cassini and Maraldi complete at Dunkirk the arc begun by Cassini.

1719. Maraldi's (I.) researches on the rotation of Jupiter.

1721. Halley communicates to the Royal Society Newton's Table of Refractions.

1724. Occurrence of a total eclipse of the sun, which was visible in Paris.

1725. Flamsteed's 'Historia Cœlestis.' Petersburg Observatory founded. Harrison's compensation pendulum.

1726. Bianchini determines the rotation of Venus. Graham invents the mercurial pendulum.

1727. Bradley discovers aberration. Death of Newton.

We have now brought the history to a most remarkable epoch. The great comparative perfection of instruments, the invention of the telescope, of the micrometer, of the clock, of logarithms, the introduction of algebra, the invention of fluxions, and the establishment of the theory of gravitation, in England at least, were so many steps each of magnitude unequalled in former times. But the most meritorious labours of the preceding table are not those which make most show. It takes as much space to say that Cassini discovered a satellite of Saturn, as that Flamsteed published the 'Historia Cœlestis;' but the first might have been left to the present day without much loss, whereas the latter was a new era in sidereal astronomy. It would have done more for astronomy than the mathematical Syntaxis of Ptolemy, had it been similarly circumstanced: that is, the work of Ptolemy contained only a simple account of what had been done before, with no material improvements either in methods or instruments; whereas that of Flamsteed contained both, and gave a catalogue of stars such as had not been published before. [FLAMSTEED, in BIOG. DIV.]

The distinct part of Newton's great discovery, which is seldom well understood by any who have not studied it, is—*not* the notion of attraction, which had occurred to many among the ancients, and to Borelli, it is stated, and Hooke, among the moderns—*not the law*, which had been suggested by Bouillaud or Bullialdus—but the proof that the mechanical deductions from this law of attraction really do represent the celestial phenomena; a combination of improvements in mechanics and mathematics which none but the inventor of fluxions could have made, and a specimen of sagacity which it needed the author of the Optics to display. Still less is it true, as many believe, that the Newtonian theory is the Copernican, when they speak of Newton as the establisher of the latter. After what we have said, it is unnecessary to discuss this further than to observe, that it was Galileo who destroyed the mechanical objections to the notions of Copernicus, by the sound system of dynamics of which he was the inventor; and who re-enforced the notions of Copernicus, by arguments of the most forcible character drawn from probability. But it was Bradley who, by his discovery of ABERRATION (which see), furnished the direct and unanswerable proof of the earth's annual motion; and it is a coincidence worth remembering, that the year of the death of Newton was that of this remarkable accession as well to physics as to practical astronomy.

We shall now proceed to sketch the annals of astronomy from the death of Newton to the present time.

The interval between the death of Newton and the present time may be divided into two parts: the first reaching to the end of the century, abounding in magnificent discoveries both of analysis and observation; the remainder more distinguished by efforts to extend, correct, and methodise, the results of the first.

The following is the list of names from the death of Newton to the close of the 18th century, arranged in the same manner as the preceding:—

Leadbetter	(1728)	Wargentin	1783
Maraldi, J. P.	1729	Mayer, C.	1783
Blanchini	1729	Lexell	(1783)
Louville	1732	D'Alembert	1783
Manfredi	1739	Euler	1783
Sharp	1742	Cassini III. (De Thury)	1784
Halley	1742	Trebuchet	1784
Maclaurin	1746	Boscovich	1787
Bernoulli, J.	1748	Mason	1787
Châtelet (Mad. du)	1749	Fouchy	1788
Graham	1751	Maraldi II. (J. D.)	1788
Whiston	1755	Palitsch	1788
Marinoni	1755	Madame Lepaute	1789
Cassini II. (James)	1756	Taylor	1789
Fontenelle	1756	Favre	1790
Ximenes	(1757)	D'Agelet	1791
Bouguer	1758	Bertrand	1792
Maupertuis	1759	Legentil	1792
Godin	1760	Hell	1792
Simpson, T.	1760	Triesnecker	(1792)
Dollond	1761	Bailly	1793
Bradley	1762	Saron	1794
Lacaille	1762	Mudge	1794
Mayer, T.	1762	Emery	1794
Bliss	1764	Nieuwland	1794
Horrebow	1764	Du Sejour	1794
Clairaut	1765	Antonio Ulloa	1795
Bird	(1776)	Rittenhouse	1796
De L'Isle	1768	Pingré	1796
Beccaria	(1768)	Lorgna	1796
Frisi	(1768)	Toaldo	1797
Chappe	1769	Maraldi III. (J. P.)	1797
Long	1770	Callet	1798
Pemberton	1771	Borda	1799
Fontaine	1771	Lemonnier	1799
La Condamine	1774	Montucla	1799
Harrison	1776	Liesganig	1799
Ferguson	1776	Swanberg	(1800)
Pezenas	1776	Cassini IV. (Comte)	(1800)
Lambert	1777	Ramsden	1800
Zanotti	1782	Cousin	1800

1728. Observatory of Copenhagen destroyed by fire; the great mass of observations executed by Roemer and his successor, Horrebow, irrecoverably lost.

1729. A comet visible for six months, remarkable for its perihelion distance being greater than that of any other comet recorded in history. Bouguer's researches on astronomical refraction.

1731. Hadley's quadrant invented.

1732. Maraldi (II.) improves the theory of the satellites of Jupiter by observation. The introduction, by Maupertius, of the Newtonian theory into France. Wright's Lunar Tables.

1733. Occurrence of a total eclipse of the sun, which was visible in the northern countries of Europe.

1736. Maupertius, &c., measure an arc in Lapland, and Bouguer and La Condamine in Peru.

1737. Lacaille and Cassini de Thury re-measure the arc of D. Cassini. Clairaut improves the theory of the figure of the earth. An annular eclipse of the sun observed in Scotland.

1739. Dunthorn's Lunar Tables.

1740. J. Cassini's Astronomy published, containing many new tables from his own and his father's observations.

1744. Euler's 'Theoria Motuum,' &c., the first analytical work on the planetary motions. Apparition of a splendid comet which was visible in full daylight.

1745. Bradley discovers the phenomenon of nutation. Bird began to improve the graduation of mathematical instruments.

1746. Euler's Solar and Lunar Tables. Wargentin's Tables of Jupiter's satellites.

1747. Euler, Clairaut, and D'Alembert. Various researches in the planetary theory. Mayer's confirmation of Cassini's theory of libration, by observation.

1748. Bouguer proposes a micrometer with a divided object-glass.

Euler's prize essay on the motions of Jupiter and Saturn. An annular eclipse of the sun observed in Scotland.

1749. Euler's and D'Alembert's researches on precession, D'Alembert's on nutation, Clairaut's on the motion of the Lunar Apogee. Halley's Tables.

1750. Mayer first uses *equations of condition*. Boscovich measures an arc of the meridian at Rimini. Wright's 'Theory of the Universe.' In this work the author suggests the theory of the structure of the Milky Way, which is generally admitted in the present day.

1751. Lacaille goes to observe at the Cape of Good Hope.

1752. Lacaille measures an arc of the meridian at the Cape.

1753. Dollond makes his double object-glass micrometer. Mayer's first idea of the repeating circle. Occurrence of a transit of Mercury.

1754. Chappe publishes the solar and lunar tables of Halley. Clairaut's Lunar Tables.

1756. D'Alembert's researches on the figure of the earth; Euler's on the variation of the elements of elliptic orbits. Mayer's catalogue of zodiacal stars. Clairaut's researches on the perturbations of comets.

1757. Lacaille's 'Astronomiæ Fundamenta.'

1758. Lacaille's Solar Tables. Dollond's achromatic object-glass. Clairaut and Lalande's researches on Halley's comet.

1759. Lalande publishes Halley's Planetary Tables. Apparition of Halley's comet. Improved edition of Wargentin's Tables of Jupiter's satellites.

1760. Bird's Standard Scale.

1761. Transit of Venus. Maskelyne at St. Helena.

1762. Euler and Clairaut's researches on the perturbations of comets.

1763. Lacaille's catalogue of southern stars.

1764. Occurrence of an annular eclipse of the sun. Lalande confirms Mayer's observations of libration. Lagrange's prize essay on Libration, containing the first application of the principle of virtual velocities. Mason and Dixon begin the measurement of an arc in Pennsylvania.

1765. Harrison gains the parliamentary reward for his chronometer. Maraldi discovers the libratory motion of the nodes of Jupiter's second satellite.

1766. Occurrence of a total eclipse of the sun, which was visible in the Southern Ocean. Lagrange's theory of Jupiter's Satellites. Bailly's ditto.

1767. First 'Nautical Almanac.'

1768. Beccaria measures an arc in Piedmont, and Liesganig in Hungary.

1769. Transit of Venus. Apparition of a comet with a tail of immense length.

1770. Mayer's Solar and Lunar Tables. Discovery of Lexell's comet.

1771. Bailly's further researches on Jupiter's satellites.

1772. *Bode's law* of the distances of the planets.

1773. Lagrange's researches on the attraction of spheroids. Laplace on the secular inequalities of the solar system.

1774. Maskelyne's observations on local attraction at Schehallien.

1778. Occurrence of a total eclipse of the sun.

1780. Mason's Lunar Tables.

1781. Herschel discovers the new planet now called Uranus. Messier's catalogue of Nebulæ. Wargentin discovers that the inclination of Jupiter's fourth satellite is variable.

1782. Laplace finds the elements of the orbit of Uranus. Laplace's researches on the attraction of spheroids.

1783. Nouet's tables of Uranus. Pingré's 'Cometographie.'

1784. Laplace's researches on the stability of the solar system, on the relation between the longitudes of Jupiter's first three satellites, and on the great inequality of Jupiter and Saturn. General Roy measures a base on Hounslow Heath for the connection of the observatories of Paris and Greenwich. Herschel's catalogue of Nebulæ.

1786. Lagrange gives the differential equations for the variations of the elliptic elements.

1787. Laplace's theory of Saturn's ring, and explanation of the acceleration of the moon's mean motion. Herschel discovers two satellites of Uranus. Legendre and General Roy finish the connection of the observatories of Paris and Greenwich. Beginning of the trigonometrical survey in England. Herschel's first observations with his forty-foot telescope. Herschel discovers two satellites of Uranus (Oberon and Titania).

1788. Lagrange's 'Mécanique Analytique.' Herschel suspects that the movements of the satellites of Uranus are retrograde.

1789. Herschel measures the rotation of Saturn, and discovers two satellites of Saturn (Mimas and Enceladus). Delambre's tables of Jupiter and Saturn.

1790. Herschel determines the rotation of Saturn's ring, and suspects the existence of two more satellites of Uranus. Delambre's tables of Uranus. Maskelyne's catalogue. Brinkley appointed to Dublin Observatory.

1791. An annular eclipse of the sun observed in America.

1792. Beginning of the French survey. Taylor's Logarithms. Lalande's improved Planetary Tables. Zach's first Solar Tables, and Catalogue of Stars. A comet discovered by Miss Herschel.

1793. Laplace on the satellites of Jupiter and figure of the earth. Schroeter determines the rotation of Venus.

1795. Herschel's observations on variable stars, and separation of the milky way into stars.

1796. Establishment of the French Institute. Herschel gives strong presumptions that the rotations of Jupiter's satellites are of the same duration as their orbital revolutions. Oriani on the perturbations of Mercury.

1797. Delambre's observations on refraction. Laplace's theory of tides. Olbers publishes the method for determining the parabolic elements of a comet's orbit, which has since been generally used in Germany.

1798. Cavendish demonstrates and measures the mutual attraction of metal balls. Herschel announces his discovery of the retrograde motions of the satellites of Uranus.

1799. Commencement of the 'Mécanique Céleste.' Occurrence of a transit of Mercury. Kramp's researches on astronomical refraction.

The following list comes down to the present time (March, 1859):—

Bory	1801	Gambart	1836
Jeaurat	1803	Tiarks	1837
Méchain	1804	Colebrooke	1837
Lalande, J.	1807	Moll	1837
Cavendish	1810	Bowditch	1838
Maskelyne	1811	Rigaud	1839
Lagrange	1813	Olbers	1840
Wollaston, Fr.	1815	Poisson	1840
Messier	1817	Bouvard	1840
Burckhardt	1817	Littrow	1840
Mudge	1821	Cacciatore	1841
Herschel, W.	1822	Henderson	1844
Delambre	1822	Baily	1844
Lambton	1822	Bessel	1846
Hutton	1823	Damoiseau	1846
Bode	1826	De Vico	1848
Fraunhofer	1826	Taylor	1848
Piazzi	1826	Schumacher	1850
Laplace	1827	Cerquero	1850
Wollaston, W.	1828	Boguslawski	1851
Young	1829	Goldschmidt	1851
Fallows	1831	Colby	1852
Pons	1831	Arago	1853
Foster	1831	Walker	1853
Oriani	1832	Lindenau	1854
Zach	1832	Petersen	1854
Groombridge	1832	Mauvais	1854
Legendre	1833	Gauss	1855
Brioschi	1833	Sheepshanks	1855
Caturegli	1833	Busch	1855
Harding	1834	Colla	1857
Troughton	1835	Raper	1858
Kater	1835	Bond	1859
Brinkley	1835	Wichmann	1859
Pond	1836	Johnson	1859

1799-1804. Humboldt's voyage and observations in South America.

1800. Wollaston's circumpolar catalogue. Bode's maps and catalogue. Mudge begins his great arc of the meridian, from the Isle of Wight to Clifton in Yorkshire. Commencement of the 'Monatliche Correspondenz' (an astronomical periodical, which terminates in 1812).

1801. Lalande's catalogue. Piazzi discovers the planet Ceres. Swanberg begins the measurement of an arc in Lapland.

1802. Olbers discovers the planet Pallas. Lambton begins the measurement of an arc in India. Herschel's catalogue of Nebulæ.

1803. Cagnoli's catalogue. Herschel observes the changes in the position of double stars.

1804. Harding discovers the planet Juno. Piazzi gives the proper motion of 300 stars. Zach's solar tables.

1805. Legendre, method of least squares. Discussion on the parallax of the fixed stars, from this date to 1825.

1806. Completion of the French survey by Méchain and Delambre. Delambre's Solar Tables, and Tables of Refraction. Burg's Lunar Tables. Carlini's Tables of Refraction. Pond's catalogue of North Polar Distances (altitude and azimuth instrument). Herschel suspects the motion of the whole solar system towards the constellation Hercules. Occurrence of a total eclipse of the sun.

1807. Olbers discovers the planet Vesta. Extension of the French arc into Spain. Piazzi's catalogue of 120 stars.

1808. Lagrange and Laplace's Researches on the Planetary Theory.

1809. Troughton improves the division of graduated instruments. Ivory's Theorems on the Figure of the Earth. Publication of Gauss's 'Theoria Motus.'

1810. Groombridge's Tables of Refraction. Carlini's Solar Tables. Lindenau's Tables of Venus. Bessel's researches on the orbit of the great comet of 1807. Bessel appointed Director of the Königsberg Observatory.

1811. Lindenau's Tables of Mars. Apparition of a great comet, which continued visible to the naked eye for several months.

1812. Troughton's mural circle mounted at Greenwich. Zach's Tables of Aberration. Burckhardt's Tables of the Moon.

1813. Bessel's Refractions (from Bradley). Lindenau's Tables of Mercury. Pond's catalogue of North Polar Distances (circle).

1814. Piazzi's catalogue of 7646 stars, the best and largest extant.

Observatory of Königsberg founded. Commencement of the publication of the Königsberg Observations. Commencement of the 'Zeitschrift für Astronomie' (an astronomical periodical, which terminates in 1818).

1815. Brinkley's Tables of Refraction. Bessel's researches on Precession.

1816. Lindenau's Determination of the Nutation. Poisson's Researches on the Planetary Perturbations.

1817. Delambre's Tables of Jupiter's Satellites. Damoiseau's researches on Halley's comet.

1818. Bessel's 'Fundamenta Astronomiæ.' Pons discovers a comet of short period, now called by the name of Encke. Commencement of Von Zach's 'Correspondance Astronomique' (an astronomical periodical, which terminates in 1825).

1820. Astronomical Society of London founded. An annular eclipse of the sun observed in Holland. Reichenbach's meridian circle erected at Königsberg. Commencement of the publication of the 'Astronomische Nachrichten.'

1821. Observatory of the Cape of Good Hope founded. Bouvard's Tables of Jupiter, Saturn, and Uranus. The Greenwich Observatory first introduced circle observations by reflection. Poisson on the Precession of the Equinoxes.

1822. Paramatta Observatory founded. Harding's 'Atlas Cœlestis.' Argelander's researches on the orbit of the great comet of 1811.

1823. Beginning of the erection of Cambridge Observatory. Ivory's Researches on Refraction. Encke infers a resisting medium of very little density, from observations of the comet known by his name. Apparition of a comet with two tails, one extending in the direction of the sun, and the other in the opposite direction.

1824. Herschel, J., and South, Catalogue of Double Stars. Damoiseau's Lunar Tables. Encke determines the solar parallax from the transits of Venus in 1761 and 1769. Dorpat refractor erected.

1825. Commencement of *Berlin Zones*. Second mural circle (Jones) erected at Greenwich. Apparition of a conspicuous comet.

1826. Bessel's researches on the oscillations of a pendulum. Biela discovers the comet of short period known by his name.

1827. Astronomical Society's Catalogue. Struve's Catalogue of 3112 Double Stars. Commencement of the publication of the 'Monthly Notices' of the Royal Astronomical Society.

1828. Professor Airy discovers a long inequality in the motions of the Earth and Venus. Captain Kater's vertical collimator.

1829. Pond's Catalogue of 720 Stars. Poisson on the Attraction of Spheroids. Pontecoulant's researches on Halley's comet.

1830. Sir J. Herschel's Measures of 1236 Double Stars. Publication of the 'Tabulæ Regiomontanæ.'

1831. J. Herschel; micrometrical measures of 364 double stars. An annular eclipse of the sun observed in America. Plana's 'Theory of the Moon' (first volume).

1832. Occurrence of a transit of Mercury. Sir J. Herschel; investigation of the orbits of revolving double stars. Don Joaquin de Ferrer; determination of the solar parallax, from observations of the transit of Venus over the sun's disc in the year 1769. Sir John Herschel's catalogue of 2007 double stars.

1833. Herschel's catalogue of Nebulæ in the Northern Hemisphere. Airy obtains an important correction to the value of Jupiter's mass. Publication of the results of Lieutenant Foster's pendulum experiments for determining the ellipticity of the earth.

1834. Occurrence of a total eclipse of the sun, which was visible in North America. Sir John Herschel; Researches on the Satellites of Uranus; Dawes, micrometical measures of 121 double stars. Lubbock's theory of the moon.

1835. Brisbane's catalogue of 7385 stars. Encke's researches on planetary perturbation (continued in 1836). Encke obtains a correction of the value of the solar parallax as deducible from the transits of Venus in 1761 and 1769. Apparition of Halley's comet. Airy determines the time of rotation of Jupiter. Sir John Herschel's catalogue of 286 double stars. Johnson's catalogue of 606 southern stars. Airy appointed Astronomer-Royal. Rosenberger's researches on Halley's comet. Lehmann's researches on Halley's comet.

1836. Publication of Baily's 'Life of Flamsteed.' Biot's researches on astronomical refraction. Damoiseau's tables of Jupiter's satellites. Steinheil's experiments on the brightness of the fixed stars. An annular eclipse of the sun, visible in Scotland.

1837. Lamont's researches on the satellites of Uranus. Pontecoulant's researches on the lunar theory. Henderson determines the value of the moon's equatorial parallax. Publication of W. Struve's 'Mensuræ Micrometricæ,' containing the mean distances and angles of position of 3112 stars. Argelander's researches on the motion of the solar system in space. Wrottesley's catalogue of 1318 stars. Completion of the measurement of the great Indian arc of the meridian.

1838. Second part of Lubbock's researches on the lunar theory. Bessel determines the parallax of 61 Cygni. Hansen's new method of investigating the lunar theory. Robinson's determination of the constant of lunar nutation. Airy's catalogue of 726 stars. Lamont's determination of the mass of Uranus. Lacaille's catalogue of 9766 southern stars, published by the British Association. An annular eclipse of the sun observed in America.

1839. Le Verrier's researches on the secular variations of the planets. Henderson's determination of the parallax of α Centauri. The Imperial Observatory of Pulkowa founded. Johnson appointed Director of the Radcliffe Observatory, Oxford. Amici's double image micrometer.

1840. Observatory of Cambridge, U. S., founded. Santini; catalogue of 1677 stars. Airy's double image micrometer.

1841. Repsold's meridian circle erected at Königsberg. Hansen's researches on the lunar theory.

1842. National Observatory of Washington, U. S., founded. Peters determines the constant of nutation. Baily; determination of the mean density of the earth. A total eclipse of the sun occurs, which is visible in the southern countries of Europe. Pearson's catalogue of 520 stars. Greenwich catalogue of 1439 stars.

1843. Hansen's new method of investigating the effects of planetary perturbation, whatever be the eccentricity or inclination of the orbit. Detection of a periodicity in the recurrence of the solar spots, by Schwabe. Faye discovers the periodic comet known by his name. Apparition of one of the most splendid comets of modern times. W. Struve's determination of the constant of aberration.

1844. Sheepshanks commences his operations for the re-construction of the standard yard, which he continues to prosecute till his death in 1855. Argelander's zone observations in the Northern Hemisphere concluded. Taylor's catalogue of 11,015 stars. Transmission of local time by the electric telegraph commenced in America.

1845. Hencke discovers the planet Astræa, forming the fifth of the group of minor planets, or asteroids, revolving between Mars and Jupiter. British Association catalogue of 8377 stars. Le Verrier's researches on the theory of Mercury. Smyth's 'Cycle of Celestial Objects.'

1846. Weisse's reduction of Bessel's zone-stars comprised between +15° and −15° of declination. Airy; measurement of the arc of parallel comprised between Valentia and Greenwich. Discovery of the planet Neptune,—the result of the independent theoretical researches of Adams and Le Verrier. Publication of the results of the reduction of the planetary observations made at Greenwich between 1750 and 1830. Biela's comet, on the occasion of its return to the perihelion, is seen to separate into two parts. Brorsen discovers the periodic comet known by his name.

1847. Three new asteroids discovered during this year. Motion of the solar system in space. Erection of the Altazimuth at Greenwich. An annular eclipse of the sun observed in England. Catalogue of the mean places of 47,390 stars contained in the 'Histoire Celeste' of Lalande, published by the British Association. Hansen's discovery of two long inequalities in the mean motion of the Moon. Herschel's 'Results of Astronomical Observations made at the Cape of Good Hope.' Everest's account of the measurement of two sections of the meridional arc of India between lat. 18° and lat. 29½°. Galloway's researches on the motion of the solar system in space. W. Struve's 'Etudes d'Astronomie Stellaire.' Lassell's discovery of the satellite of Neptune.

1848. Challis; researches for determining the orbit of a planet or comet. Jacob; catalogue of double stars observed at Poonah. Lassell in England, and Bond in America, independently discover the eighth satellite of Saturn (Hyperion). Wichmann's researches on the physical libration of the moon. Publication of the Greenwich lunar reductions (1750—1830). Researches of Peters on the parallax of the fixed stars. Greenwich catalogue of 2156 stars. Discovery of a new asteroid.

1849. Discovery of a new asteroid. Shortrede's logarithms. Powell's researches on irradiation. Main proves from micrometrical measures, made during the disappearance of Saturn's ring in 1848, that the figure of the planet is strictly elliptical,—a result corroborative of the previous researches of Bessel.

1850. Lord Rosse's observations of Nebulæ. Discovery of three new asteroids. Main's catalogue of the proper motions of 875 stars. Occurrence of a total eclipse of the sun, which was observed in the Pacific Ocean.

1851. Discovery of two new asteroids. D'Arrest discovers a periodic comet. Lassell discovers two satellites of Uranus (Ariel and Umbriel). Peters's researches on the variability of the proper motion of Sirius. Occurrence of a total eclipse of the sun, visible in Norway, Sweden, and the other countries of Northern Europe. Foucault's pendulum experiments for demonstrating the rotation of the earth. Discovery of the innermost or dusky ring of Saturn. Transit Circle erected at Greenwich. Termination of the operations for measuring the great Russo-Scandinavian arc of the meridian. Gould's Astronomical Journal commences.

1851-2. Oeltzen's reduction of Argelander's zones, extending from 45° to 80° of north declination.

1852. Discovery of eight new asteroids. Publication of the American Lunar Tables. Commencement of zone observations at the Cambridge Observatory, U.S. Publication of W. Struve's 'Positiones Mediæ,' containing the mean positions of 2874 stars, of which 2682 are double. Villarceau's researches on the orbits of double stars. Rümker's catalogue of 12,000 stars. Secchi's researches on the temperature of the different parts of the sun's surface. Observations with the reflex zenith tube commenced at Greenwich. Argelander's zone observations from 15° to 31° of south declination.

1853. Apparition of a brilliant comet in the northern hemisphere. Cooper's Catalogue of 30,168 stars observed at Markree. The method of recording transits of the stars by means of electro-galvanism introduced at Greenwich. Airy's researches on ancient eclipses. Adam's researches on the secular inequality in the mean motion of the moon. Hansen's researches on the theory of the pendulum, taking into account the figure and motion of the earth. Publication of the American Lunar Tables. Encke gives a new solution of the problem of planetary perturbation. Apparition of a conspicuous comet. Discovery of four new asteroids. Hansen's Solar Tables.

1854. Occurrence of a total eclipse of the sun which was visible in Chili. Discovery of six new asteroids. Lubbock's Researches on Refraction. Captain Jacob's Catalogue of 1440 stars. Airy's Pendulum experiments in the Harton coal mine for determining the mean density of the earth. Determination of the difference of longitude of Greenwich and Paris by galvanic signals.

1855. Greenwich Catalogue of 1576 stars. Bond's Zone Observations of Small Stars near the equator (First Part). Main's Researches on Aberration and Nutation. Commencement of the publication of the 'Annales de l'Observatoire Impérial,' Paris. Main's Researches on the dimensions of the Rings of Saturn. Commencement of the American Nautical Almanac. Discovery of four new asteroids.

1856. Discovery of five new asteroids. Researches of Professor Challis on the problem of three bodies. Main's researches on the diameters of the planets.

1857. Discovery of eight new asteroids. Airy's researches on ancient eclipses. Main's researches on refraction. Carrington's catalogue of circumpolar stars. Hansen's Lunar Tables. The application of photography to astronomy makes sensible progress. De La Rue and Secchi execute photographs of the moon. Bond obtains photographs of double stars.

1858. Discovery of six new asteroids. De La Rue succeeds in executing a stereographic photograph of the moon. Le Verrier's Solar Tables. The first comet of the year found by Dr. Bruhns to be periodic, and to be identical with a comet which appeared in 1790. Dr. Winnecke discovers a comet, which he finds to be periodic, the time of revolution being somewhat more than five years. Professor Encke establishes beyond doubt the existence of a continued diminution in the time of revolution of the comet which bears his name, by means of researches prosecuted during a period of nearly thirty years. Occurrence of a total eclipse of the sun which was visible in Brazil. An annular eclipse of the sun observed in England. Completion of the calculations for determining the principal triangles of the Trigonometrical Survey of the British Isles, and deduction of the definitive results relative to the dimensions, ellipticity, and mean density of the earth. Maclear, having re-measured and extended Lacaille's arc of the meridian at the Cape of Good Hope, obtains a result which accords with the generally admitted value of the earth's figure. Apparition of a comet of unusual splendour (Donati's), which continued visible to the naked eye for several weeks.

1859. Airy's researches on the motion of the solar system in space.

The following list of public observatories now in action is taken from the 'Nautical Almanac' for 1862:—

Altona.	Leyden.
Ann-Arbor, U. S.	Liverpool.
Armagh.	Madras.
Athens.	Manheim.
Berlin.	Marburg.
Bilk.	Marseilles.
Bonn.	Milan.
Breslau.	Modena.
Brussels.	Moscow.
Buda.	Munich.
Cambridge.	Naples.
Cambridge, U. S.	Nicolaieff.
Cape of Good Hope.	Oxford.
Christiania.	Padua.
Copenhagen.	Palermo.
Cracow.	Paris.
Dorpat.	St. Petersburg.
Dublin.	Portsmouth.
Durham.	Prague.
Edinburgh.	Pulkowa.
Florence.	Rome.
Geneva.	San Fernando.
Georgetown College, U.S.	Stockholm.
Göttingen.	Turin.
Greenwich.	Upsala.
Hamburgh.	Venice.
Kazan.	Vienna.
Königsberg.	Warsaw.
Kremsmünster.	Washington.
Leipsic.	Wilna.

The enormous masses of observations which are now published every year are silently affording the means of increased accuracy in every department, and are rapidly seized and applied for the improvement of the theory.

The materials of modern astronomy are contained—1st, In the publications of scientific societies; 2nd, In the introductions to the volumes which emanate from public observatories; 3rd, In the appendices to the annual volumes of ephemerides; 4th, In journals devoted exclusively to astronomical subjects; and lastly, in the independent publications of individual authors. By far the greater part of the science is to be found recorded in the third and fourth of these distinct repositories.

The ephemerides, chiefly remarkable for the papers on astronomical subjects contained in them, are:—The 'Connaissance des Temps,' of Paris; the 'Berlin Jahrbuch,' and the 'Effemeridi di Milano.' During the course of the present century a great number of valuable papers by Lagrange, Laplace, Poisson, &c., have appeared in the 'Connaissance des Temps,' but recently the volumes have been falling off somewhat in this respect. The 'Berlin Jahrbuch,' of which Professor Encke is superintendent, maintains in the present day a decided pre-eminence among publications of this class, in so far as relates to the papers appended to each volume. The volumes of the 'Effemeridi di Milano,' for the years corresponding to the close of the last century and the beginning of the present, contain many valuable papers by Oriani, Carlini, &c. A very small number of papers only have been published in the form of supplements to the 'Nautical Almanac.'

The greater part of the astronomy of the present day is to be found in the periodicals devoted exclusively to astronomical subjects. These are:—The 'Astronomische Nachrichten,' published at Altona; the 'Monthly Notices,' of the Royal Astronomical Society; and Gould's 'Astronomical Journal,' published at Cambridge, U. S.

Works on the History of Astronomy.—Sherburn's edition of Manilius, London, 1675, contains a list and short account of a very large number of astronomers, and has been much used by succeeding authors. A somewhat similar account is given by De Chales in tome i. (pp. 74-108) of his 'Cursus seu Mundus Mathematicus,' Lugdini, 1690. Weidler, 'Historia Astronomiæ,' Vittemb., 1741, contains a valuable collection of facts and dates. Heathcote, 'Historia Astronomiæ,' Cantab., 1747. Esteve, 'Histoire Générale et Particulière de l'Astronomie,' Paris, 1755. Costard, 'History of Astronomy,' London, 1767. Bailly, 'Histoire de l'Astronomie Ancienne,' 4to, Paris, 1775; 'Traité de l'Astronomie Indienne et Orientale,' 4to, Paris, 1787; 'Histoire de l'Astronomie Moderne,' 3 vols., 4to, Paris, 1779-82. Pingré's 'Cometographie,' 2 vols., Paris, 1783. Lalande's 'Astronomie,' Paris, 1792, contains a considerable number of historical facts. 'Bibliographie Astronomique, avec l'Histoire de l'Astronomie, depuis 1781 jusqu' à 1802:' this work gives a list of every known astronomical publication, and also an enormous alphabetical list of astronomers. The historians of mathematics—Vossius, Montucla, Kästner, Bossut, and Delambre, 'Rapport Historique,' &c., Paris, 1810—treat astronomy as a part of their subject. Hutton's 'Mathematical Dictionary,' and Martin's 'Biographia Philosophica,' contain information on English astronomers which is not to be found in foreign works; and there is a good deal in the histories of the Royal Society, written respectively by Sprat, Birch, and Thomson. Small's 'Account of the Discoveries of Kepler,' 1804, contains valuable information on the earlier systems of astronomy. Laplace's 'Précis sur l'Histoire de l'Astronomie,' Paris, 1821, which is also appended to his 'Exposition du Système du Monde,' is delightfully written; and there is also much information in the historical chapters of the fifth volume of the 'Mécanique Celeste.' Voiron, 'Histoire de l'Astronomie, depuis 1781 jusqu' à 1811,' Paris, 1811, is a continuation of Bailly's 'Histoire de l'Astronomie Moderne.' Delambre, 'Histoire de l'Astronomie Ancienne,' 2 vols., 4to, Paris, 1817; 'Histoire de l'Astronomie du Moyen Age,' 4to, 1819; 'Histoire de l'Astronomie Moderne,' 2 vols., 4to, 1821; 'Histoire de l'Astronomie au dixhuitième siècle,' 4to, 1827 (a posthumous work): these various works of Delambre contain a vast amount of critical research; they are indispensable to the student of astronomical history. Airy's 'Report on the Progress of Astronomy, published in the 'British Association Report' for 1832, contains a great mass of valuable facts relative to the history of astronomy in the present century. Narrien's 'Account of the Origin and Progress of Astronomy,' 8vo, London, 1835, contains an excellent account of the progress of astronomy, especially down to Kepler's time. Whewell's 'History of the Inductive Sciences,' 1847, and the 'Supplement,' 1857, may also be consulted with advantage. Professor De Morgan, in a series of papers which have been published from time to time in the 'Companion to the British Almanac,' has thrown much valuable light on the history of astronomy in modern Europe. We give the titles of the following:—'Old Arguments against the Motion of the Earth' (Comp. 1836); 'Notices of English Mathematical and Astronomical Writers between the Norman Conquest and the year 1600' (Comp. 1837); 'References for the History of the Mathematical Sciences' (Comp. 1843); 'On the Difficulty of Correct Description of Books' (Comp. 1853); 'The Progress of the Doctrine of the Earth's Motion between the times of Copernicus and Galileo' (Comp. 1855). Jahn's 'Geschichte der Astronomie,' 2 vols., 1844. Grant's 'History of Physical Astronomy, from the Earliest Ages to the Middle of the Nineteenth Century,' 8vo, London, 1852, comprises a detailed account of the progress of the theory of gravitation; besides a history, more or less extensive, of the various other branches of astronomical science. Much historical information will be found in the Annual Reports of the Council of the Royal Astronomical Society. For the general reader, it may be well to mention the 'History of Astronomy,' and the 'Lives of Galileo and Kepler,' in the Library of Useful Knowledge; and the 'History of Natural Philosophy,' in Lardner's Cabinet Cyclopædia.

ASTY'LAR, one of the numerous compound architectural terms from the Greek *stylos* (στῦλος), column; which, having the Greek privative a prefixed to it, signifies without columns. It is a term of recent introduction, but very convenient and expressive, inasmuch as it explains at once that the building described by it is without any order of columns or pilasters, however ornate it may be in all other respects. Thus, we speak of Astylar Italian in contradistinction from the columnar class of buildings in that style, or such as are decorated with the orders. Astylar composition is not only susceptible of a very high degree of embellishment, but of a species of grandeur not attainable (that is, on the same scale) in the Palladian style, or that where an order is raised upon a basement, or even more than a single order is employed for a façade, because in the former the cornice is proportioned to the entire elevation; sometimes of greatly increased proportions, and then distinguished by the name of *cornicione*. In this country we had no examples of such *astylar* class of design, until it was introduced by Mr. Barry, in the Travellers' and Reform Clubhouses.

ASY'LUM, the Latin and English form of the Greek Ἄσυλον, which is generally supposed to be made up of *a privative* and the root of the verb συλάω, 'to plunder,' and therefore to signify, properly a place free from robbery or violence. Some, however, have derived the Greek word from the Hebrew אשל, 'a grove;' the earliest asylums, it is said, having been usually groves sacred to certain divinities. It is a pretty, rather than perhaps a very convincing illustration of this etymology, which is afforded by Virgil's expression as to the asylum opened by Romulus,—

> "Hinc lucum ingentem, quem Romulus acer asylum
> Retulit."—Æn. VIII. v. 343.

The tradition was, that Romulus made an asylum of the Palatine Hill preparatory to the building of Rome. Plutarch tells us that he dedicated the place to the god Asylæus. (Plut. 'Romul.' 9.)

Probably all that is meant by these stories is, that in those ages whoever joined a new community received shelter and protection; and even if he had committed any crime, was neither punished by those whose associate he had become, nor surrendered to the vengeance of the laws or customs he had violated. Such an asylum was not an appointed place of refuge established by general consent; it was merely a congregation of outlaws bidding defiance to the institutions of the country in which they had settled, and proclaiming their willingness to receive all who chose to come to them.

But both in the Grecian states, and in Rome, the temples, or at least some of them, were endowed with the privilege of affording protection to all who fled to them, even although they had committed the worst crimes. The practice seems to have been, that they could not be dragged from these sanctuaries; but that, nevertheless, they might be forced to come out, not only by being prevented from receiving food while they remained, but even by such compulsory measures as the application of fire to the building. (See 'Thucyd.' i. 126, 134; 'Herodot.' vi. 80.) Anything appears to have been permitted except the actual dragging forth of the criminal. Eventually, these places of refuge became great nuisances, being, especially among the Greek cities, established in such numbers as sometimes almost to put an end to the administration of justice. After Greece had become a part of the Roman empire, an attempt was made to repress this evil by an order of the senate, directed to all the pretended asylums, to produce legal proofs of the privilege which they claimed. (Tacit. 'Annal.' iii. 60, &c.) Many were put down in consequence of not being able to satisfy this demand. At last, all the asylums throughout the empire were abolished by an edict of the Emperor Tiberius. (Sueton. in 'Vitâ Tiberii.' cap. 37.)

The term Ἄσυλος was given as an epithet to certain divinities; as, for example, to the Ephesian Diana. It is also found on medals as an epithet of certain cities; in which application it probably denoted that the city or district was under the protection of both of two otherwise belligerent powers, and enjoyed accordingly the privileges of neutral ground.

After the decline and fall of Paganism, the privilege of serving as asylums for malefactors was obtained by the Christian temples. The credit of conferring this honour upon churches in general is attributed to Pope Boniface V., in the beginning of the 7th century; but more than two hundred years before, certain sacred buildings of the new religion are said to have been declared asylums by the Emperor Honorius. The asylums thus established eventually grew throughout all Christendom to be a still more intolerable abuse than those of the ancient world had been. In most countries, not only churches and convents, with their precincts, but even the houses of the bishops, came to be at length endowed with the privilege of sanctuary. In all these places the most atrocious malefactors might be found bidding defiance to the civil power. At the same time, there can be no doubt, that while in this way criminals were frequently rescued from justice, protection was also sometimes afforded to the innocent, who would not otherwise have been enabled to escape the oppression or private enmity which pursued them under the perverted forms of law. The institution was one of the many which then existed, having the effect of throwing the regulating power of society into the hands of the clergy, who certainly were, upon the whole, the class in whose hands such a discretion was by far least likely to be abused. When communities, however, assumed a more settled state, and the law became strong with the progress of civilisation, the rights which had at one time armed the church as a useful champion against tyranny, became not only unnecessary but mischievous. The church maintained a long and hard struggle in defence of its old supremacy; and in the face of the stand thus made, and in opposition to ancient habits, and the popular superstition by which they were guarded, it was only very cautiously that attempts could be made to mitigate the evil. For a long time the legal extent of the privilege of sanctuary appears to have been matter of violent dispute between the church and the civil power. In this country, it was not till the year 1487, in the reign of Henry VII., that by a bull of Pope Innocent VIII. it was declared, that if thieves, robbers, and murderers, having taken refuge in sanctuaries, should sally out and commit fresh offences, and then return to their place of shelter, they might be taken out by the king's officers. It was only by an Act of Parliament passed in 1534, after the Reformation, that persons accused of treason were debarred of the privilege of sanctuary. After the complete establishment of the Reformation, however, in the reign of Elizabeth, neither the churches nor sanctuaries of any other description were allowed to become places of refuge for either murderers or other criminals. But various buildings and precincts in and near London, continued for a long time after this to afford shelter to debtors. At length, in 1697, all such sanctuaries, or pretended sanctuaries, were finally suppressed by the Act 8 & 9 Will. III. chap. 26.

In Scotland, the precincts of the palace of Holyrood in Edinburgh still remain a sanctuary for debtors. The boundaries of this privileged place are somewhat extensive, comprehending the whole of what is called "the King's Park," in which is the remarkable hill called "Arthur's Seat." The debtors find lodgings in a short street, the privileged part of which is divided from the remainder by a kennel running across it. Holyrood retains its privilege of sanctuary as being a royal palace; but it is singular as being now the only palace in this country any part of the precincts of which is the property, or at least in the occupation, of private individuals, and therefore open to the public generally.

In England, a legal asylum, or privileged place, is called a sanctuary; and this use of the word sanctuary appears to be peculiar to the English language. Both in this country and in America, the name of asylum is commonly given to benevolent institutions intended to afford shelter neither to criminals nor to debtors, but to some particular description of the merely unfortunate or destitute.

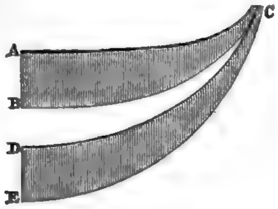
The Jewish Cities of Refuge, established by Moses and Joshua, may be quoted as the most remarkable instance on record of a system of asylum founded and protected by the state itself for the shelter of persons who had violated the law. These cities, as we are informed in the twentieth chapter of the Book of Joshua, were six in number, three on each side of the Jordan. They only, however, protected the person who had killed another unawares. This institution may be regarded as an ingenious device for protecting, on the one hand, the guiltless author of the homicide from the popular resentment, which his unfortunate act would have been likely to draw upon him: and cherishing, on the other, in the public mind, that natural horror at the shedding of human blood, which, in such a state of society, it would have been so dangerous to suffer to be weakened. We see the same principle in the deodand formerly awarded by our law in the case of the accidental destruction of life by any inanimate object.

One of the most curious instances of the privilege of sanctuary, is that long enjoyed in Scotland by the descendants of the celebrated Macduff, Thane of Fife, the dethroner of the usurper Macbeth. It is said to have been granted at the request of the thane by Malcolm III. (Canmore), on his recovery of the crown of his ancestors soon after the middle of the 11th century. By this grant it was declared that any person, being related to the chief of the clan Macduff within the ninth degree, who should have committed homicide without premeditation, should have his punishment remitted for a fine, on flying to Macduff's Cross, which stood near Lindores, in Fifeshire. Although this, however, is the account of the old Scottish historians, it is probable that the privilege only conferred upon the offender a right of being exempted from all other courts of jurisdiction, except that of the Earl of Fife. Sir Walter Scott ('Minstrelsy of the Scottish Border,') has printed a Latin document of A.D. 1291, in which the privilege to this latter extent is pleaded. The original deed still exists. Of Macduff's Cross, only the pedestal now remains, the cross itself having been destroyed at the Reformation. It bore a metrical inscription, in a strange half Latin jargon, the varying copies of which, still preserved, have given much occupation to the antiquaries.

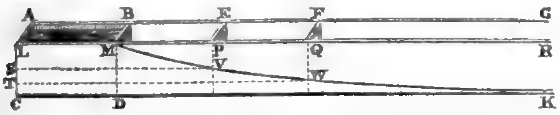
(Sibbald's *History of Fife*, second ed., 8vo, Cupar-Fife, 1802; Cunninghame's *Essay upon Macduff's Cross;* Camden's *Britannia*, by Gough).

A'SYMPTOTE (ἀσύμπτωτος), a compound Greek word signifying *which does not fall with:* if taken literally with respect to two lines, it would mean that they do not meet one another. But it is used only in speaking of two lines (one of which at least must be curved) which continually approach each other, but never meet; so that the distance between them diminishes without limit, or they may be brought to any degree of nearness, without ever actually meeting.

This appears a paradox to beginners in geometry, who are generally unable to imagine it possible that two lines should continue to approach one another for ever, without absolute contact. But this arises from their confounding the thing called a straight line in practice (which is not a straight line, but a thin stroke of black lead or ink, as the case may be) with the straight line of geometry, which has neither breadth nor thickness, but only length. And they also imagine that if two lines might be asymptotic, the fact might be made visible, which is impossible, unless the eye could be made to distin-

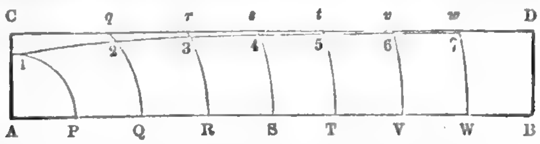


guish any distance, however small. But if the unassisted eye cannot detect a white space between two black lines, unless that space be a thousandth of an inch in breadth, which is about the truth, it is evident that two geometrical surfaces with asymptotic boundaries, such as A B C, D E C, would appear to coincide from the point where the distance between them is about the thousandth part of an inch. The idea of a geometrical asymptote is therefore an effort of pure reason, and the possibility of it must be made manifest to the mind, not to the senses. A L M B C D is a vessel of water, of which the sides and



bottom are extended indefinitely towards G and R; the end A L is fixed, but the end B M is moveable parallel to its first position, so as always to form a water-tight obstacle; by which means the length of the vessel may be increased to any extent, while its breadth and height remain the same. Let the water be a perfect fluid, without any adhesion to the sides of the vessel (which is mathematically possible, though not physically), and let the bottom of the vessel be geometrically horizontal. Then, as the end M B changes its position and moves towards G R, it is manifest that the vessel will grow larger, and the level of the water will fall. Suppose the side L K to be of glass. Thus, when the vessel ends at E P, the water may stand at S V; when the end is at F Q, the water may stand at T W, and so on. But the level of the water never can fall absolutely to the bottom C K; for so long as the preceding mathematical suppositions hold good, and there is some water in the vessel, it must stand at some determinate height above the bottom. As the end B M moves to the right, let the curve M V W, &c., mark out the positions of the level upon the edge of the moving end, as is done in the diagram. Then for the reason above given, this curve never can meet the line C K, though obviously in a state of continual approach towards it. Hence the curve M V W and the line C K are asymptotes.

As another illustration, let there be two parallel lines A B, C D, the perpendicular distance of which is A C; and from A, with different



radii, describe arcs of circles P 1, Q *q*, R *r*, S *s*, &c. From A B on all these circles measure *arcs* equal in length to the *straight line* A C; that is, let P 1, Q 2, R 3, ... W 7, &c., be all equal to A C. Now it is plain that the arcs Q *q*, R *r*, &c., are all greater than A C, and will continue so, however great the radius may be; for A C is the shortest distance which can be drawn from one parallel to the other. But as the radius is extended, the arcs T *t*, V *v*, &c., become *more upright*, as a person unused to geometrical phraseology would say, that is, more and more nearly coincident with a perpendicular drawn from A B; they also become more and more nearly equal to A C. Hence the points 5, 6, 7, &c., come nearer and nearer to C D, with which they would actually coincide, if it were possible that one of the arcs could become equal to A C. Hence the curve, 1, 2, 3, &c., is an asymptote to C D.

The mathematical theory of asymptotes will be found in all works on the theory of curves, and in most on the differential calculus. The following are the most general notions which it will be within our limits to give, and will be understood by a moderately well-informed mathematician. If the equation of a curve be $y=\phi(x)$, and if the function $\phi(x)$ can be separated into two others, say $\psi(x)$ and $\chi(x)$, of which $\chi(x)$ diminishes without limit when x is increased without limit; then the curve whose equation is $y=\psi(x)$ is an asymptote to the curve whose equation is $y=\phi(x)$ or $\psi(x)+\chi(x)$. For the difference of the ordinates of the two curves (to a common value of x) is $\chi(x)$, which diminishes without limit. For instance, let the first curve have the equation

$$y=\frac{b\,x}{x-a}$$

since $\frac{b\,x}{x-a}$ is $b+\frac{ab}{x-a}$, of which $\frac{ab}{x-a}$ decreases without limit when x is increased without limit, it follows that the straight line having the equation $y=b$ is an asymptote to the curve. If the preceding equation be reversed and put under the form

$$x=\frac{ay}{y-b}$$

similar reasoning will show that the straight line whose equation is $x=a$ is also an asymptote. If the first expression be developed in inverse powers of x, giving

$$y=b+\frac{b\,a}{x}+\frac{b\,a^2}{x^2}+\frac{b\,a^3}{x^3}+\&c.$$

the equations of curves which are asymptotes to the preceding may be found by taking any of the preceding terms for y, provided b be always one. Such are

$$y=b+\frac{b\,a}{x}$$

$$y=b+\frac{b\,a^2}{x^2}+\frac{b\,a^3}{x^3}$$

or generally, any curve whose equation is

$$y=b+\chi(x)$$

where $\chi(x)$ diminishes without limit, when x is increased without limit, is an asymptote to the preceding. Observe that a curve may first cut another, then recede from it, and afterwards become an asymptote to it.

The following is a mere sketch of the most general method of finding asymptotes to *algebraical* curves. The first part of the method detects the number and direction of the *rectilinear* asymptotes, those only excepted which are parallel to either axis of co-ordinates, which will easily admit of a separate determination.

Clear the equation of all radicals. Suppose it then of the second degree, though the same reasoning applies to all degrees. Its form will then be (putting all the highest terms on one side)

$$a\,y^2+b\,xy+c\,x^2=dy+e\,x+f.$$

The following theorem can then be demonstrated. If the equation

$$a\,y^2+b\,xy+c\,x^2=0 \qquad \text{(A)}$$

be possible, then it is the collective equation of two lines passing through the origin of co-ordinates, which two lines are parallel to two asymptotes of the curve and the curve can have no others. It is a well-known theorem that any *algebraical* equation between x and y, which is homogeneous with respect to these letters, is not the equation of a curve, but of a collection of straight lines passing through the origin. Thus the asymptotes of the curve of the third degree will be determined by the solution of an equation of the form

$$a\,x^3+b\,x^2y+c\,xy^2+dy^3=0$$

which may belong either to one or three straight lines.

If $y=k\,x+l$ be the equation of an asymptote, the value of k may be any one of the values of $\frac{y}{x}$ determined from the equation (A). To find l, remember that any homogeneous algebraical expression of the mth degree, containing x and y, may be expressed by the form

$$x^m\,\phi\left(\frac{y}{x}\right)$$

and let the equation of the curve, when its various sets of homogeneous terms have been collected, be

$$x^m\,\phi\left(\frac{y}{x}\right)+x^{m-1}\,f\left(\frac{y}{x}\right)+\&c.=0.$$

Then if $\phi'(k)$ represent the differential coefficient of $\phi(k)$, the equation of the asymptote is

$$y=k\,x-\frac{f\,(k)}{\phi'\,(k)}$$

when the highest dimension in the equation exceeds the next highest by more than one, all the asymptotes must pass through the origin of co-ordinates.

The term asymptote is first found in the Conic Sections of Apollonius; and the properties of the hyperbolic asymptote are found in the second book of his Conic Sections.

A'TABEKS are the rulers of several of the small principalities into which the empire of the Seljuk Turks, soon after its establishment, became divided, during the eleventh, twelfth, and thirteenth centuries.

it may be well to mention the 'History of Astronomy,' and the 'Lives of Galileo and Kepler,' in the Library of Useful Knowledge; and the 'History of Natural Philosophy,' in Lardner's' Cabinet Cyclopædia.

ASTY'LAR, one of the numerous compound architectural terms from the Greek *stylos* (στῦλος), column; which, having the Greek privative *a* prefixed to it, signifies without columns. It is a term of recent introduction, but very convenient and expressive, inasmuch as it explains at once that the building described by it is without any order of columns or pilasters, however ornate it may be in all other respects. Thus, we speak of Astylar Italian in contradistinction from the columnar class of buildings in that style, or such as are decorated with the orders. Astylar composition is not only susceptible of a very high degree of embellishment, but of a species of grandeur not attainable (that is, on the same scale) in the Palladian style, or that where an order is raised upon a basement, or even more than a single order is employed for a façade, because in the former the cornice is proportioned to the entire elevation; sometimes of greatly increased proportions, and then distinguished by the name of *cornicione*. In this country we had no examples of such *astylar* class of design, until it was introduced by Mr. Barry, in the Travellers' and Reform Club-houses.

ASY'LUM, the Latin and English form of the Greek Ἄσυλον, which is generally supposed to be made up of *a privative* and the root of the verb συλάω, 'to plunder,' and therefore to signify, properly a place free from robbery or violence. Some, however, have derived the Greek word from the Hebrew אשל, 'a grove;' the earliest asylums, it is said, having been usually groves sacred to certain divinities. It is a pretty, rather than perhaps a very convincing illustration of this etymology, which is afforded by Virgil's expression as to the asylum opened by Romulus,—

> "Hinc lucum ingentem, quem Romulus acer asylum
> Retulit."—Æn. VIII. v. 343.

The tradition was, that Romulus made an asylum of the Palatine Hill preparatory to the building of Rome. Plutarch tells us that he dedicated the place to the god Asylæus. (Plut. 'Romul.' 9.)

Probably all that is meant by these stories is, that in those ages whoever joined a new community received shelter and protection; and even if he had committed any crime, was neither punished by those whose associate he had become, nor surrendered to the vengeance of the laws or customs he had violated. Such an asylum was not an appointed place of refuge established by general consent; it was merely a congregation of outlaws bidding defiance to the institutions of the country in which they had settled, and proclaiming their willingness to receive all who chose to come to them.

But both in the Grecian states, and in Rome, the temples, or at least some of them, were endowed with the privilege of affording protection to all who fled to them, even although they had committed the worst crimes. The practice seems to have been, that they could not be dragged from these sanctuaries; but that, nevertheless, they might be forced to come out, not only by being prevented from receiving food while they remained, but even by such compulsory measures as the application of fire to the building. (See 'Thucyd.' i. 126, 134; 'Herodot.' vi. 80.) Anything appears to have been permitted except the actual dragging forth of the criminal. Eventually, these places of refuge became great nuisances, being, especially among the Greek cities, established in such numbers as sometimes almost to put an end to the administration of justice. After Greece had become a part of the Roman empire, an attempt was made to repress this evil by an order of the senate, directed to all the pretended asylums, to produce legal proofs of the privilege which they claimed. (Tacit. 'Annal.' iii. 60, &c.) Many were put down in consequence of not being able to satisfy this demand. At last, all the asylums throughout the empire were abolished by an edict of the Emperor Tiberius. (Sueton. in 'Vitâ Tiberii.' cap. 37.)

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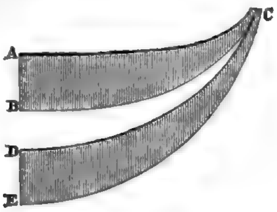

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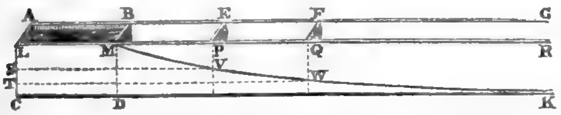

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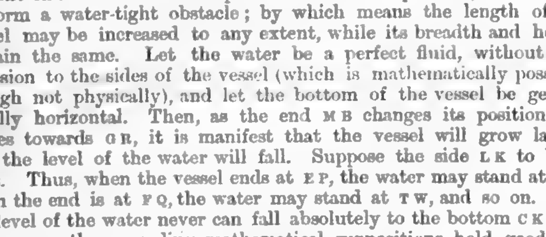

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since $\dfrac{b\,x}{x-a}$ is $b+\dfrac{ab}{x-a}$, of which $\dfrac{ab}{x-a}$ decreases without limit when x is increased without limit, it follows that the straight line having the equation $y=b$ is an asymptote to the curve. If the preceding equation be reversed and put under the form

$$x=\frac{ay}{y-b}$$

similar reasoning will show that the straight line whose equation is $x=a$ is also an asymptote. If the first expression be developed in inverse powers of x, giving

$$y=b+\frac{b\,a}{x}+\frac{b\,a^2}{x^2}+\frac{b\,a^3}{x^3}+\&c.$$

the equations of curves which are asymptotes to the preceding may be found by taking any of the preceding terms for y, provided b be always one. Such are

$$y=b+\frac{b\,a}{x}$$

$$y=b+\frac{b\,a^2}{x^2}+\frac{b\,a^3}{x^3}$$

or generally, any curve whose equation is

$$y=b+\chi\,(x)$$

where $\chi\,(x)$ diminishes without limit, when x is increased without limit, is an asymptote to the preceding. Observe that a curve may first cut another, then recede from it, and afterwards become an asymptote to it.

The following is a mere sketch of the most general method of finding asymptotes to *algebraical* curves. The first part of the method detects the number and direction of the *rectilinear* asymptotes, those only excepted which are parallel to either axis of co-ordinates, which will easily admit of a separate determination.

Clear the equation of all radicals. Suppose it then of the second degree, though the same reasoning applies to all degrees. Its form will then be (putting all the highest terms on one side)

$$a\,y^2+b\,xy+c\,x^2=dy+e\,x+f.$$

The following theorem can then be demonstrated. If the equation

$$a\,y^2+b\,xy+c\,x^2=0 \qquad \text{(A)}$$

be possible, then it is the collective equation of two lines passing through the origin of co-ordinates, which two lines are parallel to two asymptotes of the curve and the curve can have no others. It is a well-known theorem that any *algebraical* equation between x and y, which is homogeneous with respect to these letters, is not the equation of a curve, but of a collection of straight lines passing through the origin. Thus the asymptotes of the curve of the third degree will be determined by the solution of an equation of the form

$$a\,x^3+b\,x^2y+c\,xy^2+dy^3=0$$

which may belong either to one or three straight lines.

If $y=k\,x+l$ be the equation of an asymptote, the value of k may be any one of the values of $\frac{y}{x}$ determined from the equation (A). To find l, remember that any homogeneous algebraical expression of the mth degree, containing x and y, may be expressed by the form

$$x^m\,\phi\left(\frac{y}{x}\right)$$

and let the equation of the curve, when its various sets of homogeneous terms have been collected, be

$$x^m\,\phi\left(\frac{y}{x}\right)+x^{m-1}\,f\left(\frac{y}{x}\right)+\&c.=0.$$

Then if $\phi'\,(k)$ represent the differential coefficient of $\phi\,(k)$, the equation of the asymptote is

$$y=k\,x-\frac{f\,(k)}{\phi'\,(k)}$$

when the highest dimension in the equation exceeds the next highest by more than one, all the asymptotes must pass through the origin of co-ordinates.

The term asymptote is first found in the Conic Sections of Apollonius; and the properties of the hyperbolic asymptote are found in the second book of his Conic Sections.

A'TABEKS are the rulers of several of the small principalities into which the empire of the Seljuk Turks, soon after its establishment, became divided, during the eleventh, twelfth, and thirteenth centuries.

The word Atabek is of Turkish origin, and properly signifies 'The Father of the Prince,' or, as Abulfeda explains it ('Ann. Mosl.' t. iii. p. 226, ed. Reiske), 'a faithful Parent.' Four dynasties of Atabeks are particularly noticed in eastern history; those of Syria (and Irak), those of Azerbijan, those of Persia, and those of Laristan: but none of them acquired any historical importance.

ATELLA'NÆ FA'BULÆ, a species of comedy which was common among the people of Campania, and was thence introduced at Rome, where it met with much favour. The name of Atellanæ, or Atellanicæ, was derived from Atella, an ancient town of Campania, now ruined, the site of which is about two miles S.E. of the modern town of Aversa, and near the village of Sant Elpidio. The Atellanæ were also known by the name of 'Ludi Osci,' on account of the name of the people among whom they originated. The Roman writers have transmitted to us a few brief detached traits of the nature of these plays, of which no specimen has reached us. The Atellanæ seem to have somewhat resembled the Greek Satyric drama, with this difference, that, instead of satyrs and other fantastic characters, they had real Oscan characters, or actors, speaking their own dialect, and who were the representatives of some peculiar class or description of people of that country, much in the same manner as the Brighella, Arlecchino, Polecinella, &c., of the modern Italian stage, who are meant as caricatures of the peculiarities of certain classes in their respective provinces, and who speak each his own dialect in all its native humour. Indeed these modern *maschere*, as the Italians call them, may be considered as the descendants of the old Oscan characters in the Atellanæ. One of these Oscan characters was Macchus, a sort of clown or fool. There were others called Buccones, that is, babblers, empty talkers. (Diomedes 'de Grammatica,' lib. i. and iii.) The Atellanæ differed from the *comœdia prætextata*, which represented high characters, as well as from the *tabernaria*, which exhibited vulgar ones; the Atellanæ were a mixture of high and low, pathetic and burlesque, without however degenerating into trivialities or buffoonery. They seem to have been a union of high comedy and its parody. They were also distinct from the performances of the *mimi*, who indulged in scurrilities and in obscene jokes and gestures. (Cicero, 'Epistola ad Papirium.') Macrobius ('Saturn. III.') draws the distinction between the Atellanæ and the mimi; "the latter made use of the Roman language, and not of the Oscan, like the Atellanæ; the performances of the mimi consisted of one act, while the Atellanæ and other comedies had five, with *exodia* (interludes consisting of songs) between the acts; lastly, the mimi had not the accompaniment of the tibicina, nor of vocal music like the others." Valerius Maximus (lib. ii. ch. 4), speaking of the Atellanæ, says, that their jests were tempered by Italian strictness of taste; and Donatus extols their antique natural elegance. Even in their satirical allusions their object was to provoke joyous laughter, rather than excite feelings of hatred or contempt. It would appear that their humour dealt chiefly in ingenious allusions and equivocations clothed in decent words, the meaning of which could only be caught by the better-educated and more refined classes. In their plots they did not aim at any intricate development, or embody an intrigue, but seem rather to have depended on farcical situations, which gave a freer scope to the jointless and satirical dialogue. The Atellanæ were performed by Roman citizens, who were not thereby disgraced, like the common *histriones*, or actors; their names were not erased from the roll of their tribes, and they were not obliged to take off their masks at the will of the audience. In course of time, however, and in the general corruption of morals under the empire, the Atellanæ degenerated; common mercenary players appeared in them, and they became as loose in their language as the performances of the mimi. This may explain the different judgments given of the Atellanæ by different writers. The exodia, or interludes played between the acts of the Atellanæ, are mentioned by Juvenal ('Sat. VI.'), and Suetonius quotes from one of them a line in which Tiberius was alluded to as an old goat; the pun resting on the word *capris*, which means goats as well as the island (Capreæ) noted as the scene of Tiberius's depravity. When Galba entered Rome, an actor in one of the Atellanæ began singing the first line of a familiar tune: 'Venit io Simius a villa,' that is, *the baboon is come to town*, which the audience immediately took up, and continued the song in chorus, repeating the first line as a burthen.

The Atellanæ were written in verse, chiefly iambic, with a frequent recurrence of tribrachs and other trisyllabic feet. Lucius Sylla, the famous dictator, is said to have written Atellanæ. Quintus Novius, who flourished soon after Sylla's abdication, wrote about fifty plays of this kind; the titles of some of them have come down to us; as 'Macchus Exul,' that is, Macchus in Exile; 'Vindemiatores,' or the Vintagers; 'Gallinaria,' or the Poulterer; 'Surdus,' the Deaf Man, &c. Lucius Pomponius of Bononia, who lived about the same time, wrote 'Macchus Miles,' that is, Macchus Soldier, the 'Pseudo Agamemnon,' &c. The Atellanæ afterwards fell into neglect, but were revived by a certain Mummius, mentioned by Macrobius, who however does not state the epoch of the revival. They were, as we have seen, in full vigour under the emperors. (Munk, 'De Fabulis Atellanis,' Lips. 1840.)

A TEMPO, in music, signifies that after any change in motion, by retardation or acceleration, the original movement is to be restored.

ATHAMANTIN ($C_{24}H_{15}O_7$), is a crystalline, fatty body, obtained from the root of *Athamanta oreoselinum*. It contains valerianic acid united to a base called *Oreoselone* ($C_{14}H_5O_3$). Athamantin combines with hydrochloric acid, and the compound, when boiled, deposits crystals of oreoselone combined with water ($C_{14}H_6O_4$), a compound that is isomeric with benzoic acid.

$$\underbrace{C_{24}H_{15}O_7}_{\text{Athamantin.}} = \underbrace{C_{10}H_{10}O_4}_{\text{Valerianic acid.}} + \underbrace{C_{14}H_5O_3.}_{\text{Oreoselone.}}$$

ATHANASIAN CREED, or *Symbolum Athanasianum*, which is also called from the words of its beginning the *Symbolum Quicunque*, is not extant in the works of Athanasius (which contain, vol. i. part i. p. 98, *seq.* another creed, stating the same doctrine, but differently expressed), and is not quoted by contemporary writers; it seems to refer to the later Nestorian and Eutychian controversies—has a Latinised character, or it sounds in Greek like a translation from a Latin original, and appears to contain phrases taken from the writings of Augustine, the bishop of Hippo. Hence we conclude that it was composed about the middle of the 5th century. Some have supposed that Vincentius Lerinensis; others, that Venantius Fortunatus; others again, that Hilarius Arelatensis wrote what is now called the Athanasian creed. According to Paschasius Quesnel, Virgilius of Tapsus, who has been considered to have interpolated the passage, 1 John v. 7, was also the author of the Athanasian creed.

From the 7th century we find that the Athanasian creed has been considered in the western churches to be the most genuine document of the ecclesiastical trinity. It is remarkable that the Athanasian creed was not introduced by the authority of ecclesiastical councils, nor by any external compulsion, but was generally received by the free conviction of the churches that it contained a correct exposition of Christian doctrine, and that it was necessary to give some ecclesiastical definitions of the statements of the New Testament. This important document may illustrate the difference between the solution of an historical question concerning authenticity, and one involving the internal truth of doctrinal contents. (See Cave, 'Historia Litter.,' vol. i. p. 189; Oudin, 'de Scriptor Eccles.,' vol. i. p. 312; Fabricius, 'Biblioth. Gr.,' vol. v. p. 297; Montfauçon, 'Præf. ad Op. Athanasii;' and Schröckh, 'Kirchengesch.' vol. xii. pp. 93–252.) Sherlock has also written on the Athanasian creed. Dr. Waterland supposed it, without much foundation, to have been made by Hilary, bishop of Arles. Hooker ('Eccles. Polity,' B. xlii. c. 11–13) at considerable length defends its use by the Church of England; on the other hand, Archbishop Tillotson said, "The church were well rid of it;" (see Clarke's 'Succession of Sacred Literature,' London, 1830, p. 274.) A defence of the Athanasian creed on physiological principles, by Thomas William Chevalier, Esq., was printed in the 'Morning-Watch,' and published separately, London, 1830. In this dissertation a surgeon refutes the attack of some clergymen.

Before the close of the 6th century, the Athanasian creed had become so well known, that comments were written upon it; it was not, however, then styled the Athanasian Creed, but simply the Catholic Faith. Before the expiration of another century, it had obtained the appellation which it has since preserved. It is supposed to have received the epithet 'Athanasian,' on account of its reference to the subjects of the controversy between the orthodox and the Arians. But Athanasius himself confined his exertions to the establishment of the doctrine of incarnation, and seems not to have insisted much upon the doctrines relative to the Spirit.

This creed was used in France about the year 850; was received in Spain about a hundred years later, and in Germany about the same time. It was both said and sung in England in the 10th century; was commonly used in Italy at the expiration of that century, and at Rome a little later. In the English church it is ordered to be read only on certain feast days.

Many learned men, especially Cardinal Bona, Petavius, Bellarmine, and Rivet, are of opinion that the creed which bears the name of Athanasius was really the production of that bishop. Baronius maintains this opinion, and suggests that it was composed by Athanasius when at Rome, and offered to Julius as a confession of his faith. Bishop Pearson, Dr. Cave, and others, believe that it was not known in the Christian church before the 5th century, and that it was composed by Vigilius, the African bishop. Bingham says, "Whoever was the author, there never was any question made of its orthodoxy, except by the Samosatenians and Arians, in these latter ages of the church." The damnatory clauses have been objected to, but in the Articles of the English church, it is said of the three creeds (the Nicene, Athanasian, and that commonly called the Apostles'), that they "ought thoroughly to be received and believed," adding, however, no anathema; and Jeremy Taylor says, "I am most heartily persuaded of the truth of them, and yet I dare not say all that are not so are irrevocably damned;" an opinion in which other divines of unquestionable orthodoxy coincide.

The controversy on the Athanasian creed has produced in England a great number of works; the most learned and impartial work on this subject is, 'A Critical History of the Athanasian Creed,' by Daniel Waterland, D.D.; the second edition, corrected and improved, Cambridge, 1728.

ATHEISM. [MATERIALISM.]

ATHELING, or ÆTHELING. The indications, in the Saxon period of our history, of anything like the hereditary nobility of the times after the conquest are exceedingly few: certainly, the system which gives to particular families particular names of distinction and particular social privileges, which are to descend in the families as long as the families endure, we owe entirely to the Normans. The Saxons had among them earls, but that word was used to designate, not as in these times only a rank of nobility, to which certain privileges are attached, but a substantial office bringing with it important duties; the superintendent indeed, under the king, of one of the counties or shires, the sheriff, gerefa, in Latin vice-comes, being his inferior, his delegate or deputy. These earls, who were nominated by the sovereign, held their offices as it seems for life, and were usually selected from the most opulent families. Even the sovereignty among the successors of Egbert seems not to have descended uniformly according to our modern principles of hereditary succession.

Yet there were persons in the Saxon times who are spoken of as Æþel-boꞃen, Athel, or Ethel-boren, persons nobly born. The term is used in Luke (xix. 12), in the Anglo-Saxon version of the New Testament, where, in the modern translation, we have the words 'a certain nobleman.' Æthel, Athel, or Ethel, is frequently used by Saxon writers in senses correspondent to those annexed to the Latin word *nobilis*, the English word *noble*, and the German *adel* or *edel*. In the earlier Saxon times there is little doubt the word denoted the free possessor of lands (a member of the Mark or manorial division), in opposition to the noble by service under the king, who were to that extent no longer freemen; "even the Comes," says Mr. Kemble, in his excellent work, 'The Saxons in England,' 1849, "may indeed have become the possessor of land, even of very large tracts, by gift from his prince, but he could not be the possessor of a free hide, and consequently bound to service in the general *fyrd*, or to suit in the folcmot. He might have wealth, and rank, and honour, be powerful and splendid, dignified and influential, but he could not be free; and if the free man so far forgot the inherent dignity of his station as to carry himself (for his *ethel* I think he could not carry) into the service of a prince . . . . can it be doubted that the remunerative service of the chief would outweigh the barren possession of the farmer? . . . . Even if the markmen razed him from their roll, and committed his ethel to a worthier holder, what should he care whom the liberality of his conquering leader could endow with fifty times its worth." As the king's retainers, however, gradually acquired a supremacy over the land-holding freemen, it is probable that the title of nobility which Atheling implied was transferred by degrees from the one to the other.

Polydore Vergil, an Italian, who in the middle of the 16th century wrote a History of England in elegant Latin, falls into the error of mistaking Atheling for a surname, for which he is rebuked by Selden, the author of the admirable work on the various titles of honour which have been in use in the countries of modern Europe. He shows that Edgar Atheling is the same as Edgar the Atheling, or the noble, and that while some of our earlier chroniclers, as Henry of Huntingdon and Matthew Paris, so designate him, others, as Hoveden and Florence, call him Edgarus Clyto. *Clyto* is the Greek term answering to *eminent*, *illustrious*. It is rather a remarkable fact concerning the Saxon kings of England and their families, that they affected titles and denominations of Greek origin, as Clyto, Basileus (king), and Adelphe (sister); the last appears on the seal of the royal abbess of Wilton.

There is no sufficient information to show when the word Atheling first began to be used in the Saxon dynasty, but it has been supposed that it was used from the earliest times by those who could boast of being of the blood of Woden, who was regarded as the common ancestor of all the races of Saxon sovereigns. Some have represented the term as confined to the eldest son of a reigning monarch, or at least to one who was the heir-presumptive to the throne. Sir Francis Palgrave ('Rise and Progress of the English Commonwealth—Anglo-Saxon Period') considers that the heir of the throne received the title of Atheling, but adds, that the heir might be nominated by the reigning king. The Atheling of the Saxons has been by some regarded as equivalent to the term Dauphin in the line of the French monarchy, and Prince of Wales in our own. But this restriction of it seems not to be sanctioned by the passages in Saxon and other early writers in whom it occurs. Cyneheard, an Atheling of Wessex, who had pretensions to the crown, slew king Cynewulf in 786 (Kemble's 'Saxons in England,' 1849).

Nothing is known of any peculiar privileges belonging to the Athelings, as sons of the kings, or members of the royal family. But those who in modern times have had occasion to speak of the term and the circumstances under which it was used, such as Lingard and Turner in their histories of the Saxon period, speak of lands being usually given to the Atheling while still in his minority, probably bestowed to give the ethel dignity. And hence it is that this word Atheling has descended to our times in the local nomenclature of England.

As we have numerous Kingstons, so have we Adlingtons; and both King and Atheling, with slight variations, have descended in union with other local terminations. We have Kingsbury, Kingsley, and Kingswood; Conington, Coniston, Conysthorpe, and Cony-Weston; as we have also Bere-Regis, as it is now called, but by the Saxons, Conybere. So also have we Adling-flete, Edlingham; and no doubt such names of places as Addingham, Addington, and Edington, are of the same etymology. In one instance we have an Edlington at a very short distance from the walls of a castle called Coningsborough—the one the seat of a Saxon Rex or Regulus—the other, no doubt, one of the portions of land which were settled on one of the Athelings.

ATHE'NE, or PALLAS ATHENE, or ATHENA, the Goddess of Wisdom, of Arts, and of Sciences, among the Greeks; known to the Romans as Minerva. The Greeks seem to have included under this name several divinities of a perfectly distinct origin—a goddess of Libya, the daughter of Neptune and of the nymph Tritonis (Herodot. iv. 180), or of Terra, brought forth on the banks of the river Triton in Libya (Diodor. iii. 69); but the one best known to us is the divinity worshipped by the Athenians, and as it would appear, brought from Egypt, at least if we may judge from some of the symbols with which her statue was adorned: she had a sphinx on her helmet and at her feet. Plato ('Timæus,' Opera, vol. iii. p. 21) tells us that she was called Neith by the Egyptians; and Eratosthenes, in his 'Catalogue of the Kings of Thebes' (Euseb. 'Chron.' p. 21), says, that 'Nitocris' may be translated into Greek by 'Athene Nikephoros.'

According to Homer she was the daughter of Zeus; but there is no allusion in either the Iliad or Odyssey to the fable of her having sprung forth completely armed from the brain of that god: it appears, however, in the 'Hymn to Athene,' usually ascribed to Homer. A scholiast on Apollonius ('Argon.' iv. 1310) remarks, that this fable first made its appearance in Stesichorus (who died B.C. 553), and the 'Hymn' therefore must be of a comparatively recent date. In the legend of Hesiod ('Theogon.' 885-889), Jupiter is made to devour his wife Metis, and in process of time Athene is the result of this strange union. She seems to have participated in many of the attributes of her father: she had the power of hurling the thunderbolts of Jupiter, of prolonging the life of man, and of conferring the gift of prophecy. She was a virgin exalted above all feminine weakness. She might be regarded as the opposite in most respects of Aphrodite. In the battle with the giants, she overwhelmed Enceladus with Sicily; she assisted at the building of the ship Argo, and a wooden figure of Athene graced the prow of the vessel; she assisted Hercules; gave the art of prophecy to Tiresias, and immortality to Tydeus, though she afterwards deprived him of it. She was one of the three goddesses who submitted their beauty to the decision of Paris, and she disputed with Neptune the honour of giving name to the new city of Cecrops. The contest was decided in her favour by the production of an olive tree, and the city was hence called Athenæ. (Apollodor. 'Biblioth.' iii. 14.) According to Diodorus (i. 12), the Egyptians gave this name to the goddess of the air, and she was thought to be the daughter of Zeus, because the air is not naturally subject to corruption; and was made to spring from his brain, because air occupies the highest parts of the world. She was called Glaucopis (blue-eyed), because the air is of a bluish colour. The serpent, the owl, and the cock, were sacred to her; and, among plants, the olive. She was worshipped in all parts of Greece, but the most celebrated temple was the Parthenon at Athens, in which there was a chryselephantine statue of colossal size by Phidias.

The statues of the goddess, called Palladia, exhibited her in very ancient times with upraised shield and poised spear, ready to engage

Archaic Head of Athene from the British Museum.

in battle; sometimes, as symbols of her peaceful character, she had in her left hand the spindle and distaff. A stiffly folded peplum was thrown over her chiton (tunic), and she was armed with an immense ægis, which sometimes served as a shield, and sometimes was so contrived as to cover both the breast and back. The outline of the body exhibits none of the fulness of woman in the hips and breasts, while the form of the bones, arms, and back, resembles that of man. Her countenance, at least in the earlier periods of Greek art, was always marked by a serious, almost earnest expression. As far as possible the Greek artist endeavoured to impart sublimity of character to the statues of Athene. But the age of Phidias changed considerably the ancient characteristic marks of the different gods, and from that time Athene was distinguished by her unclouded forehead, her long and well-formed nose, by the somewhat firm compression of the mouth and cheeks, the strongly marked and almost angular chin, the half-closed eyes, and by the hair streaming carelessly over her neck. There are many representations of the goddess in sculpture, on coins, &c., still extant, no public collection of any importance probably being without some. The British Museum contains many fragments of statues of Athene, and numerous representations on Greek vases, coins, and gems. We give an engraving of a very early colossal head of the goddess, now in the first Græco-Roman Saloon, where are also two other busts of Athene: the sockets of the eyes of that here engraved were filled with some different material, locks of hair of some metal were probably also fixed under the helmet, and there were pendants in the ears. A fragment, supposed to belong to the statue of Athene, which was in one of the pediments of the Parthenon, is in the Elgin collection of the British Museum. Numerous examples of all the kinds of statues of Athene are pointed out by Müller in his 'Archäologie der Kunst,' where the subject will be found fully treated.

Minerva, or *Menerva*, was the ancient Italian divinity, known to the Greeks as Pallas Athene. Her attributes corresponded in most respects to those of the Grecian goddess. She was the patroness of arts and industry, such as spinning, weaving, &c., and was the goddess of all the mental powers. Her statue was usually placed in schools; and the pupils were accustomed every year to present their masters with a present called *Minerval*. (Varro, 'De Re Rust.,' iii. 2; compare Tertull., 'De Idol.,' c. 10.) Minerva also presided over olive grounds (Varro, 'De Re Rust.,' i. 1); and goats were not sacrificed to her, according to Varro, because that animal was considered to do peculiar injury to the olive ('De Re Rust.,' i. 2).

There was an annual festival of Minerva celebrated in Rome in the month of March, which was called *Quinquatrus*, because it lasted five days. (Varro, 'De Ling. Lat.,' v. 3; Ovid, 'Fast.,' iii. 809; Gell., ii. 21.) On the first day sacrifices were offered to the goddess, and on the other four there were gladiatorial combats, &c. There was also another festival of Minerva celebrated in June, which was called *Quinquatrus Minores*. (Ovid, 'Fast.,' vi. 651.) There were several temples in Rome sacred to Minerva. Ovid mentions one on the Cælian Hill, in which she was worshipped under the name of Minerva Capta, but the origin of the name is unknown. ('Fast.,' iii. 835-839.) It also appears from several inscriptions, in which she is called Minerva Medica, that this goddess was thought to preside over the healing art.

The etymology of the name of Minerva is doubtful. The first part probably contains the same root min, men, or man, that we have in the Latin me-min-i, men-s, &c., the Greek *μέν-ος*, *μι-μνή-σκω*, &c., and the Sanskrit man-as. Cicero ('De Nat. Deor.,' iii. 24) gives a very curious etymology, "Minerva, quia minuit aut quia minatur;" but some of the ancient grammarians appear to have been nearer the truth in considering it a shortened form of *Meminerva*, since she was the goddess of memory. Festus connects it with the verb *monere*. Müller ('Etr.,' ii. p. 48) supposes that the word is of Etrurian or Sabine origin.

ATHLETÆ (ἀθληταί), were men who contended for the prizes (ἀθλα) given to the victors at the public games of the Greeks and Romans. These games were divided into the light (κουφα), which included running, leaping, and throwing the disc; and the heavy or severe (βαρεα), which consisted of boxing and wrestling, either separately or in combination. In the early periods of Greek history there was little distinction between the agonistæ, or those who practised gymnastic exercises for the sake of improving their health, or for pleasure, and the athletæ, since the public games were open to all. But in course of time the value of the prizes induced men to prepare themselves for the contests by a severe course of training, and it was found that those who did not in fact devote themselves entirely to the practice stood little chance of becoming victors. In the later periods of Greek history the athletæ became, therefore, a distinct class, and private individuals ceased to contend.

The public games formed an important feature in Greek civic polity. Prizes of great value were awarded to the victors, and the victorious athletæ were treated with great honour. A victor at the Olympian, Isthmian, Nemean, and Pythian games, the four great festivals of the Greeks, was honoured by the state to which he belonged with a public triumph. A breach was made in the city walls, through which he entered in a chariot drawn by four white horses, and he was conducted to the temple of the guardian deity, where hymns of victory were chanted. At the public spectacles a seat of honour was assigned to him; he was relieved from the payment of taxes; occasionally his statue was erected in a public place, and in battle he occupied a privileged station.

The training of the athletæ became in course of time a matter of great care, and was conducted with exceeding strictness. Their exercises were conducted by a public officer (the gymnasiarch), in a gymnasium appropriated to the purpose, and known as the *palæstra*; and their diet, to which great importance was attached, was directed by *aliptæ*. Their exercise was prolonged, severe, and continued from day to day; their food, though strictly regulated, was enormous in quantity; and they slept for a long time. In the earlier times the athletæ wore a girdle round the loins ('Iliad,' b. xiii.; Thucyd. i. 6); but later they contended naked. Before the contest they were anointed with oil by the aliptæ; in wrestling they were covered with sand, to allow the combatants to hold each other firmly. Boxing and wrestling were the games which required most strength, and were most admired for the display of manly beauty in the various positions induced during the contest. Wrestling and boxing in combination were known as the *pancratium* (παγκράτιον), the combatants being called pancratistæ. The lighter games were known as the *pentathlon* (πένταθλον, quinquertium among the Romans), and consisted of the five games of running, leaping, throwing the disc, throwing the spear, and wrestling. These were generally played on the same occasion, but sometimes only three of the games were played: the prize of the pentathlon seems to have been adjudged to the victor in the larger number of the games.

Athletæ were very favourite subjects with Greek artists; indeed, there can be little doubt that it was owing to the facilities afforded by the performances of the athletæ for studying the well-developed human form in every variety of position, and exerting itself in energetic action, that the wonderful mastery of the ancient Greek sculptors is largely due. As Müller observes, the statues of athletæ, and the representations of them on rilievi, vases, and gems, enable us to form a tolerably clear idea of the ancient corporeal exercises. From these statues and representations we see that the athletæ were, as a class, remarkable for their well-shaped, robust forms, immense muscular development, powerful limbs, and small heads with crisp curling hair. They are represented in action, in repose, anointing themselves, and indeed in almost every variety of way in which they could be shown in accordance with the conventions of the several branches of art.

Among the Romans, public games were regarded with no less favour than among the Greeks. Athletæ are, however, said to have been first introduced into Rome by M. Fulvius, at the termination of the Ætolian war, B.C. 186. The passion for athletic performances rapidly increased under the emperors, and in the time of Nero large numbers of Greek athletæ were living in Rome. As in Greece, the athletæ enjoyed many privileges, though in Rome they were hirelings. They formed an entirely separate body; were allowed to deliberate on matters connected with their calling; were presided over by one of their own number; lived together, and possessed a common hall. The Roman athletæ must not be confounded with the gladiators, who fought with swords, and whose performances were altogether of a less refined character. There were no gladiators in Greece. [GLADIATORS.]

(Krause, *Gymnastik und Agonistik der Hellenen*; Müller, *Dorians*, iii. § 3, and *Archäologie der Kunst*, § 423; Philipp, *De Pentathlo sive Quinquertio Commentatio*, Berlin, 1827.)

ATLANTES (Ατλαντες), so called by the Greeks, probably, from the well-known fable of Atlas supporting the heavens. This is a term applied to figures or half figures of men used in the place of columns or pilasters, to sustain an entablature; they are called also Telamones, a word of doubtful derivation. Female figures used for the same purpose are called Caryatides. [CARYATIDES.] Though the Egyptians did

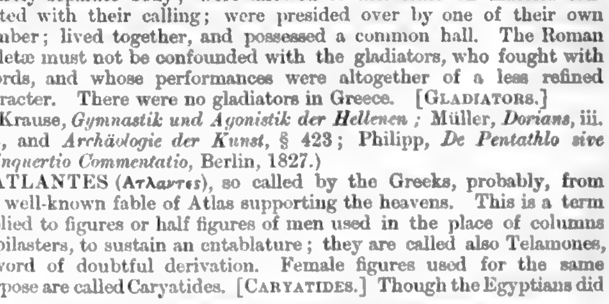


Fig. 1.—From the Temple of Jupiter at Agrigentum.

not use human figures in the place of columns, they used Caryatidic figures attached to the pillars in front of some of their temples, as at Medinet Abou, where the figures are each 24 feet high. Similar figure-pillars occur at Hadjah-Selseleh, and elsewhere. At Denderah, cylindrical columns are surmounted with square capitals, on each side of which is an Isis' head (*Fig.* 2).

There can be little doubt that the Greeks derived the idea of Atlantes and Caryatides from Egypt, but they always used them sparingly. In the temple of Jupiter Olympius, at Agrigentum, restored by Mr. Cockerell, and described in the fourth volume of Stuart's 'Athens,' Atlantes are represented standing upon a plinth placed on the entablature above the pilasters of the cella of the temple, and supporting with their heads and arms the entablature on which the beams of the roof were to have been placed. The Atlantes of this temple were 25 feet high, built in courses of stone, corresponding with the walls of the cella, and partly attached to it. The annexed cut (Fig. 1), showing the front elevation of the figures, with a profile of one of them, has been engraved with the permission of the publishers of Stuart's 'Athens.' (For a

Fig. 2.—Caryatid Pilaster at Medinet Abou.

more detailed account of these figures, see vol. iv. cap. i. of Stuart's 'Athens.')

In the Tepidarium of the baths at Pompeii, Atlantes of baked clay, in high relief, and incrusted with the finest marble stucco, painted to represent life, are ranged at equal distances round the room, to support

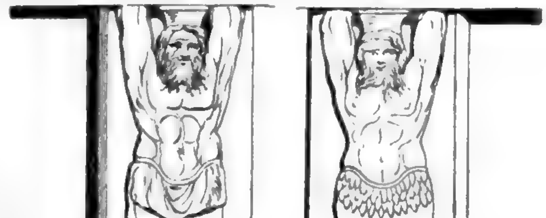


Fig. 3.—From Pompeii.

an entablature from which the arched ceiling springs; in the intervals between the figures, niches are formed for the dress of the bathers. The figures are about two feet high, and stand, like those at Agrigentum, on a plinth; they are represented in Fig. 3.

In the architecture of the modern Italians, the Atlantes are often found supporting the entablature over an entrance to a palace or a garden. At Milan, there is a colossal example of the former; and the rustic gate to the Farnese Gardens at Rome, the design of Vignola, may be adduced as an example of the latter.

The propriety of employing representations of human figures as supporting the entablature or roof of a building, is at least very questionable.

ATLAS, a collection of maps; so called probably in allusion to the mythological figure of Atlas represented as bearing the world upon his shoulders, symbolical of Mount Atlas.

Boucher in his 'Glossary,' says, the word seems to be derived from the German, in which language *atlass* means satin; because a collection of maps was usually made of a smooth satin paper. The word is also now frequently used, and probably for the same reason, for a collection of plates illustrative of a work which is printed on a size much larger than the work itself. It is generally, however, in such cases, distinguished as an Atlas of plates.

ATMOSPHERE (from the Greek ἀτμὸς, and σφαῖρα, *sphere of vapour*), is the whole body of air or other mixture of gases which envelopes a planet. We shall here devote ourselves exclusively to that which surrounds the earth, merely observing, that we have more or less reason to suppose that atmospheres, in density comparable to that of the earth, envelope the Sun, Venus, Mars, Jupiter, and Saturn, but not the Moon.

The subject of the atmosphere, treated in all its extent, would lead us much too far; we shall therefore confine ourselves to the description of its average state. We have already discussed the properties of its constituent materials in the article AIR, and we must further refer as follows, both for subjects which we cannot here enter upon, as well as for extensions of various points which must be incidentally mentioned.

For the general subject of the atmosphere, as connected with the weather, see METEOROLOGY, HYGROMETRY, TEMPERATURE, and articles on particular subjects, such as EVAPORATION, DEW, RAIN, WIND, AURORA BOREALIS, HEAT, ELECTRICITY (ATMOSPHERIC), &c. &c.

For the atmosphere as a medium of communication (taking this word in its widest sense), see ACOUSTICS, AERODYNAMICS, BALLOON, WINDMILL, SAIL. For its effects upon animal and vegetable life, see RESPIRATION, VEGETATION, ANTISEPTICS, DECOMPOSITION. For the effects of the imponderable substances upon it, and *vice versâ*, see HEAT, ELECTRICITY, REFRACTION. For instruments used to measure its state, see BAROMETER, THERMOMETER, MANOMETER, EUDIOMETER, HYGROMETER; and for its uses in the investigation of the elevations of different parts of the earth, see BAROMETER, HEIGHTS (MEASUREMENT OF).

The atmosphere, in its average state, must be considered as a body of air revolving with the earth. This gives its several strata an increasing velocity, as we recede from the earth's axis: and hence, the convex surface of the atmosphere is probably *spheroidal*, and not spherical, since, in the first place, its height would be greater over the equator by reason of its greater centrifugal force, and secondly, by reason of the expansion of the same parts by the greater temperature. Again, at the equator, the air (if any) which is twice as distant from the centre of the earth as the surface, must revolve with twice the actual velocity of the air at the surface. This consideration shows positively that the atmosphere which really accompanies and revolves with the earth cannot certainly extend in the smallest quantity above 26,000 miles from the surface. For at that height the tendency to recede from the centre, known by the name of centrifugal force, would counterbalance the weight, or tendency of particles towards the earth, and at higher distances would overcome it entirely.

But we are not therefore to conclude that there must be air, more or less, *revolving with the earth* up to so great a height. Forty or fifty miles is supposed to be the limit which it attains. Previously, however, to entering upon this question, it is material to know whether we are to consider air as infinitely divisible or not. By which we mean, is it possible for air to be rarefied to any extent whatever, and still preserve its great characteristic, namely, mutual repulsion among its several parts? We might mention various arguments drawn from the ATOMIC THEORY, but Dr. Wollaston ('Phil. Trans.' 1822) has discussed this subject in a form which, while it adds some force to the atomic theory itself, for reasons unconnected with our subject, furnishes a very strong presumption for the finite extent of the atmosphere. The following is a synopsis of his argument:—

If there be air throughout the universe, we are obliged to suppose that every planet would collect an atmosphere around itself, proportionate to its attracting power. In this case, we know that Jupiter, at whose surface the force of gravity must be much greater than at that of our earth, would collect a powerful atmosphere around him. The effect of the refraction of light through this atmosphere would become visible in the approach of the satellites to the planet, when they disappear behind his disc, and would cause a sensible retardation in their rate of approach. No such retardation can be observed in the smallest sensible degree; and, consequently, Jupiter has no such atmosphere, nor the means of collecting it: consequently, air, such as we have at the earth, is not diffused in any degree of rarefaction through the whole solar system. Dr. Wollaston argues that this finite character of the atmosphere is more conformable to the atomic theory than to that of the infinite divisibility of matter, since, in the first case, a boundary is possible, and will exist at the point where the weight of a single atom is as great as the repulsive force of the medium, which has been calculated to be 26,000 miles distant from the earth's equatorial surface; while in the latter case it is difficult to see the possibility of any boundary.

It has been observed, that Encke's comet appears, in successive revolutions, to show in a slight degree the effect of some medium resisting its motion; and the same thing has been said of that of Biela. It might therefore appear that the preceding argument is weakened in force by this circumstance, or *vice versâ*, since the large planets might collect sensible atmospheres of the resisting fluid, whatever it be. But on this we must observe, that supposing the fact of the resisting medium to be established (and several astronomers are of that opinion), it by no means follows that it is common air, or anything approaching to it in the proportion of its density to its elastic power. On the contrary, the facts observed with regard to the motion of the planets (which show no signs whatever of a resisting medium), and the extreme tenuity of the comets themselves (through which very faint stars may be seen), justify us in supposing that the resisting medium may be of a very high degree of elasticity as compared with air; and it is by no means improbable that the planets actually may have atmospheres of this same medium, not sensible to our instruments, on account of the very small increase of density which is sufficient to counterbalance the action of a planet. To elucidate this subject, see Elasticity, Fluid (Elastic).

The preceding arguments go to show, that even supposing the temperature of the atmosphere to be uniform throughout, there is no inconsistency in the supposition of a finite atmosphere. But a very strong presumption in favour of such an hypothesis is derived from the rapid decrease of temperature which takes place as we recede from the surface of the earth. This decrease is conspicuous from the fact that the tops of high mountains are perpetually covered with snow. But the law of decrement is not known with much certainty. According to the latest observations, it would appear that for every 100 yards of ascent, there is an average decrement of 1° F. A slower rate of decrease is evidently given by observations taken during balloon ascents, since it is determined by the barometer, so that they contain the very element in question. Thus, the celebrated ascent of Gay-Lussac at the commencement of this century, gave a decrement of 1° for 316 feet, while Mr. Green and others have made it 485 feet; so that the general average from balloon ascents would seem to be 400 feet, instead of 300. The causes of this decrement are, 1. That, in receding from the earth's surface, we are leaving a heated body, and interposing a badly-conducting medium. Indeed, Fourrier and Pouillet give—226° F. as the temperature of the interplanetary spaces. 2. The heat conducted from the earth is nearly all absorbed by the lower strata of the atmosphere; and 3, Leslie has shown that when air is dragged upwards by masses of rising vapour, it expands, and consequently absorbs caloric; while that which descends contracts, and gives out caloric.

If we take the general law of decrement given above as a basis of calculation (and it is probably nearly correct for heights not exceeding 20,000 feet), we get the following remarkable connection between x, the height in yards, and ϖ, the barometric pressures compared at the higher and lower levels:

$$\varpi = \left(\frac{X}{a}\right)^{5\cdot581}.$$

where $a = 180$ yards $(273 + T)$, T being the centigrade reading at the lower station, and $X = a - x =$ the *depression* of the upper station *below* the height a. "This formula," says Sir John Herschel, in the article Meteorology, in the 'Encyclopædia Britannica,' "makes it very apparent how completely the law of equable decrease is subversive of the received notion of a diminution of pressure in *geometric* progression upwards from the sea-level."

The old theories on the subject of the decrement of temperature as we ascend in the atmosphere may probably be considered as mere hypotheses, and unfounded. Such is that of M. Biot, which assigns a decrement in geometric progression for heights in arithmetic progression, setting out from the assumption that the whole heat of the air at any point is due to the extinction of heat radiated or conducted from the earth to that point.

The argument in favour of the finite extent of the atmosphere, derived from the preceding, is as follows. If we suppose an elevation of 200 yards to produce a fall of 1° of Fahrenheit's thermometer (which, as we have seen, is likely to be below the truth, that is, to give the higher regions of the atmosphere a higher temperature than they really have), it follows, that at a height of forty miles above the level of the sea, the temperature of the air must be 350° of Fahrenheit below that of the sea, or certainly more than 300° below the freezing point. There is the strongest reason to suppose that no gas that we are acquainted with would preserve its gaseous state at this low temperature, but would become liquid: and though no gas has yet been rendered liquid by reduction of temperature alone, yet several have been reduced to that state by cold and pressure united.

If, then, we suppose the atmosphere to be of finite extent, its form (as mentioned above) must be nearly that of an oblate spheroid, the lesser axis passing through the poles of the earth; at the same time the action of the sun and moon must produce certain small *atmospheric tides;* and the tides of the sea, which are constantly disturbing the base on which the atmosphere rests, must produce periodical alterations of form in the latter also. If any such exist, sensibly, they may be detected by the barometer; for, *cæteris paribus*, any increase in the height of the superincumbent column of air must be accompanied by a small increase in the height of the counterbalancing column of mercury. Laplace was the first who examined this curious branch of the subject. He showed by analysis that the attraction of the sun and moon could produce no permanent effect upon the currents of the atmosphere; for instance, such as the trade winds. He also showed that the diurnal oscillations caused by the above-mentioned attractions would only produce a very small effect upon the barometer—in fact, less than one millimetre, or 1·25th of an inch. The reduction of a large number of observations gave, at first, ·055 of a millimetre for the quantity in question; those of another set gave ·018; from which Laplace concluded, taking into account the smallness of the quantities, and the degree of probability which could be attached to results so different, that the *sensible* existence of the atmospheric tide was doubtful. In the meanwhile, however, the diurnal variation of the barometer has been completely established by observations made in several different places. But the law and quantity of this oscillation appears to vary so much with latitude, climate, and other circumstances, that no positive conclusion can yet be drawn, either to the exclusion of atmospheric *tides*, properly so called, or the adoption of any other cause in conjunction with it.

The average pressure of the atmosphere is found to be the same, or very nearly so, at any one place from year to year, notwithstanding the various temporary alterations arising from meteorological causes. But it is not yet accurately determined in a sufficient number of places to settle the question, whether it is the same at the level of the sea throughout the globe or not. Indeed, it is obvious that it must always be difficult to decide whether an observed difference in the mean height of the barometer at two places on land arises from difference of level, or from the atmosphere itself. The mean height of the barometer in London is stated at 29·88 inches; at Paris, where it has been determined with great accuracy, it is 0·760 metres = 29·922 inches. [Barometer.]

As we advance higher in the atmosphere, the barometer falls; and the quantity of the fall is used to ascertain the height ascended. The method of doing this will be explained in the article Heights (Measurement of); we notice it here in order to mention a circumstance which shows that our knowledge of the general conditions of the atmosphere has not been overstated. In order to construct the formula, it is necessary to take into account the diminution of the weight of the air, not only from its rarefaction, but also from its increasing distance from the earth,—the variation of elastic force, as well from rarefaction as from change of temperature,—the alteration of density in the mercury itself, arising from the alteration of temperature,—and to use the formula in different latitudes, the variation of the force of gravity on the earth's surface. In our ignorance of the variation of the temperature, it is usual to allow to the whole column of air contained between the points of observation, the average temperature of its upper and lower extremities. This is the most doubtful part of the process; and as a verification, recourse is had to the comparison of heights measured by the barometer, and also by the processes of trigonometry. It is thus found that a co-efficient which, when deduced from theory alone, is 18337·46, appears from a number of heights measured trigonometrically to be 18336, differing from the former only by about its 18,000th part. This shows the effect of temperature to be sufficiently well taken into account, for such heights as we can measure, by the preceding supposition.

In the article Air some reasons were shown for supposing that its component parts were not united chemically, but only mixed. Now a law is found to prevail in the mixture of gases and vapours, as universal as the one described in the article Air, relative to the expansion arising from temperature—namely, that two gases in a state of mixture exercise no influence one upon the other, except communication of temperature, but that each is disposed in exactly the same manner as it would be if the other were not present. Thus it is found that no pressure of dry air upon water exerts the least influence in preventing the formation of steam, which goes on exactly as if the space above were a vacuum, and continues until further evaporation is stopped by the pressure of the *steam already formed*. It is found that no pressure of one gas can confine another in water; but that supposing a bottle partly full of water, the gas confined in the water will escape to the surface and distribute itself in precisely the same way as if the other gas were not present. By this it is not meant that the action commonly called mechanical cannot take place, or that a stream of hydrogen would not trouble the air; but only that the permanent settlement of one gas is not affected in any way by the presence of another, so long as no *chemical* action is excited. From this principle, Mr. Dalton ('Phil. Trans.' 1826), taking into consideration the presumptions which exist against the *chemical* union of the ingredients of the atmosphere, infers that the atmosphere does not consist altogether of the compound called air, but that the *nitrogen atmosphere* is higher than the *oxygen*

atmosphere. In fact, if there be no chemical union, the above law of the mixture of gases requires us to allow that each is an atmosphere independent of the other, and that the two are most probably of unequal heights. From some considerations, into which we cannot here enter, Mr. Dalton thinks that the actual pressures exerted by the oxygen and nitrogen are in the proportions of the *volumes* occupied by them [AIR], that is as 1 to 4; and concludes that the *oxygen atmosphere* extends to 38 miles in height, that of nitrogen to 54 miles, that of carbonic acid to 10 miles, and that of aqueous vapour to 50 miles. It must however be observed, that the state of the carbonic acid of the atmosphere is very variable; that there is not the same quantity by night as by day, in moist weather as in dry; and that the higher strata of the atmosphere contain more of it than the lower, which may arise from rapid absorption by the earth. This was observed by M. Saussure in his ascent of Mont Blanc, who mentions the large quantity of carbonic acid at that height, which, with the rarity of the air, produced in him hæmoptysis from the lungs.

Against the hypothesis just described, it might be asserted that the air which Gay-Lussac brought down from a height of more than four miles was not found to differ from that of the earth's surface in the proportion of its oxygen to its nitrogen, which would be the case if the oxygen atmosphere diminished in density more than in proportion to the diminution of that of the nitrogen, or *vice versâ.* We do not know whether the experiment of M. Gay-Lussac was made, or even intended to be made, with that degree of accuracy which would justify its being considered a test of Mr. Dalton's theory; but in any case it is an experiment which it was very desirable to repeat. Accordingly, in the balloon ascents undertaken by Mr. Welsh and Mr. Green, under the direction of the Kew Committee of the British Association, specimens of air were collected at different elevations. A portion of air collected in August, 1852, at an elevation of 18,000 feet, was analysed by Professor Miller of King's College, and found to contain 20·88 per cent. of oxygen by volume, while air collected at the same time at the surface of the earth contained 20·92, a difference too slight to be of any importance. Indeed, the results obtained by Regnault, Brunner, Verver, and others, on air collected at different points of the earth's surface, and subjected to different methods of analysis, do not vary more than $\frac{1}{500}$th from the quantity of oxygen given by Dumas and Boussingault as the result of numerous careful analyses, namely, 20·81 per cent. of oxygen per measure, and 79·19 of nitrogen, or by weight, 23·01 of oxygen and 76·99 of nitrogen.

The weight of the whole atmosphere is calculated thus:—The weight of a column of it having a base = 1 sq. inch, is 14·7304 lbs.; hence, taking the diameter of the earth = 7926 miles, we easily find the weight of the atmosphere = 11·67085 trillions of pounds, which is about $\frac{1}{1550000000}$th part of the mass of the earth itself.

The specific gravity of dry air is to that of mercury as 1 : 10513½, and a cubic foot of it weighs 1·29 ounces; hence, were the air of uniform density throughout its mass, in order to exert the same pressure, it must be 26214 feet, or about 5 miles in height. This is what is called the *height of a homogeneous atmosphere.*

We mentioned, under article AIR, that the average pressure on the human body is nearly 15 tons. Now, since at one time, the barometer in this country stands at about 31 inches, at another time at only 28 inches, it will be seen on calculation, that this will cause a difference in pressure on the body of as much as 1½ tons at different times. The reason why we do not feel this change of pressure is, that when, in very fine weather, the barometer stands at 31°, the tone of the system is strengthened, and we are more lively and active; while in damp muggy weather, on the other hand, we become sensible of listlessness and inactivity. All the while too, the external and internal pressure become very soon equalised, and the animal juices which in the one case are secreted with increased energy, in the other are but moderately produced.

For the colour of the atmosphere, see AIR and SKY. For the quantity of moisture contained in it, see HYGROMETRY.

For the history of atmospherical researches, see the following names in BIOG. DIV., HERO, CTESIBIUS, GALILEO, TORRICELLI, PASCAL, BOYLE, MARIOTTE, PRIESTLEY, SCHEELE, BLACK, LAVOISIER, CAVENDISH, &c.

The actual constitution of the atmosphere, whether composed of molecules exerting a repulsive force upon each other or not, must remain unsettled until some mathematical hypothesis can be found which shall satisfy all observed phenomena. That probabilities are at present all on the side of the molecular or atomic hypothesis, is pretty generally admitted; and the repulsion of the several parts of air is a fact of every-day experience. Newton entered upon this question, and showed ('Principia,' book ii. prop. 23) that if the constitution of the atmosphere be atomic, and if the force exerted by each particle extend only to those nearest to it, and be either nothing or inconsiderable as to all others, that then the observed proportionality of the elastic force to the density is consistent with no hypothesis except that of a repulsive force inversely proportional to the distances of the particles from each other; that is, which becomes double when the distance is halved, and so on. But in the scholium to the same proposition, he takes notice of the imperfection of the hypothesis, and describes his theory as a mathematical 'handle' to induce philosophers to consider the subject further. The molecular theory, on the supposition that every particle repels all the rest, or, which is as likely to be the case, has alternate spheres of attraction and repulsion, is beyond the reach of the present state of mathematical analysis.

ATMOSPHERIC AIR, a distinction which has been preserved after the necessity for it has ceased. In the time of Priestley all gases were called *airs,* and common air was called *atmospheric* to distinguish it from other gases. It is sufficient simply to refer to the word AIR.

ATMOSPHERIC INFLUENCE. In the following remarks it is proposed to confine attention exclusively to the action of the atmosphere upon the materials usually employed in the arts of construction. All organic bodies are no doubt affected, in a greater or less degree, by the same influences which affect building materials; but the mysterious power of life so distinctly modifies the action of the laws of mere inorganic matter, that a sufficiently broad line of demarcation may be observed between the chemistry of organic and inorganic bodies, to justify the exclusive investigation of the action of the atmosphere on inorganic matter in this place. Moreover, the striking circumstances under which many of our recently erected public buildings have decayed, and many valuable works of art have been lost, has of late years attracted so much attention as to require more than a passing notice.

The atmosphere affects the materials used in the arts chemically and mechanically; and at the same time it acts as the medium through which moisture, heat, electricity, and other natural powers are able to attack the elements of which those materials are composed.

The chemical decompositions determined by the influence of atmospheric agents, depend of course, upon the composition of the atmosphere itself; and this is known to vary in an extraordinary manner in different localities. The normal composition of air is considered to be of 208 parts of oxygen to 792 of nitrogen, but there are also numerous other gases present in it, such as carbonic acid, ammoniacal, hydrochloric, nitric, sulphuric, and sulphuretted hydrogen, the proportions of all which are affected by local causes in every imaginable manner. Thus the quantity of carbonic acid gas has been ascertained to vary within the range of from 3 to 6 parts (in volume) in 10,000; the amount of ammonia taken up by rain water in falling through the atmosphere, is said to vary notably with the position in which the observations are made, within a range of from 1 to 5·45, even according to M. Boussingault. The atmosphere of the large towns of England especially, contains large quantities of sulphuric acid arising from the combustion of coal, and according to Dr. Angus Smith, its amount may occasionally attain to as much as ·0042 per cent. in weight of the atmosphere. In Paris, the acetate and hydrosulphate of ammonia replace the sulphuric acid of English cities; and on the sea shores hydrochloric acid may be very distinctly traced, in consequence of the evaporation from the sea water.

The meteorological conditions of the atmosphere also are subject to periodical variations; but these are, generally speaking, of great regularity. Thus the electrical state of the atmosphere attains, in clear weather, two maxima and minima, in the course of the day; the first maximum occurring between 7 and 9 A.M.; and the second, between 7 and 9 P.M.; but of course, the hygrometric state of the air must interfere with this phenomenon. The intensity of the sun's light, and, as a necessary consequence, its actinic power, attains its maximum rather before midday; and its minima, a few minutes before, and after the termination or commencement of twilight. Upon the average of the year, the maximum of the daily temperature occurs about 2 P.M.; whilst the minimum appears to exist when the sun occupies a position of about 14° 47′ below the horizon in the morning. The atmosphere is driest about midday, and it contains the greatest amount of moisture by night: but the deposition of dew takes place with the greatest copiousness between midnight and sunrise, on account of the cold then prevailing. In our latitudes the horary differences in the barometric pressure are hardly perceptible; but it would appear that there is a normal tendency to produce a rise of the barometer in the morning, and that the mercury falls about midday, to rise again about sunset, and to fall again at midnight. These facts lead to the inference that the meteorological fluctuations of every day are affected by the relative positions of the sun and earth; and that they correspond, more or less closely, with the cardinal positions of the former at its rising and setting, at midday and midnight.

The rate of evaporation, and the amount of humidity in the atmosphere are amongst the most important conditions of its action; and it is to be observed, that the intensity of their respective actions is the greatest at directly opposite seasons of the year; for evaporation takes place to the greatest extent during the summer months, and is the least apparent in winter, whilst the amount of humidity in the atmosphere is greatest in winter and least in summer. It thus happens that the greatest amount of moisture is in suspension in the atmosphere, in a state to be absorbed by porous materials, precisely at the season of diminished temperature and exposure to the attacks of frost; and again, evaporation takes place at the period when the conditions of temperature are such as are most favourable to the production and development of the salts generated by the previously absorbed moisture acting upon the earthy bases.

The various external agents above noticed produce their destructive effects upon materials used in the arts, either by the new combinations they superinduce between the earthy bases, the metals, and the metalloids; or by the solution and removal of the combinations previously existing. Under some conditions, however, the very same agents which are occasionally so injurious, may produce advantageous results; and as they thus act to consolidate as well as to destroy, the study of their mode of action becomes one of great interest and importance to the architect and builder especially. Strange to say, nothing of any scientific value is known upon the subject; and there is upon record nothing beyond a few empirical observations, to guide the student in his inquiries. The following brief remarks will, it is believed, be found to contain all that is known with respect to the changes produced by the atmosphere upon the various descriptions of materials enumerated. The choice of those materials has been made distinctly on account of their frequent use in the arts of construction.

Granites, which are usually considered to be amongst the most durable of building materials, present nevertheless many varieties differing greatly in their composition, and the mechanical arrangement of their elements; and consequently also in their durability. Thus the granites from Devonshire and Cornwall often contain a large proportion of schorl, and they are frequently pervaded by masses of felspar, of such dimensions and so distinctly crystallised as to cause the mass to assume a porphyritic character. According to Sir H. de la Beche, the granites of Ireland are of the same character, but the schorl occurs in smaller proportions; whilst the granites of Aberdeen are more decidedly micaceous, and schorl is rarely found in them. The Aberdeen granites also differ from those of the west of England and Ireland in their mechanical structure, as they have their component parts more equal in volume and more evenly distributed. In some cases hornblende takes the place of mica; and in others, the quartz and felspar are so much affected in colour, by the presence doubtlessly of the hydrous oxide of iron, as to assume a general rosy hue, as in the case of the Peterhead granites, and the red Egyptian porphyries. The granites of Guernsey, Jersey, and of the French coast, as well as those of the north-western parts of Spain are very similar in their composition to those of Cornwall; and the decomposition of the excess of felspar they contain, gives rise to the large deposits of kaolin clay to be found in some of those respective localities.

Sir H. Davy ('Agr. Chem.,' p. 189) explains the mode of decomposition of granites as follows: "The quartz in them is almost pure silicious earth in a crystalline form. The felspar and mica are very compounded substances; both contain silica, alumina, and oxide of iron. In the felspar there is usually lime and potassa; in the mica, lime and magnesia. When a granitic rock of this kind has been long exposed to the influence of air and water, the lime and the potassa contained in its constituent parts, are acted upon by water and carbonic acid; and the oxide of iron, which is almost always in its least oxidised state, or in that of the protoxide, tends to combine with more oxygen: the consequence is, that the felspar decomposes, and likewise the mica, but the first the more rapidly." There does not appear to be any reason to question the correctness of this explanation, and indeed it is still received as being the true mode of accounting for the decay of granite; but there appear to be different conditions in the combinations of the bases of felspar, which give rise to some apparent anomalies. Thus, the Egyptian porphyries, which contain a notable excess of rose-coloured felspar, resist the influence of the atmosphere in an extraordinary manner. Possibly this may be accounted for by the closeness of the grain (so to speak), which would to a certain extent prevent atmospheric moisture from communicating with anything beyond the immediate surface; or the more simple character of some of these porphyritic rocks may be favourable to their preservation; whereas the different rates of expansion of the ingredients must have a material mechanical influence in disintegrating rocks when they exist in considerable numbers. The difference between the rapid rate of decomposition of the porphyritic granites of Spain, Brittany, and Cornwall, and that of the Egyptian specimens, appears to justify the inference that the cause last suggested has great influence upon their durability. The former are, in fact, composed of a greater number of ingredients than the latter, in which both mica and hornblende are wanting. Practically it is found that the uniform character of the Aberdeen granites resists atmospheric influences in our latitude better than the more easily worked stones of Devonshire and Cornwall.

Whinstones, or basalts, become disintegrated unequally under the effects of exposure to the atmosphere, in consequence of the variable proportions of felspar they contain, and perhaps also of the particular combinations of alumina, lime, and magnesia, which, in connection with silica, constitute their base. If any potassa be present in combination with the silica in the shape of felspar, the action is more rapid than under ordinary circumstances, the humidity of the atmosphere decomposing the felspar into two substances, one of which is soluble, and easily removed by succeeding rains. Serpentines, and the diallage rocks, which are silicates of magnesia combined with hydrates of that base, yield easily to the attacks of acids when the silicates are in certain proportions and alumina is present. The most beautiful varieties of these materials employed in the arts are obtained from the environs of Genoa, and from Zœblitz in Saxony; but it is much to be feared that the atmosphere of large towns, especially when containing sulphuric acid gas from the combustion of coal, renders the employment of even the best of these decorative materials very hazardous. It appears also that in parting with their water of crystallisation upon exposure to the air, an unequal construction takes place in the constituent parts of the serpentine obtained in certain localities, which in consequence breaks in an irregular manner.

The next description of building materials to be considered, in following the ascending order of the geological series, are the slate rocks. Those worked for the supply of the London market are principally situated in North Wales, Cumberland and Westmoreland, the former being a tolerably homogeneous clay slate, the latter being much more chloritic. Exposed freely to the action of the atmosphere, both varieties appear to be tolerably durable, but Westmoreland slates decay very rapidly in damp positions, when the air around them is not frequently renewed. They decay, in fact, in the covered parts, probably from the decomposition of the silicate of iron to which they owe their peculiar colour. The combination of silica and alumina in the Welsh slates appears to be more stable than that which prevails in any other material of the same nature; for their powers of resistance to atmospheric influence are greater than those of any slates employed in Western Europe or North America. As a general rule, the denser the slate the more durable it will be; and the most important condition to be observed in its use is, that water should not be allowed to percolate between the edges of the strata. Practically, it is found that the smoother the surfaces of the slates, and the closer they lie, the greater is the pitch requisite to be given to the roof; because, under such circumstances, capillary action takes effect to a greater extent than when the slates present irregular and perceptibly large intervals.

The various sandstones, millstone grits, and conglomerates are affected by the atmosphere, either through the decomposition of the material cementing their particles together, or by the mechanical effects of moisture. These last may consist either in the removal of the cementing material, or in the destruction of the cohesion of the particles by the expansion of the water in freezing. Many of the sandstones occur in regular layers, separated by thin films of a species of clay, as in the common Yorkshire flagstones; and when these films are sufficiently thick to offer an efficient resistance to the passage of water, to retain it in fact under the upper shale, the expansion during frost will almost inevitably detroy the stone. If the water should change its form from other causes, such as heat, the same effect will be produced; and it is therefore found that the Yorkshire stones of a very porous, and at the same time of a very fissile character, are unable to resist the extremes either of cold or heat.

The best materials of this description are those of an homogeneous nature, such as the Park Spring, the Idle, and the Darley Dale stones, in all of which the minute subdivisions appear, and the mass may be described as consisting of an assemblage of distinct molecules of similar nature, united by mechanical juxtaposition. The sandstones, in which the silicious molecules are united by a calcareous cement, are however far more susceptible of decomposition than those united by a silicious cement; for it appears that in the former cases the chemical combination is rarely effected between the lime and the silica, as the latter is not in the state known as free silica, nor such as can easily form combinations with other materials. In the case of some of the millstone grits, however, the cementing substance, which is silicious, forms so energetic a combination with the molecules it envelopes, that both resist the action of external causes in an equal manner, and the durability of the Bramley Fall stone may fairly be compared even to that of granite itself. These remarks may be extended to the conglomerates, in all essential respects at least; because in fact, generally speaking, they differ from the millstone grits only in the size of their elements.

The crystalline marbles vary in such a very marked manner, both in the nature and the proportion of some of their constituents, and they have been so modified by the accidental circumstances of their geological position, that it is more than usually difficult to trace the laws of their decomposition under the action of atmospheric causes. In many instances they are traversed by veins filled in with more perfectly defined crystals of the base of the rock, or the fissures caused by these veins are filled in with extraneous matters, such as clay, and sometimes even with minerals. Again, however regular the structure of the mass may seem, there is always a tendency in the more crystalline rocks to assume a distinct cleavage, which is often different from the direction of the planes of stratification. Under such circumstances, the moisture furnished by the atmosphere either furnishes the elements necessary for the decomposition of the materials introduced into the veins, or by the mechanical effects it produces in consequence of the changes of temperature, disintegrates the mass. The former class of phenomena may be most distinctly observed in the Breccias, or such marbles as the Brocatello and the Oriental Jasper; the white marbles very frequently exhibit the cleavage above alluded to, and are the most exposed to the injuries produced by the infiltration of water between the planes of division. It is to be observed, that the species of false stratification indicated by the cleavage is most apparent in the rocks which, like the slate rocks, have been affected by proximity to igneous formations, and that the more crystalline the marble the more exposed it is to this inconvenience. At the same time, it must be observed, that the more perfectly crystallised carbonates of lime, under which denomination in fact nearly all the finer marbles may be included, resist the chemical influences of the atmosphere more successfully than similar substances where the forms are not so distinctly marked. It would appear as though the process of crystallisation were accompanied by the development of some chemical affinity between the ultimate particles, similar to that which is noticed with respect to the various forms of silica, and which enables them afterwards to resist more energetically external causes of decay. In some marbles the joints assume different directions from either the lines of stratigraphical deposition, or from the planes of cleavage; but in the practical operations of building the consideration of this peculiarity may be neglected, because they are usually so distinctly marked as to place in reality the natural limits to the sizes of the blocks raised.

M. Durocher communicated to the Académie des Sciences a memoir "sur l'absorption de l'eau atmospherique par les substances minérales," which throws some light on the subject of the decomposition of silicated materials, or those containing metallic oxides. From his experiments it appears that all substances of this description actually absorb water from the atmosphere, and undergo a commencement of hydration, which must necessarily facilitate the decomposition of mixed minerals, such as the silicates, and is apparently the commencement of that action. Messrs. Jamin and Bertrand have also shown that in porous bodies gases are condensed with remarkable facility, so that it is possible that the conditions of molecular aggregation influence the durability of mineral substances in the direct proportion of the facilities which are offered to the passage of air to the interior. From this we may infer that the existence of a crystalline structure is in itself a protection to the materials in which it may occur, because under such circumstances the porosity is usually less; or at any rate, the intervals between the ultimate molecules are proportionately smaller than in the case of materials held together simply by aggregation without crystallisation. Sir H. de la Beche notices the universality of this law ('Geol. Observer,' ed. 1851, p. 8), but he does not attempt to account for it.

The magnesian, the oolitic, and the ordinary secondary and tertiary limestones are liable to decay under the influence of the atmosphere with very various degrees of rapidity; and it is moreover to be noted, that the same formations yield materials varying singularly in their powers of resistance according to the position they occupied in the quarries, and the exposure of the building in which they are employed. The results obtained by the use of the Anston magnesian limestone, and the marked differences to be observed in the Bath, Caen, and Portland oolites, as well as in the several members of the tertiary series of the Paris basin, appear to show that no *à priori* laws can be laid down with respect to their durability when exposed to the air. All these classes of materials are supposed to have been deposited by waters containing their elements in solution; and if they were once in that state (that is, of solution), it must be evident that they are always susceptible of passing into it again if the necessary conditions are presented, unless the deposition should have been effected by the introduction of some additional element, or such element should have been supplied at a later period. There is another chemical agent at work in many cases to hasten the decomposition of the sedimentary rocks unaffected by Plutonic action, namely, the animal matter which they so often contain; and as the distribution of this matter is not subject to any definite law, it necessarily produces irregular effects. Occasionally, also, the body of the stones is traversed by numerous fissures, which have been subsequently filled in by more crystalline materials of greater powers of resistance; and again, the chemical nature of these stones often varies, owing to the presence of more or less silica in combination with the ordinary bases. Every possible variety in the mode of disintegration may therefore be observed in these stones.

Experience has shown that the magnesian limestones are not more capable of resisting the effects of our London atmosphere than the carbonates of lime formerly used, when proper care has been exercised in the selection of the latter. Mr. Rogers indeed remarks ('Brit. Assoc.' 1849), that rain water slightly carbonated takes up the carbonate of magnesia more rapidly than it does the carbonate of lime, and that the magnesian silicates are easily soluble even in pure water. Forchhammer also observes, that water which contains carbonate of soda acts easily upon magnesian rocks. Now, it is very probable that the rain water falling through the atmosphere of London may become charged at any rate with carbonic acid gas, and thus be rendered extremely prejudicial to this class of materials; and it is possible that the rain may give rise to a catalytic action between the lime and magnesia contained in this class of stones, which would facilitate their decomposition. Every stone, as may be gathered from what has been said above, is exposed to decay in the precise ratio of its porosity, but in addition to this cause of disintegration, which acts principally by allowing water to exercise its natural mechanical powers, all the ordinary building stones are exposed to the peculiar process known by the name of nitrification, which, in consequence of the formation of the crystals of nitre, combined with a base, tends to disintegration of the surface. The magnesian limestones allow the development of this process as freely as the carbonates of lime, even if they do not offer extraordinary facilities for its action. The generally received opinion is, that the azote, furnished by the decomposition of the animal matters diffused through the rocks, combines with the oxygen of the atmosphere to form nitrogen, which latter gas in its turn combines with the soda, existing in small quantities in all sedimentary deposits, to form the nitrate of soda. Dumas says that azote and oxygen combine most readily under the influence of electricity, but that the energetic bases, lime and magnesia, may suffice, especially when moisture is present, to replace that intermediate agent. At any rate, this chemical operation takes place in nearly all building stones of a porous nature, and it may confirm the common opinion that of stones of the same description geologically, the densest are the most likely to resist the action of the atmosphere.

Of late years attempts have been made to cast doubts upon the correctness of the generally received opinion, that it is essential to place stones on the same bed as they occupied in the quarry. With some few stones when in place, it may be true that the position of the layers is a matter of indifference; for the roche de St. Cloud, and the Villebois stone of the neighbourhood of Lyon, amongst the secondary and tertiary limestones, have been employed without reference to the planes of bed for many centuries without inconvenience. But these cases are decidedly exceptional, and even in them the powers of the stone to resist a crushing weight are less when it is applied in a direction parallel to the beds, than when it is applied transversely. In almost every other case it will be found that when stones are used the wrong way of the bed, to employ a workman's phrase, they disintegrate in parallel plates. Great care requires to be exercised to ascertain the precise direction of the natural beds, because many stones present the appearance of inclined planes of deposition, which cut the beds and joints under every modification of angle. When from the stones having been worked in the quarry it is difficult to ascertain the precise bed, it is possible that the mason may be misled by the greater facility with which they work in one direction, and may mistake this cleavage for the real bed. The only remedy appears to be to cause the stones exposed to this danger to be marked in the quarry, but fortunately the examples of its occurrence are rare.

The principal danger of exfoliation arises from the expansion of the moisture contained in the stone under the influence of frost, and a very elegant process was invented by M. Brard, for the purpose of ascertaining the probable extent due to this cause. M. Brard in his experiments upon the resistance of stones, caused them to be boiled for half an hour in a saturated solution of the sulphate of soda. They were then withdrawn and allowed to stand in a flat vessel, at the bottom of which was a small quantity of the same solution, the first efflorescences were washed off, and the degradation of the stones during the next five or six days, under the effects of the continued efflorescence, was taken as an indication of the probable extent to which they would be affected by frost. In the first volume of Rondelet's 'Art de Bâtir,' p. 307 (ed. 1842, Paris), M. Brard's process is described in detail; but some very curious experiments recorded in vol. vii. première série des 'Annales des Ponts et Chaussées,' by M. Minard, together with an article by M. Vicat, inserted in the same volume, throw very considerable doubts upon the exact amount of dependence to be placed on its indications. M. Vicat, indeed, very properly observes, that it still remains to be proved that the expansive action of water in freezing is identical with that of crystallisation, which can only produce energetic effect at temperatures between 68° and 86° Fahr. According to this very accurate observer, stones which are exposed to a southerly aspect on the north of the equator, are more affected by frost than those exposed to the north; and the most efficient protection to materials of this description of a porous nature is a coating of oil paint, or any other fatty pigment which prevents moisture from being driven or absorbed into the stone. M. Minard recommends that stone should be quarried in the spring, and not employed in a building until it has been exposed to the effects of one winter at least.

In many varieties of the oolites, the fossil shells are to be observed left in high relief upon the surface by the decomposition of the materials in which they were embedded, and in Bath stone the veins of calcareous spar frequently become detached. It appears that the cause is the same in both cases, and that the shells and the veins protrude in consequence of the resisting powers of the more perfectly crystallised carbonate of lime, of which they are composed, exceeding those of the amorphous mass in which they are embedded. When nodules of flint or chert occur in the numerous varieties of carbonate of lime, the stone around them is usually more durable than the general mass of the rock, doubtless because it contains a portion of the silica in combination with the lime. It is known, indeed, that the application of a soluble solution of silica will at all times add much to the durability of the purer carbonates of lime; but it is very desirable that the conditions under which such a solution should be employed, should be made the subject of close and careful experiments. The application of Kuhlman and Ransome's processes for the preservation of stone, may hereafter throw light upon this obscure branch of practical chemistry.

With respect to the gypseous formations, it appears that where they occur in sufficient abundance to be used as ordinary building materials, they absorb moisture from the atmosphere with extraordinary facility; while they decompose with such rapidity that the municipal authorities of Paris have forbidden their being used for the walls of houses. Occasionally, however, rubble plaster stone is used for inclosure walls, but it rarely lasts more than from twenty to thirty years, when exposed to the weather near Paris. The cause of this rapid decay, according to Gmelin, is to be found in the fact that the sulphates with an earthy base (gypsum being a sulphate of lime), are soluble in water. It is also to be observed that many of the gypseous deposits, especially those found near Paris, are impregnated with an extraordinary proportion of organic matter; this decomposes on exposure to the air in warm and damp positions, and gives rise to the formation of nitrous salts to such an extent, that the saltpetre used by the French powder manufacturers, during the last war, was almost entirely obtained from cellars constructed of rubble masonry, set in plaster in the style usually adopted in France. It is possible that the gases which are present in rain water, or in the atmosphere, may give rise to a species of decomposition by relative affinity, in combination with the sulphuric acid of the gypsum.

Atmospheric influence upon bricks, tiles, and other building materials obtained by the burning of plastic clays, depends very much on the chemical composition of the clays and on the degree of burning. Thus any distinct portions of limestone present in them would be converted into quick lime in the kiln, and when the bricks were thoroughly wetted, would expand in such a manner as to disintegrate the mass. If the clay used be too poor, that is to say, if it contain an excess of sand, the bricks will not become sufficiently fused, and upon exposure to the weather their constituent parts will separate. It is to be observed that in bricks, as in stones, decomposition does not take place with the greatest rapidity where constant moisture exists, but rather where, from the influence of capillarity, variable according to the moisture furnished by the atmosphere either directly or indirectly, a series of alternations of dryness and humidity prevail. The foundation walls of buildings do not in fact suffer so much in the parts immediately upon the ground, as they do in those at a height of from one to three feet, according to the permeability of the materials employed. When bricks made of clay containing free silica are laid in mortar, and moisture can pass freely from either one or the other, it may be observed that the edges in contact become harder than the body of the bricks. No doubt this arises from the formation of a silicate of lime and alumina, the lime being furnished by the passage of the water through the bed of mortar.

Upon limes and cements the effects of the atmosphere are very marked, although at present they are considered to be of far less importance than formerly. All the materials of this class, whether the hydraulic or the rich limes, the cements or the plasters properly so called, have a remarkable avidity for water, and abstracting it from the surrounding atmosphere assume the form of hydrates. If these occur in the conditions requisite to enable them to pass into the carbonates or sulphates, a species of confused crystallisation, or aggregation, takes place. But it must be evident, from what was said in the commencement of this notice, that the quantity of carbonic acid gas the atmosphere is capable of furnishing within a moderate period is exceedingly small, and the theory that limes or cements harden originally by the absorption of that gas, and the consequent conversion of the lime into carbonate of lime, must be abandoned. There can be no doubt but that the conversion of the lime into the carbonate must increase its cohesion, but the rapid setting, to use a workman's phrase, cannot be accounted for in this manner. It appears, so far as we are able to judge in the actual state of applied chemistry, that mortars harden in consequence of the formation of an insoluble silicate of lime and alumina, the silica being either furnished by the limestone itself, or by the sand, pozzolano, or other ingredient mixed with the slaked lime. When the setting has been once effected, the absorption of carbonic acid gas from the atmosphere may tend to harden a thin external film; but the very perceptible character of this film militates against the supposition that the cause producing it can act upon the interior of the mass.

Nevertheless, the numerous classes of limes, cements, and plasters exhibit very marked differences in their manner of resisting the action of the atmosphere. The purer carbonates of lime, when used for the preparation of mortar, are excessively soluble in water; and if the mortar obtained from them be much exposed to the weather or to the action of running water, it will be rapidly removed. The argillaceous limestones, on the contrary, furnish the elements necessary to form an insoluble double salt of lime with the silica and alumina; and if the mortars made from them be protected from running water during the period required for their setting, the action of either weather or running water subsequently, will rather tend to increase their powers of resistance. The practical lesson to be drawn from these facts would appear to be, that none but the limes obtained from argillaceous limestones should be employed in damp situations. With respect to the use of plaster, the observations before made upon the gypseous stones will apply here perhaps with even greater force. Indeed, the marked difference between the external aspects of the applied plaster and the natural stone, would show that in the process of calcination some element we are unable to ascertain must be driven off. It may be that the burnt plaster yields more readily on account of the absence of this very element; but certain it is that plaster of Paris very rapidly decays when exposed to the influence of the atmosphere.

Temperature appears to act in a distinct manner upon limes and cements; for if they are used in summer, without the adoption of any precautions to defend them from the sun, they invariably crack; and of course, if their water of crystallisation becomes frozen in winter, the whole mass will disintegrate. The more rapidly limes or cements solidify, the more they appear to be exposed to the danger and inconvenience of cracking in warm weather, and it would appear that the most favourable condition for their resistance is when a certain degree of uniform moderate dampness prevails. It must also be observed, that sea air has a marked influence upon the durability of some limes, because the minute particles of sea-water it contains hold in solution many salts with which free lime has more affinity than with silica.

The decay of wood superinduced by atmospheric action, is affected by a different class of phenomena from those which tend to destroy stones and metals, namely, those connected with organic chemistry; although at the same time the changes produced by inorganic elements are as powerful in the one case as in the other. From the day when wood is felled to the day it is used, it requires care and attention, and when it is in place, precautions should still be taken to insure its durability. Currents of air which are either renewed with too great rapidity or are too dry, a temperature too elevated, constant moisture at high temperatures, alternations of dryness and humidity, absence of ventilation producing wet rot, the accidental transport by the atmosphere of the seeds of certain cryptogamous plants producing a species of dry rot, and the attacks of insects, together with the fermentation of the sap of the trees, may be cited amongst the numerous sources of danger from which it is necessary to secure wood, either when in store or when employed.

When wood is exposed to frequent currents of air, especially at high temperatures, the moisture it contains evaporates too rapidly, and gives rise to cracks and fissures which either destroy the resistance of the material, or open a passage for the water contained at other times in the atmosphere, to penetrate to the interior of the mass. If the temperature to which wood is exposed, whilst any sap remains in it, is too elevated, the vegetable fluids ferment, the tenacity is diminished, and when the action is carried to its full extent, the wood quickly becomes affected by the dry rot. Exposure to the atmosphere in positions where rain can lodge in quantity, contact with the ground, and application in damp situations deprived of air, will render wood liable to the wet rot; and however well seasoned it may have been previously to being brought within the influence of any of these causes, it will infallibly suffer. It is therefore of the highest importance, that whether in the merchants' stores, or subsequently when placed in a building, wood should be preserved from contact with the ground, and that air should have free access to it in every direction. The germs of destruction are often communicated whilst the wood is in store, from neglect of these simple precautions; if they be once implanted, the progress of decay can never be subsequently arrested. It has been supposed that keeping wood in water tends to prevent the commencement of dry rot, because in that position the sap is washed out of the pores. If this theory is correct, it must be evident that the oftener the water is changed, the greater will be the probability of its producing the desired effect; because if it be allowed to stagnate it must become saturated with the sap in course of time, and unable to take up any additional quantity which may be present. Duhamel observed, that if wood were immersed immediately after it was felled, it would be less liable to decay than if put in water at a subsequent period; he also found that immersion tended to preserve the wood from the attacks of insects, and even to arrest the progress of some kinds of decay, but that a notable portion of the strength was thus lost. The drying and seasoning take place with greater rapidity after immersion, probably because the water displaces the sap, which does not evaporate so rapidly as the thinner fluid. Duhamel asserts that the process of charring the ends of posts, &c., built into the ground, is very inefficient, and that it is only of use to the extent of interposing an extraneous substance between the wood and the earth; in his opinion it would be better to inclose the lower ends in sand, stone, cinders, or other materials which would easily carry off the water supplied by the surrounding media.

When wood is converted and placed in a building, its durability may be greatly increased by covering it with a coating of paint or other substance which will prevent the moisture of the atmosphere from obtaining access to it. But it is essential that the wood so covered should be free from sap or internal moisture, or the very perfection of the coating will be found to accelerate its decay. Care must be taken to prevent water from finding its way into the joints, and if the wood be exposed directly to the action of the sun, it should be painted of a colour able to reflect, rather than to absorb, heat. It is desirable that it should be planed before being painted, in order that the paint may be applied in an equal manner over the surface. It is important also to observe, that the moisture in the atmosphere not only affects the volume of the wood, but frequently alters the position of the fibres, by producing a torsion analogous to that which may be observed in hygrometric cords.

Of late years the processes of Kyanising, creosoting, and immersing timber in solutions of mineral salts, have been applied with various success for preserving it from rot and the attacks of worms or ants. Of these, Kyanising, which employs a solution of deutochloride of mercury, appears to be most satisfactory; and among some striking illustrations of its results may be cited the fence of the Regent's Park, the posts of which were inserted in the ground, without being painted, at least twenty-three years since, and remain at the present day in very tolerable condition. For railways and harbour works, English engineers appear to prefer the system of creosoting, or immersing the timbers in the rough oil of tar, until it has absorbed at least 7 or

8 lb. per cubic foot. The difficulty of injecting so large a quantity of oil is overcome by exhausting the sap and moisture from the wood *in vacuo*, and then forcing in the oil under great pressure; a species of artificial drying is, however, frequently necessary, and indeed the success of this process appears to depend entirely upon the extent to which the original moisture is withdrawn. Both corrosive sublimate and oil of tar are capable of resisting the causes of decay communicated by the atmosphere, and the latter is said to be an effectual preservative against the attacks of boring animals; but it is to be feared that the ordinary manner of applying them does not insure their penetration to a sufficient depth to attain the objects desired. The use of the sulphate of copper and of the other metallic salts has hitherto been unsuccessful.

In the bent timber bridges which have been constructed on some of the modern lines of railway, although every ordinary precaution was taken in selecting the timber, immersing it in solutions of the metallic salts, and in painting it when in place, the wet rot has exhibited itself in so many instances as to render it almost necessary to abandon a system which appeared to have many recommendations. It is, however, to be observed, that these bridges decayed solely because their elasticity caused them to yield upon the passage of every train. The play thus produced caused the joints to open, and moisture, furnished by rain or the condensation of vapour, found its way into the interior of the beams. The failure of the bent timber ribs in such situations does not, therefore, in any manner affect the propriety of using that construction on more suitable occasions. A valuable lesson is, however, to be learnt from the above fact, namely, that it is difficult, if not impossible, to protect complicated systems of carpentry from the effects of the atmosphere, when exposed to the occasional action of heavy loads able to produce a disturbance of their main parts.

The action of the atmosphere upon metals is even more complicated than that which takes place upon stones, because the electro-chemical changes are more decided, and the metallic bases are susceptible of combining with a greater number of gases than are the earthy bases or the metalloids. In building operations the metals commonly used are iron, lead, copper, tin, zinc, with the mixed metals, brass or bronze, and to them we will confine our attention.

Iron, whether cast or wrought, becomes rusted on exposure to the air or water under certain conditions; that is to say, the outer portions of the metal are converted into a hydrous oxide, and can be detached in scales or flakes. Many systems have been proposed to obviate the danger, and many substances applied to correct the evil, arising from this cause, full information concerning which is contained in Mr. Robert Mallet's papers in the Transactions of the British Association for the Advancement of Science. His experiments appear to show that gas tar applied hot is the most efficacious protection for iron work exposed to cold water, and that a coating of caoutchouc varnish resists the longest in hot water; but that neither of them can be considered a durable defence. Cases cited by M. Vicat are within the knowledge of every architect who has examined this class of phenomena, which prove that in some waters, as in some positions in the open air, iron work, totally unprotected, will last an indefinite period. These exceptions are, nevertheless, so rare and the destruction of iron unprotected is generally so rapid both in air and in water, that constant care and attention are required to guard against the destructive tendencies of those agents. If iron work be exposed to the air in positions which render the renewal of the air difficult, and at the same time retain it in a marked degree of dryness, the iron will become covered with a coat of rust, through which the atmosphere cannot penetrate to attack the metal beneath. If the water in which iron is immersed contains a very small portion of some of the earthy salts, the decomposition will take place slowly. But it is necessary to observe that these remarks only apply to iron of considerable dimensions: small wires decay rapidly on exposure to either of these causes of disintegration.

Should iron, however, be exposed to confined air in damp positions, the decay attains its maximum. Carbonic acid gas contributes much to this destruction; for under its influence iron passes (to use the words of Vicat) into the state of the carbonate of protoxide, which, absorbing fresh doses of oxygen, transforms itself into a hydrated peroxide. It is indeed generally considered that oxidation cannot take place to a dangerous extent unless carbonic acid be present; and it is precisely for this reason that iron bedded in fresh masonry or concrete resists the action of the air, because either the mortar absorbs the carbonic gas, which has a greater affinity for lime than it has for iron, or the masonry is sufficiently dense to protect the iron from contact with the atmosphere. The investigations of the Commission in 1850, respecting the fall of the bridge over the Maine, at Angers (recorded in 'Les Annales des Ponts et Chaussées,' vol. xxix. seconde série, page 394), appear to prove that the preservative action of the lime depends upon its being in immediate contact with the iron, and that if a space, however small, be left between the two substances moisture will insinuate itself, and in course of time produce active oxidation. M. Vicat, in a note inserted in the 'Annales des Ponts et Chaussées' for May and June 1853, appears to doubt the correctness of this conclusion, but even he admits that the preservative action of the lime depends upon its absorption of carbonic acid gas, and that directly its hardening ceases, it loses its power of resisting the action of the atmosphere on the iron.

M. Payen found that the addition of very small quantities of the sub-carbonate of potassa, or of sodium, to pure water, was sufficient to render it innocuous either to cast or wrought iron, and the same property existed in nearly all alkaline solutions; whilst, on the contrary, the addition of a small quantity of the chloride of sodium rendered the process of oxidation much more rapid than it usually is in pure water. It appears that gray cast-iron is more susceptible of destruction by oxidation than either wrought iron or white cast-iron; and that wrought iron resists the action of sea water more effectually than cast. It is a peculiar fact connected with this subject, that iron, exposed to frequent displacements, shocks, or vibrations, is less affected by oxidation than when it remains constantly in one place, without disturbance. Thus, anchors in constant use are less exposed to rust than those preserved in the magazine; the rails of the main lines of railroads are less corroded than those in the sidings; iron steamers rust less when in active service than when in dock. But the positions in which iron decomposes with the greatest rapidity are those where it is fixed, and alternately exposed to the air and immersed in sea-water. Ammoniacal and sulphuric acid gas exercise very serious effects upon the durability of cast and wrought iron. It is important, therefore, to prevent their use, either in urinals, roofs over gasworks, or the engine sheds of railway stations. There appears also to be some danger in using iron in contact with sulphate of lime, or in fact under any circumstances where it is likely to take up sulphuric acid gas, for which it has great affinity.

The galvanisation of iron, which, as generally practised, consists in forming a superficial coating upon the metal by immersing it in melted zinc, appears to constitute an efficient protection, so long as the iron is covered. The contact with the zinc brings the iron into an electro-negative state, and it is known that so long as the latter prevails there is little tendency on the part of the iron to combine with oxygen. From a series of experiments made at Brest between the years 1842 and 1851 (see note by M. Dehargne, 'Annales des Ponts et Chaussées,' 1851), it appears that the zincing process does not, in any sensible degree, affect the tenacity or the ductility of the iron; but it is important to secure the protected metal from any shocks or friction likely to remove the surface.

Zinc, when exposed to the atmosphere in its ordinary state, becomes rapidly covered by a whitish efflorescence, which adheres to the metal, and forms, as it were, a species of varnish, capable of arresting any further decay. This efflorescence is considered to be a carbonate of zinc; but if the atmosphere should contain any sulphuric or hydrochloric acid (as in London and in the immediate neighbourhood of the sea), compounds are formed of a nature to compromise the solidity of the metal. In the purer atmosphere of Paris, and other Continental towns, where wood is the ordinary fuel, and to which the sea air does not reach, zinc is employed successfully for roofing purposes; in London, and on the sea shore, its durability is very limited; and at all times its fusibility, and even its combustibility must be a serious objection to its use externally, especially for roofs.

Copper resists the action of the atmosphere very successfully, and the presence of some of the gases mentioned above does not seem to affect it in any material degree. A film of oxide, or carbonate, of copper is rapidly formed over the surface, and secures the metal from further decay. It is found, however, that a mixed metal or bronze, made of copper and zinc, resists the influence of the atmosphere and sea water more successfully than pure copper alone.

Lead undergoes little change upon exposure either to air or water, especially when the latter contains small proportions of the salts of lime. According to Brande, when lead is kept in distilled water to which air has access, small crystalline scales of oxide of lead are formed, a portion of which dissolves in the water, and is again slowly precipitated in the form of a carbonate. Soft water also, or that without the salts of lime, appears to be more likely to attack lead than that containing lime. The use of lead for cisterns must, therefore, be regulated by the nature of the water to be preserved in them; for all roofing or analogous purposes there do not appear to exist any philosophical reasons to object to the use of this metal, or to limit its application to any particular districts.

A very important remark with respect to the use of metals must be made, namely, that when two of them are used in contact, in positions where moisture in any form has access to them, a species of galvanic action is established, which causes them to decay with great rapidity. Illustrations of this may be observed in iron railings, when the bars are secured to the stone curb with lead, and the decay is most evident when the iron is of the best and most malleable description. A similar phenomenon may also be observed when copper or bronze is in contact with iron in sea water; though the iron decays rapidly, it appears to exercise a protective influence upon the copper.

The laws of electricity developed by the contact of two metals with a liquid containing a solution of an alkaline salt, are treated at some length in vol. 1, Gmelin's 'Handbook of Chemistry,' p. 364. From this authority it appears that zinc, tin, and iron, protect copper in sea water. Zinc protects iron and tin plate, but it is not so effective for the defence of iron in sea water if air be present, and it is itself rapidly corroded when used with iron in the sea. In that element tinned iron decays unequally, the iron oxidating whilst the tin remains intact; and appears that the decay, superinduced by the contact with tin, is greater than that resulting from the contact with copper. The corrosion of copper may be considerably retarded by fastening to it at several points, pieces of cast or wrought iron, or of zinc, when sulphuretted hydrogen is likely to be present. Water containing bicarbonate of lime will deposit the lime if placed in contact with zinc and copper, the deposit taking place upon the copper: and when water of this description flows through leaden pipes, the carbonate of lime is deposited at the solder joints (composed of an alloy of tin and lead), on the brass cocks, and on any piece of iron or silver which may be introduced. The inconvenience arising from the stoppage thus produced may be obviated by the use of a lateral pipe fitted to the main at intervals, and furnished with plugs of a metal likely to deposit the calcareous matter, which can thus be withdrawn from the main.

Glass under certain circumstances is affected by the action of the atmosphere; for the potash and soda employed in its manufacture are susceptible of being decomposed and removed by the moisture, or the gases contained in it; and according to Gmelin the decomposition takes place with greater ease in proportion as the glass is richer in the above-named alkalies, and the temperature of the moisture or water is higher. Glass in which there is a deficiency of silica is exposed to this description of decay, which may often be distinctly perceived in window glass, the alkali from which is gradually attracted (Knapp's 'Applied Chemistry,' vol. ii. p. 8) by atmospheric moisture and washed away, whilst a thin layer of silica or of silicate of lime remains upon the surface and exhibits a play of prismatic colours. An analogous decomposition takes place in the glass used in stables, in consequence of the ammoniacal gases; and, according to Knapp, glass containing oxide of lead is liable to blacken on exposure to air impregnated with sulphuretted hydrogen.

The chemical changes produced in oleaginous and metallic pigments by the gases contained in the atmosphere are subjects of the highest importance to the decorative artist; but as the examination of them would extend this notice beyond the usual limits, the reader is referred to the researches of M. Chevreul in the 'Mémoires de l'Académie des Sciences,' 1850 (vol. xxii.). It may here, however, suffice to say that M. Chevreul attributes the solidification of paints to the oils they contain absorbing oxygen from the atmosphere, and states that the driers act by facilitating the power of absorption. The various substances introduced to communicate colour appear to affect the rate of absorption; and the surfaces upon which the paints are applied, have an influence independent of their mere capacity of taking up moisture. The varieties in the rates of drying upon the several woods and metals experimented upon by M. Chevreul, indicate some peculiar differences in this respect, which have not hitherto been sufficiently examined.

[The greater part of this article was read by our contributor, Mr. Geo. R. Burnell, at the ordinary general meeting of the Royal Institute of British Architects, June 5, 1854; and as the notice embraces a great variety of substances used in construction, Mr. Burnell reprints it for general information in preference to any abridgment.]

ATMOSPHERIC RAILWAY. The history of failures constitutes an important part of the history of science and practical art; and, on this ground, the atmospheric railway may suitably receive a little notice here. The idea of producing motion by atmospheric pressure was conceived by Papin, the well-known French engineer, nearly two centuries since. After slumbering for more than a century, the subject was successively taken up by Lewis, Medhurst, Vallance, and Pinkus, and lastly by Clegg, in connection with Jacob Samuda. Medhurst not only cherished the idea of locomotion by atmospheric pressure, but devised many plans for its accomplishment. One of these plans related to the construction of an air-tight tunnel of sufficient magnitude to admit the passage of carriages within it, running upon iron rails, and propelled by air forced in behind them by pumping machinery; the carriages being made so nearly to fit the tunnel that the air thus forced in could not pass them, but must act upon them as upon a piston. Another invented the use of a vacuum in front of the piston, instead of compressed air behind it. A third related to the arrangement of carriages *outside* the tube, connected by mechanism with the air-driven piston inside. In a fourth plan there was to be a smaller tube between the two rails of an iron tramway. Vallance's plan, made public in 1825, related to the conveyance of passengers along a railway laid within an air-tight tunnel, which he proposed to construct either of cast-iron or of vitrified clay, resembling common brickwork, but less permeable to air; but, knowing that experiments had proved a very great loss of power to result from the attempt to impel air through a long pipe, he proposed to set the piston-carriage in motion solely by exhausting the tunnel in advance of it, and suffering the full pressure of the atmosphere to act upon its rear. This plan, which was patented in 1823, was brought into experimental operation at Brighton upon a sufficiently large scale to prove the possibility of so singular a mode of transport; but, had there been no other difficulties, the objections of the travelling public to transmission in a dark close tunnel would have proved sufficient to prevent its general adoption. About the year 1835 the subject was revived in consequence of a patent being taken out by Mr. Henry Pinkus, an American gentleman residing in England, for an apparatus which he called the Pneumatic Railway. This, as originally proposed, was to consist of a cast-iron tube from 36 to 40 inches internal diameter, of an average thickness of three-quarters of an inch, and having a

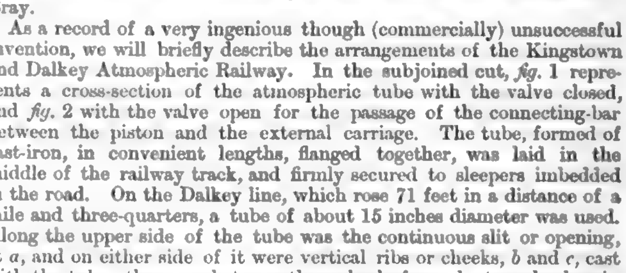
longitudinal slit or opening from one to two inches wide along what was, when laid in its proper position upon the railway, intended to be its upper side; this slit furnished an opening through which the mechanism of the piston inside the tube could be connected with that of the carriages on the outside. Some time afterwards, Mr. Pinkus made trial, on a piece of experimental railway laid down near the Kensington Canal, of a tube much smaller in diameter, and differently arranged; but the experiment led to no immediate results.

In 1840, Messrs. Clegg and Samuda arranged with the West London Railway Company for the temporary use of a portion of their line near Wormwood Scrubs, upon which they laid down about half a mile of railway, with a rising gradient of about 1 in 120; and notwithstanding the defective arrangements, the results of the first trials showed a maximum speed of 30 miles per hour with a load of 5 tons 9 cwt. in one carriage, and of 22½ miles per hour with a load of 11 tons 10 cwt. in two carriages. This experiment was deemed so satisfactory, that the directors of the Dublin and Kingstown Railway determined to adopt the atmospheric mode of working upon a projected extension of their line from Kingstown to Dalkey, the gradients and curves of which rendered it unsuitable for working by locomotive engines. This line was so far completed as to be ready for working in August, 1843. In 1844, the London and Croydon Railway Company obtained parliamentary sanction to a plan for laying down a line of atmospheric railway alongside of their locomotive line from London to Croydon, and making an extension of the same from Croydon to Epsom. About the same time, and within a year or two afterwards, many other atmospheric railway schemes were brought before the notice of Parliament, some of which were sanctioned by Acts.

The result of these schemes has not borne out the expectations of the projectors. The atmospheric system was tried on portions of the Croydon and the South Devon Railways; and after lengthened trials, the costliness and the inconvenience of the system led to the removal of the atmospheric apparatus from those railways. The only line which was worked during a lengthened period was that of the Kingstown and Dalkey Railway; but even that was ultimately abandoned in favour of locomotive engines, when the line was extended to Bray.

As a record of a very ingenious though (commercially) unsuccessful invention, we will briefly describe the arrangements of the Kingstown and Dalkey Atmospheric Railway. In the subjoined cut, *fig.* 1 represents a cross-section of the atmospheric tube with the valve closed, and *fig.* 2 with the valve open for the passage of the connecting-bar between the piston and the external carriage. The tube, formed of cast-iron, in convenient lengths, flanged together, was laid in the middle of the railway track, and firmly secured to sleepers imbedded in the road. On the Dalkey line, which rose 71 feet in a distance of a mile and three-quarters, a tube of about 15 inches diameter was used. Along the upper side of the tube was the continuous slit or opening, at *a*, and on either side of it were vertical ribs or cheeks, *b* and *c*, cast with the tube; the space between these cheeks formed a trough wherein the valve lay secure from injury. The valve itself consisted of a piece of strong leather, firmly enclosed between two pieces of iron. The leather was on the side marked *b*, considerably wider than the upper plate, and its projecting edge was attached to the flat floor of the valve-trough, at the base of the cheek *b*, so as to form a continuous hinge. The more perfectly to prevent the ingress of air, the opposite or opening edge of the valve was, when closed as in *fig.* 1, hermetically sealed with a composition of wax and tallow, which filled the small groove or space left between it and the cheek *c*. To protect the valve more thoroughly, the trough was closed in with a sheet-iron cover *d*, hinged with leather to the top of the cheek *b*, and shutting down closely upon the top of the cheek *c*. The interior of the tube was lined with a soft composition, which filled up all little irregularities, and rendered the passage perfectly smooth and even. The piston was attached to the fore end of a rod which is seen in

Fig. 1. *Fig.* 2.



section at *f*, and which carried rollers so fixed as to lift up and open the valve immediately after the piston had passed, thus bringing it into the position indicated in *fig.* 2. This position allowed room for the passage of the connecting-bar *e*; the iron cover *d* being previously raised and held open by a coulter and a series of wheels or friction-rollers attached to the carriage. After the connecting-bar had passed, a roller attached to the carriage pressed the valve down into its seat, while a heater gliding along the mass of composition at its opening edge melted it, thereby sealing the joint afresh. The cover *d* was then allowed to fall into its place, and all was ready for the passage of another train as soon as the piston had quitted the pipe so as to allow of its being exhausted afresh. The end of the tube behind the train was left open, to admit the air by which the piston was to be impelled; but the end in advance of the train was closed, and the air was pumped out from the tube by a branch pipe near it, leading to the air-pumps. These pumps could be worked either by a steam-engine or by any other prime mover of sufficient power. The mode of action, then, was as follows: the train of carriages was pushed forward by manual labour until the piston had entered the tube; which it might do, by the aid of an ingeniously contrived valve, without impairing the partial vacuum previously produced. It then advanced with a speed proportionate to the rate at which air was abstracted from the tube by the air-pumps until it reached the opposite end of the tube, where, without the aid of an attendant, the valve which had closed the tube sprang open, and the piston and train proceeded by momentum until stopped by breaks. At Dalkey the inclination of the road was sufficient to produce rapid motion in one direction by gravity alone; so that the atmospheric pressure was only required in ascending, while in descending the piston was moved aside in such a way as to pass clear of the tube. In longer and in level lines of railway there would necessarily be a greater complexity of arrangement. It was this complexity that led to the subsequent abandonment of all the schemes.

The main arguments in favour of the atmospheric system of traction are based upon the facilities which it affords for ascending steep gradients, and consequently for constructing railways at less cost than where heavy cuttings and embankments are necessary in order to procure easy slopes for the locomotive; the saving in the wear and tear, and consequently in the necessary strength and cost of the railway itself, in consequence of not having to convey the moving power with the train; and the security against collision, owing to the impossibility of moving two trains on the same stage or engine-length of railway at the same time. The objections raised to this apply to every other mode of using stationary engines; such are the necessity of providing and constantly maintaining a power sufficient to conduct the largest amount of traffic which can ever be conveyed, which would render it as costly, as regards some large items of expense, to maintain a railway for the passage of four or five trains per diem as one upon which trains are constantly succeeding each other; and the liability of derangement to the whole system in consequence of the failure of a single point in it. These are the principal grounds for objection to what has been termed the *inflexibility* of the system, or, in other words, the comparative want of power to modify the mode of working according to the fluctuations of a variable traffic or the exigencies arising from accident. It is this inflexibility, together with the waste of power which results from any defect in the valve, that led to the abandonment of the system. It would be too much, however, to say, that the system, though at present in abeyance, is unsuited for further application. [RAILWAY.]

ATOMIC THEORY, in chemistry, sometimes termed the *doctrine of definite proportions*. This very important theory, founded on well-ascertained facts, has bestowed on modern chemistry an almost mathematical degree of precision. The hypothetical, which is to be distinguished from the experimental part of the subject, supposes that chemical compounds result from the combination of the ultimate atoms of their constituent parts. It has been determined by experiment, and the fact serves as the basis of the theory, that a compound body, when pure, always contains the same proportions of its constituents: thus, calcareous spar, and the pure part of marble, chalk, and limestones, consist of carbonate of lime, composed of the same proportions of carbonic acid and lime; the carbonic acid always contains the same quantity of carbon and oxygen, and the lime the same proportions of calcium and oxygen. The same law also exists with regard to all similarly-constituted oxides, sulphurets, and salts, and indeed as to all chemical compounds whatever, whether presented to us by nature or formed by art: this is a simple statement of the fundamental facts upon which the superstructure of the atomic theory has been raised.

Before we proceed to detail the minutiæ of the theory, it will be proper to give a sketch, though a slight one, of the principal discoveries connected with the subject.

The earliest experiments which could have served as a basis for the atomic theory are those of Wenzel, a German chemist, who published, in 1777, a work 'On the Affinities of Bodies;' the experiments detailed in it, though neglected at the time, are now acknowledged to possess a very considerable degree of accuracy. The author showed that when any two neutral salts decomposed each other, the resulting new compounds were exactly neutral. "The very attempt," remarks Dr. Thomson, "to analyse the salts was an acknowledgment that bodies united with each other in definite proportions; and these definite proportions, had they been followed out, would have ultimately led to the doctrine of atoms." ('History of Chemistry,' vol. ii. p. 278.)

With reference to this subject, it is observed by Sir H. Davy, that "there may be found in the works of Dr. Bryan Higgins, Mr. William Higgins, and Professor Richter, hints or conclusions bearing directly on this doctrine. Dr. Bryan Higgins, in his 'Experiments and Observations relating to Acetic Acid, Fixable Air, Dense Inflammable Air, &c.,' published in 1786, contends, that elastic fluids unite with each other in limited proportions only; and this depends upon the combination of their particles or atoms with the matter of fire which surrounds them as an atmosphere, and makes them repulsive of each other; and he distinguishes between simple elastic fluids, as composed of particles of the same kind, and compound elastic fluids, as consisting of two or more particles combined, in what he calls molecules, definite in quantity themselves, and surrounded by definite proportions of heat. Dr. Bryan Higgins's notions have, I believe, never been referred to by any of the writers on the atomic theory. Mr. William Higgins's claims have, on the contrary, often been brought forward. Yet, when it is recollected that this gentleman was a pupil and relation of Dr. Bryan Higgins, and that his work, called the 'Comparative View,' was published some years after the treatises I have just quoted, and that his notions are almost identical (with the addition of this circumstance, that he mentions certain elastic fluids, such as the compounds of azote, consisting of one, two, three, four, and five particles of oxygen to one of azote,) it is difficult not to allow the merits of prior conception, as well as of very ingenious illustration, to the elder writer." ('Discourse before the Royal Society,' 1826.)

In justice however to Mr. Higgins, it must be admitted that his views were much more extended than those of Dr. Higgins; for it appears that he entertained precisely the same notion of the composition and atomic constitution of water as that now generally admitted, in this country at least. In his 'Comparative View of the Phlogistic and Antiphlogistic Theories,' published in 1790, p. 37, he says, "As two cubic inches of light inflammable air require but one of dephlogisticated air to condense them, we must suppose that they contain an equal number of divisions, and that the difference of their specific gravity depends chiefly on the size of their ultimate particles; or we must suppose that the ultimate particles of light inflammable air require two or three, or more, of dephlogisticated air to saturate them. If this latter were the case, we might produce water in an intermediate state, as well as the vitriolic or the nitrous acid, which appears to be impossible; for in whatever proportion we mix our airs, or under whatsoever circumstances we combine them, the result is invariably the same. This likewise may be observed with respect to the decomposition of water. Hence we may justly conclude, that water is composed of molecules formed by the union of a single particle of dephlogisticated air to an ultimate particle of light inflammable air, and that they are incapable of uniting to a third particle of either of their constituent principles."

It is a remarkable circumstance, that although Mr. Higgins's view of the atomic constitution of the five compounds of oxygen and azote is that which is even now very commonly admitted, he does not state their composition; and his idea of the comparative atomic constitution of sulphurous and sulphuric acids is decidedly erroneous. "Indeed," as remarked by Sir H. Davy in the discourses above quoted, "neither of the Higginses attempted to express the quantities in which bodies combine by numbers."

In 1792, Richter, a Prussian chemist, published a work called 'Elements of Stochiometrie; or the Mathematics of the Chemical Elements.' This author treated the subject almost in the same way as Wenzel had previously done, but extended it very considerably; he endeavoured to determine the capacity of saturation of each acid and base, and to indicate by numbers the weights which mutually saturate each other. He published a table of these, but though the attempt was new and exceedingly ingenious, the results were far from accurate.

The discoveries of Proust, a French chemist who was professor of chemistry at Madrid, are well worthy of notice, he being the first person who attempted an accurate analysis of metallic oxides. He found that metals unite only with determinate proportions of oxygen, and that the same law existed with sulphur and the metals, and that these might be stated in numbers: his opinions were strenuously opposed by Berthollet, but their accuracy is now generally admitted.

In the year 1803, Mr. (afterwards Dr.) Dalton, of Manchester, communicated to the Literary and Philosophical Society of Manchester an essay containing an outline of his speculations on the subject of the composition of bodies ('Manchester Memoirs,' second series, vol. i. p. 286). The following year he explained his notions on the subject to Dr. Thomson, and in 1808 he published the first volume of his 'New System of Chemical Philosophy,' in which he gave an outline of his views of the constitution of matter, and this without any acquaintance with what had been previously done on the subject by Higgins.

Dr. Dalton was unquestionably the first who laid down, clearly and numerically, the doctrine of multiples, and endeavoured to express by simple numbers the weights of bodies believed to be elementary. He announced it as a general rule, that "when only one combination of two bodies can be obtained, it must be presumed to be a *binary* one, unless some cause appear to the contrary." Consistently with this law, and correctly at the time it was written, Dr. Dalton regarded water as a binary compound of hydrogen and oxygen, and the relative weights, since corrected, are considered as one to eight. As, then, water consists of an atom of hydrogen and an atom of oxygen, either of these elements may be selected as unity, and, in fact, as we shall hereafter notice, both have been occasionally employed as such. Dalton fixed on hydrogen, because it is that body which unites with others in the smallest proportion: thus, then, we have water composed of one of hydrogen by weight, or one atom, and eight of oxygen by weight, or one atom, and in all cases an atom of hydrogen being represented by 1, an atom of oxygen will be represented by 8; and these being the atomic weight of the elements, that of the compound will be obtained by adding them together, thus—

Hydrogen	1 atom = 1
Oxygen	1 atom = 8
Water	1 atom = 9

The weight, then, of a compound atom is obtained by adding together the atomic weights of its constituents. Although many elementary bodies unite with hydrogen, there are some which do not, but there is no one which does not combine either with hydrogen or with oxygen; when, therefore, the hydrogen standard or unit fails on this account, we may refer to the atom of oxygen, and determine what weight of the substance in question, supposing only one compound to be formed, unites with eight parts by weight, or one atom of oxygen. Now cadmium is a metal of this description; it forms no compound with hydrogen, and only one with oxygen, and as 8 parts of this element unite with 55·74 of the metal, to form the only known oxide of it, we say that the atomic weight of cadmium is 55·74, and that the oxide is composed of

Oxygen	1 atom = 8
Cadmium	1 atom = 55·74
Oxide of cadmium	1 atom = 63·74

It is, however, possible, though by no means probable, that such an inference may be incorrect, for the oxide in question may be composed either of two or more atoms of oxygen united with one atom of the metal, or the contrary, instead of what it is presumed to be; but the error may be detected by examining the proportion in which the metal unites with other elements, whose atomic weights are already determined. The atomic weights of sulphur, chlorine, and selenium, are respectively 16, 36, and 40: now if, in a series of combinations with these substances, the compounds containing the largest proportion of metal were constituted of

Sulphur	16	Chlorine	35·49	Selenium	39·62
Metal	55·74	Metal	55·74	Metal	55·74

we should then conclude, as these agree with the composition of the oxide, as above given, that 55·74 is the atomic weight of the metal. But if it was found that the compounds in question containing the largest proportion of metal were constituted of

Sulphur	16	Chlorine	35·49	Selenium	39·62
Metal	111·48	Metal	111·48	Metal	111·48

we should conclude that the atomic weight of the metal was 111·48, and consequently that the oxide formed of 8 oxygen and 55·74 metal, was a peroxide, equivalent to 16 = 2 atoms of oxygen + 111·48 = 1 atom of metal.

If, on the other hand, it appeared that the compound containing the argest proportion of metal consisted of

Sulphur	16	Chlorine	35·49	Selenium	39·62
Metal	27·87	Metal	27·87	Metal	27·87

we must then consider the oxide composed of 8 oxygen and 55·74 metal as a *suboxide*, constituted of 1 atom of oxygen = 8 + 2 atoms of metal = 57·74.

This method of proceeding is according to the rule thus laid down by Dr. Dalton: "It is necessary not only to consider the combinations of A with B, but also those of A with C D E, &c., as well as those of B with C D, &c., before we can have good reason to be satisfied with our determination as to the number of atoms which enter into the various compounds." ('New System of Chemical Philosophy,' vol. ii. p. 300.)

In fact, the protoxide of a metal, that is, 1 atom oxygen + 1 atom metal, may possess such properties as to prevent its composition from being by direct means accurately ascertained; and it is likewise possible that no protoxide may exist.

We have alluded to the circumstance, that various compounds of the same two elements may exist, and supposing an elementary body, as tin or copper united with two proportions of oxygen, various questions may arise as to the constitution of the resulting oxides; as, whether that which contains least oxygen is a suboxide, or protoxide; or whether that which contains most is a protoxide or a peroxide. These are points which can be determined only by comparison: for example, with respect to oxygen and tin, that oxide which contains least oxygen consists of 8 oxygen + 58·82 metal; that which contains most, of 16 oxygen + 58·82 metal: now, in this case, we consider that which contains *least* oxygen as composed of 1 atom of each of its elements, and that which contains *most* oxygen as formed of 2 atoms of oxygen + 1 atom of tin, thus

Oxygen . .	1 atom = 8	Oxygen . .	2 atoms = 16
Tin . .	1 atom = 58·82	Tin . . .	1 atom = 58·82
Protoxide of tin	1 atom = 66·82	Peroxide of tin	1 atom = 74·82

This rule of assuming that oxide to be a protoxide which contains least oxygen will be generally found correct, especially when confirmed, as it is in this instance, by the corresponding constitution of the two chlorides and two sulphurets. The oxides of copper, however, form an exception, though a comparatively rare one, to this rule; there are two oxides of this metal composed of

Oxygen	8	Oxygen	8
Copper	63·3	Copper	31·65

Now in this case, the oxide containing the largest proportion of copper is regarded as a suboxide, and that containing the smallest proportion as a protoxide, from certain considerations derived from the chemical behaviour of these two oxides. In general however, the rule may be relied upon, that the metallic oxide which contains least oxygen is the protoxide, and that weight of the metal which combines with 8 by weight of oxygen, denotes the weight of its atom, and their united weight that of the oxide.

It will be observed with respect to the compounds of oxygen and tin, that the second portion of that element which unites with the same quantity of the metal, is double the first. Now upon this and numerous similar facts is founded one of the most important and beautiful peculiarities of Dr. Dalton's theory, sometimes described as the *doctrine of multiple proportions*. In the case just alluded to, the second portion of oxygen is precisely double the first; but there are some cases in which the greater proportions are not multiples of the less, by any entire number: for example, there are two well-known oxides of iron consisting of

Oxygen	8	Oxygen	12
Iron	28	Iron	28

The first of these is the protoxide, and the second the peroxide; but it will be observed, the second portion of oxygen is only one half greater than the first, instead of double, as happens with respect to tin. In fact, the additional quantity is equal to only half an atom of oxygen; but as the idea of dividing an atom is absurd, the difficulty is overcome by multiplying both the oxygen and iron by 2, in which case we shall have $12 \times 2 = 24$, or 3 atoms of oxygen, combined with $28 \times 2 = 56$, 2 atoms of iron, and these proportions are perfectly consistent with the theory.

Other cases of apparent anomaly occur: thus there are three oxides of lead, viz.,

Protoxide.		Red oxide.		Peroxide.	
Oxygen	8	Oxygen	10·66	Oxygen	16
Lead	103·57	Lead	103·57	Lead	103·57

The first and last of these oxides are constituted exactly as the oxides of tin are, the second portion of oxygen being double that of the first; but the red oxide of lead is composed of an atom of metal and such a quantity of oxygen as is equal to one atom and a third. If, then, both the oxygen and metal be multiplied by 3, we shall have a compound of 4 atoms of oxygen and 3 atoms of lead, or 32 + 310·71 = 342·71, and it is found if these 342·71 parts of red lead be treated with dilute nitric acid, they are separated into 2 atoms of protoxide = 111·57, which are dissolved, and 1 atom of peroxide = 119·57, which remains unacted upon in the state of a brown powder. This case, then, of apparent anomaly is explained by showing that the red oxide of lead is equivalent to, or perhaps composed of, the other two oxides, and is resolvable into them.

The oxides of manganese offer a still more remarkable case of apparent irregularity of combination, and of the disposition of metallic oxides themselves to combine in definite proportions.

While on the subject of multiples, it will be proper to adduce one of the most remarkable and regular series of them presented to us. There are five compounds of oxygen and nitrogen, viz.,

	Oxygen.	Nitrogen.
Nitrous oxide, composed of	8 = 1 atom	+ 14 = 1 atom.
Nitric oxide . . .	16 = 2 atoms	+ 14 = „
Hyponitrous acid . .	24 = 3 „	+ 14 = „
Nitrous acid . . .	32 = 4 „	+ 14 = „
Nitric acid	40 = 5 „	+ 14 = „

In these compounds, it will be observed, that to form a new compound, 1 atom of oxygen is in every case added to the preceding quantity, and that the atoms of oxygen combined with 1 atom of nitrogen, are 1, 2, 3, 4, and 5.

The case in which the second portion of oxygen in an oxide, instead of being equal to the first, is only one half greater, has been pointed out in the instance of the oxides of iron, and the means by which the absurdity of supposing the existence of half an atom is obviated have been mentioned. Such oxides are, however, generally termed *sesquioxides*, and there are also several instances in which secondary compounds are similarly constituted; these are in like manner termed *sesquisalts*. The alkalies ammonia and soda, and some other bases, form three compounds with the same acid: for example, we have

Carbonate of soda, composed of	1 atom acid + 1 atom base
Bicarbonate of soda,	2 atoms acid + 1 atom „
and a carbonate of soda,	3 atoms acid + 2 atoms „

It is then evident that the last salt is equivalent to a compound of $1\frac{1}{2}$ atom acid + 1 atom base. Now if an atom of this salt, considered as a sesquisalt, be added to an atom of nitrate of lime, double decomposition ensues, 1 atom of neutral nitrate of potash remains in solution, 1 atom of neutral carbonate of lime is precipitated, and carbonic acid equal to half an atom is expelled in the state of gas. With respect to its *base* then, sesquicarbonate of potash may be regarded as a neutral carbonate, though, as to its acid, as a sesquicarbonate; for if lime-water be added to an atom of a sesquicarbonate, carbonate of lime is precipitated equivalent in quantity to 1½ atom.

It may now be easily made to appear how it happens that when two neutral salts decompose each other, the new salts obtained by the operation are also neutral; an atom of nitric acid weighs 54, and one of baryta 76·64, forming when combined, 130·64 of neutral nitrate of baryta; 86·96 = an atom of neutral sulphate of potash is composed of an atom of sulphuric acid = 40, and an atom of potash = 46·96. Now, when 130·64, or an atom of nitrate of baryta, dissolved in water, is mixed with a solution of 86·96, or an atom, of sulphate of potash, double decomposition ensues, and two new and perfectly neutral salts are formed, namely, 1 atom of nitrate of potash = 100·96, consisting of an atom of nitric acid = 54, and an atom of potash = 46·96; this remains in solution; and there is precipitated an atom of neutral sulphate of baryta = 116·64, composed of 1 atom of sulphuric acid = 40, and 1 atom of baryta = 76·64. The annexed diagram will show the constitution of the salts employed, and those formed by their mutual decomposition; and it will be seen also, that the weight of the new compounds is precisely equal to those of the original salts.

100·96 Nitrate of Potash.

54 Nitric acid. Potash 46·96.

130·64 Nitrate of Baryta.

86·96 Sulphate of Potash.

76·64 Baryta. Sulphuric acid 40.

116·64 Sulphate of Baryta.

Although the atomic theory, thus developed by Dr. Dalton in 1808, contained truths of the highest importance, quite independent of the hypothesis by which they were illustrated, it was not until after the appearance of Dr. Wollaston's Memoirs, 'On Super-acid and Sub-acid Salts,' and 'On a Synoptic Scale of Chemical Equivalents,' that chemists were fully impressed with the practical applications of which the theory was susceptible. In the first memoir ('Phil. Trans.' 1808), a memoir equally remarkable for its conciseness and clearness, Dr. Wollaston shows, that Dr. Dalton's theory, first applied to determining the constitution of gaseous bodies, is applicable to that of acid and basic salts; and he proves that carbonate of potash contains exactly half the quantity of carbonic acid existing in the bi-carbonate, by showing that if the latter be heated it loses half its acid, and is reduced to the state of carbonate by the loss; the same rule was found to exist with the carbonate and bi-carbonate of soda, the sulphate and bi-sulphate of potash, and with three oxalates of potash.

The paper on the *synoptic scale* appeared in the 'Phil. Trans.' for 1814. By this instrument the practical utility of the doctrine of definite proportions was most satisfactorily pointed out.

This instrument consists of a moveable scale of numbers on the principle of Gunter's scale, so that any number can be placed opposite the names of a series of substances in adjoining columns, arranged in the order of their combining weights, in such a manner that the number denoting the combining weight of a body being placed opposite to its name, 8, for example, opposite to oxygen—the numbers expressing the combining quantities of others will appear opposite to their names; thus copper will be found opposite to 31·65, showing that this quantity of it combines with 8 of oxygen, and opposite to 39·65 will be found oxide of copper. By mere inspection, a great number of important results are obtained. If the composition of a substance with regard to the proportion of its elements is to be determined, the slider is to be so placed that the number 100, or any required number, is opposite to its name, and the respective quantities of the ingredients will be found opposite to their names, and the quantities of other compounds required to decompose them: for example, when 68·96 is placed opposite to carbonate of potash, 22 will be opposite to carbonic acid, 46·96 to potash, 49 to oil of vitriol, 40 to dry sulphuric acid, and 9 to water. Now it is well known that carbonate of potash is decomposed by sulphuric acid; and on further inspecting the scale, it will be observed that sulphate of potash, the newly-formed salt, is opposite to 86·96, showing the quantity formed by the union of 40 of dry sulphuric acid and 46·96 of potash, while 22 of carbonic acid are expelled, and 9 of water are set free. This simple example is sufficient to show the very extensive use which by mere inspection, may be made of this instrument, in exhibiting the constitution of various oxides, acids, and salts, and of the quantities of substances required to form or decompose compound bodies.

The use of the term *atom* has been objected to as hypothetical, because it is said that we have no means of ascertaining or judging of the weight or magnitude of an atom of any element, and that any supposed relative weight of their atoms must therefore be a mere hypothetical assumption, from which no satisfactory conclusion can be drawn; and by those who appear to entertain this opinion, other terms, such as *equivalent number, molecule, combining proportion*, &c. have been substituted for the word atom.

In the year 1808, Berzelius, in consequence of a perusal of Ritcher's work already alluded to, undertook an investigation of the numerical proportions in which different bodies combine so as to neutralise each other; these investigations were accompanied by a series of analyses which for number and accuracy have probably never been equalled. As the results of these labours, he laid down certain laws relative to chemical combinations, which, however, are in general only to be considered as corollaries from those determined by Dalton. From these analyses subsequently extended and corrected, a large number of the atomic weights given in the table below have been derived, but in all cases where more recent researches have either indicated errors in the numbers obtained by Berzelius, or have added new elements to the list, the results of these researches have been embodied in the table.

In constructing tables of atomic weights several standards have been proposed by different chemists, but only two of these have been retained in use, namely, the standard proposed by Dalton, Hydrogen = 1; and that adopted by Berzelius, Oxygen = 100. The former is almost universally employed in this country, whilst the latter is almost as generally used on the continent. Both these standards are used in the following table:—

TABLE OF THE ATOMIC WEIGHTS, OR COMBINING PROPORTIONS OF ELEMENTARY SUBSTANCES.

Name of Element.	Atomic Weight. Hydrogen = 1	Oxygen = 100.
Aluminium	13·67	170·90
Antimony	129·03	1612·90
Arsenicum (Metallic arsenic)	75·00	937·50
Barium	68·64	858·03
Bismuth	212·86	2660·75
Boron	10·90	136·20
Bromine	79·97	999·62
Cadmium	55·74	696·76
Calcium	20·12	251·31
Carbon	6·00	75·00
Cerium	46·00	575·00
Chlorine	35·49	443·67
Chromium	26·27	328·38
Cobalt	29·49	368·65
Copper	31·65	395·60
Didymium	48·00	600·00
Erbium		
Fluorine	19.00	237·50
Glucinum	6·97	87·12
Gold	98·33	1229·16
Hydrogen	1·00	12·50
Ilmenium		
Iodine	126·88	1585·99
Iridium	98·56	1232·08
Iron	28·04	350·50
Lantanium		
Lead	103·57	1294·64
Lithium	6·53	81·66
Magnesium	12·65	158·14
Manganese	27·57	344·68
Mercury	100·10	1251·29
Molybdenum	47·69	596·10
Nickel	29·54	369·33
Niobium		
Nitrogen	14·00	175·06
Osmium	99·41	1242·62
Oxygen	8·00	100·00
Palladium	53·24	665·47
Phosphorus	32·02	400·30
Platinum	98·56	1232·08
Potassium	38·96	487·00
Rhodium	52·16	651·96
Ruthenium	52·11	651·39
Selenium	39·62	495·28
Silicon	21·36	267·00
Silver	108·00	1350·00
Sodium	22·97	287·17
Strontium	43·84	548·02
Sulphur	16·00	200·00
Tantalum, or Columbium		
Tellurium	64·08	801·76
Terbium		
Thorinum	59·50	743·86
Tin	58·82	735·29
Titanium	24·12	301·55
Tungsten	94·64	1183·30
Uranium	60·00	750·00
Vanadium	68·46	855·84
Yttrium		
Zinc	32·52	406·59
Zirconium	33·58	419·73

With respect to the utility of the atomic theory, we cannot do better, in concluding this account of it, than to state, in the words of Dr. Daubeny ('Introduction to the Atomic Theory,' p. 87), that "it would be superfluous to enlarge upon the proofs already afforded, with respect to the greater precision it has introduced into the science,—the wonderful saving of time and labour which is derived from it, not only by the philosopher in his more speculative inquiries, but even by the manufacturing chemist, in the every-day operations of his trade."

It is evident that, in the present state of our knowledge, no sooner have we ascertained the exact proportion in which a new substance unites with any one of those bodies whose atomic weight is already determined, than we are enabled to calculate in what quantities it must combine with all the remainder, so that, instead of being compelled, as heretofore would have appeared necessary, to analyse every existing combination, in order to determine the proportion of its ingredients, we might rest contented, were it not for the sake of obviating the chances of error in any single experiment, with ascertaining the composition of one out of the whole number of compounds, into which the ingredient in question enters. [CHEMICAL EQUIVALENTS; MOLECULES; CHEMICAL AFFINITY.]

ATOMIC VOLUME. The equivalent or atomic weight expresses the relation of *weight* in which bodies combine with each other. The atomic volume, or, as it is also called, the equivalent, specific, or molecular volume, expresses the relation of *volume* in which substances combine. If the equivalent weights of two substances are to each other as A : B, and their specific gravities as $a : b$, then the spaces occupied by these equivalent weights are as $\frac{A}{a} : \frac{B}{b}$. In other words, the atomic volume of a body is the quotient obtained when the equivalent of a body is divided by its specific gravity; or atomic volume $= \frac{\text{equivalent weight}}{\text{specific gravity}}$.

The atomic volume is not an absolute quantity; it only expresses a relation. Depending on the equivalent, it will differ according as the equivalent is based on the scale in which oxygen = 100, or on that in which oxygen = 8; it will also differ according to the assumed unit of specific gravity: only the atomic volumes of those substances are comparable whose specific gravities are based on a common unit. Gases and vapours, whose densities are based on that of atmospheric air as unity, may be compared with each other; and solids and liquids, whose densities are based on that of water as unity may be compared; but the atomic volumes of gases cannot be compared with those of solids and liquids.

The following is a list of the atomic volumes of some gases and vapours:

	Atomic Weight.	Spec. Gravity. Air = 1.	Atomic Volume.
Oxygen	8	1·108	7·22
Phosphorus	32	4·294	7·22
Arsenic	75	10·388	7·22
Hydrogen	1	0·069	14·44
Nitrogen	14	0·969	14·44
Chlorine	35·5	2·458	14·44
Mercury	100·1	6 925	14·44
Water	9	0·623	14·44
Carbonic acid	22	1·524	14·44
Hydrochloric acid	36·5	1·264	28·88
Ammonia	17	0·589	28·88
Chloride of ethyle	64·5	2·233	28·88
Acetic acid	60	2·078	28·88
Valerianate of ethyle	130	4·501	28·88

It will be seen that the atomic volumes of the elementary substances in this table stand to each other in a very simple relation. They have an atomic volume either equal to that of oxygen, as in the case of phosphorus and arsenic, or twice as great, as in the case of chlorine, hydrogen, and nitrogen.

When two gases combine, they do so in simple relations of volume, and the volume of the resultant compound, considered in the state of gas, is either equal to the sum of the volumes of the constituent gases, or stands in a simple relation thereto. Thus, two volumes of hydrogen combine with two volumes of chlorine to form four volumes of hydrochloric acid gas; two volumes of hydrogen and one volume of oxygen combine to form two volumes of steam; two volumes of nitrogen and one volume of oxygen combine to form one volume of nitrous oxide; two volumes of nitrogen and six volumes of hydrogen combine and are condensed to four volumes of ammonia.

A substance whose atomic volume in the gaseous or vaporous state is equal to that of oxygen, or is two or four times as great, is said to exhibit a condensation to one, two, or four volumes. It will be seen that the organic compounds enumerated in the above table all exhibit a condensation to four volumes; and it has been almost invariably found that all organic bodies present the same regularity. Hence, in fixing the equivalent of any new compound, a determination of the vapour density is an almost indispensable preliminary, as the following example may serve to illustrate. The vapour density of the substance furfurol was found to be 3·375, and analysis gave for it a composition whose simplest expression is $C_5H_2O_2$; these data would give for furfurol an atomic volume expressing a condensation to two volumes, an unusual fact with organic bodies. But the formula $C_{10}H_4O_4$, which equally well expresses the composition, gives for the atomic volume a condensation to four volumes, and thus brings it in accordance with other organic substances; and on this account, and also because it better expresses the decompositions, the latter formula has been adopted.

We do not notice in the atomic volumes of solids and of liquids those regularities which prevail among the atomic volumes of gases and vapours. Thus, the atomic volume of iron is 5·3; that of platinum, 4·6; of cadmium, 6·5; of tin, 8·0; of lead, 9·2; of arsenic, 13·3; of antimony, 17·9; of sodium, 23·7; of iodine, 25·7; of potassium, 45·6. But it must be remarked, that these specific gravities (and therewith the atomic volumes) have not been determined for uniform conditions. The specific gravity of a body may vary according as it is crystalline or amorphous, or with its crystalline form if it be dimorphous. The various solid elements have very different melting points; some of the specific gravities have been determined at points very near the melting temperature, as phosphorus, sodium, &c.; others at points very distant, as platinum: the atomic volume is only known for the mean temperature of the atmosphere, and hence very unequally distant from the melting points. Probably if the specific gravities were determined for really comparable temperatures, at or near the melting points, for example, the atomic volumes would no doubt exhibit more simple relations.

In certain groups of chemically similar elements the atomic volumes do exhibit agreement: for example, iron 3·6, cobalt 3·5, manganese 3·5, nickel 3·4, iridium 4·5, palladium 4·6, platinum 4·6, molybdenum 5·3, and Tungsten 5·3; lithium 11·8, sodium 23·7, and potassium 45·6, stand very nearly in the relation 1 : 2 : 4. Those elements have generally the same atomic volume which are either isomorphous or can replace each other in isomorphous compounds.

It has been shown by Kopp that bodies with a similar composition and the same crystalline form have also the same atomic volume. Thus, carbonate of strontia (strontianite), $SrOCO_2$, and carbonate of lead (cerusite), $PbOCO_2$, have the atomic volumes 20·5 and 20·7; sulphate of magnesia, $MgOSO_3 + 7HO$, and sulphate of zinc, $ZnOSO_3 + 7HO$, which have the same crystalline form, have the atomic volumes 70·2 and 70·5.

Many carbonates, as of magnesia, $MgOCO_2$, manganese, $MnOCO_2$, lime, $CaOCO_2$, and of iron, $FeOCO_2$, crystallise in the same form, that of the rhombohedron, but differ in the degree of inclination of the corresponding angles; and it has been noticed that the greater the agreement in the corresponding angles, the greater the agreement in the atomic volume.

The relation between the atomic volumes of a solid compound, and of its constituents, has not yet been sufficiently investigated, but the regularity has been observed which was first pointed out by Schröder. That when from the atomic volumes of analogous compounds, the atomic volumes of the corresponding constituents be subtracted, the common remainder is in many cases the same. Thus the atomic volumes of the analogous oxides of copper, and of zinc, are respectively 6·2 and 7·2; if from these the atomic volumes (3·6 and 4·6) of the corresponding metals be subtracted, the atomic volume of the remainder is found to be the same 2·6. The atomic volumes of lead and silver are respectively 9·2. By their conversion into the nitrates they undergo the same increase of equivalent, and the atomic volumes of the nitrate of lead, and of silver, are respectively 38·7 and 39·9; if from these numbers the atomic volumes of the metals be subtracted, the remainders 29·5 and 29·7 will be seen to be sensibly equal. The atomic volume of oxygen in binoxide of tin is 1·3, in the oxides of zinc, lead, and copper it is 2·6, and in suboxide of copper 5·2, numbers which stand in a simple relation to each other; but in many cases in which the atomic volume of oxygen has been determined, such regularities do not obtain.

The atomic volumes of liquids appear to exhibit relations when compared at their boiling points. Isomeric liquids, with unequal boiling points, when compared at the same temperatures have various atomic volumes, but when the expansion of the liquids is known; and their specific gravities, and therewith their atomic volumes, be calculated for the boiling points, the atomic volumes will be found to agree. Thus acetic acid and formiate of methyle, both $C_4H_4O_4$, which boil respectively at 118° and 36°, have at the boiling points the atomic volume 63·5; at 0° the atomic volume of the former is 55·7, and of the latter 60·1.

It has also been noticed that a common difference in the atomic volumes corresponds to the common difference in the members of an homologous series. Thus a difference $n \times 22$ corresponds very closely to a difference of $n \times C_2H_2$. The atomic volumes of acetic acid $C_4H_4O_4$, propionic acid $C_6H_6O_4$, butyric acid $C_8H_8O_4$, and valerianic acid, $C_{10}H_{10}O_4$, are respectively 63·6, 85·4, 107·2, and 130·7.

Hydrogen may be replaced in a compound by an equivalent weight of oxygen without any essential alteration in the atomic volume. Alcohol $C_4H_6O_2$, and $C_4H_4O_4$, have respectively the atomic volumes 62·3 and 63·5. Chloride of ethyle C_4H_5Cl, and chloride of othyle $C_4H_3O_2Cl$, have respectively the atomic volumes 72·8 and 74·8. A slight increase on the atomic volume appears to be produced. Equivalent weights of carbon and hydrogen may replace each other without any essential alteration. Benzoic acid $C_{14}H_6O_4$, and butyrate of methyle

$C_{10}H_{10}O_4$, have respectively the atomic volumes 126·9 and 126·5. Diethylaniline $C_{20}H_{15}N$, and Caprylamine $C_{16}H_{19}N$, respectively 190·5 and 190.

The atomic volume of a compound appears to depend not so much on the empirical formula but on the rational composition. The atomic volumes of many elements have been calculated, in order to deduce therefrom the atomic volumes of the compounds which they constitute. It appears that to certain elements the same atomic volumes must be always ascribed; thus, carbon is always 5·5, hydrogen also 5·5, chlorine 22·8, iodine 37·5, while other elements appear to have various atomic volumes; their atomic volume appearing to depend on the place which the element occupies in the compound. Oxygen, for example, when it is contained *within* a compound radical has the atomic volume 6·1, and when *without* a radical the volume 3·9. Sulphur also, according as it is contained within or without a radical, possesses a different atomic volume.

For further information upon this subject the reader is referred to 'Kopp's Researches on Atomic Volumes' (Annalen der Physik u. Chemie, vols. xlvii., lii.; and Annalen der Chemie u. Pharmacie, vol. xxxvi); to Schröder on the same subject (Ann. der Physik u. Chemie, vols. l., lii.); to Filhol (Annales de Ch. et de Phys.. vol. xxi., third series); and to Messrs. Playfair and Joules 'Memoirs' (Chemical Memoirs, vols. ii., iii.; and Quarterly Journal of the Chemical Society, vol. i.).

ATOMS (from the Greek ἄτομοι, which is from ἀ and τέμνω, to cut), the ultimate and indivisible particles of matter. Some ascribe the origin of the idea to Moschus, a philosopher who lived before the Trojan war. Leucippus, a philosopher of Abdera, who flourished B.C. 428, is generally regarded as the original propounder of what is called *the Atomic philosophy*. It was adopted by Democritus, in his 'Cosmogony,' about B.C. 380, and afterwards by Epicurus, who died B.C. 270, to whom its celebrity is chiefly owing. Lucretius, who died B.C. 54, unites the tenets of Epicurus and Empedocles (B.C. 444) with the *infinite* of Anaximander (B.C. 550) and the *atoms* of Democritus. Dr. Whewell remarks, that the atomic doctrine was one of the most definite of the physical doctrines of the ancients, and was applied with most perseverance and knowledge to the explanation of phenomena; and that, although it led to no success of any consequence in ancient times, it served to transmit, through a long series of ages, a habit of really physical inquiry. The atomic doctrine, which we have mentioned, was opposed by the 'Homoiomeria' of Anaxagoras, who held that material things consist of particles which are homogeneous in each kind of body, but various in different kinds: thus, for example, since by food the flesh, bones, &c., of animals increase, there are in food particles of flesh, bones, &c. As the theory of Leucippus points to the corpuscular theories of modern times, so that of Anaxagoras may be considered as a glimpse of the idea of chemical analysis.

All matter may be conceived to be divisible *ad infinitum*, for we must suppose every particle to have an upper and an under surface, and these may be conceived as separated. Still, chemical analysis seems evidently to show that there is a limit set by nature to division, beyond which no natural powers can subdivide. [ATOMIC THEORY.] Hence, in physics, an atom is called *simple* when it cannot be further divided without separating its chemical elements. Thus, the dark spot on a soap-bubble, just before it bursts, cannot exceed $\frac{1}{3000000}$th of an inch in thickness; yet even this is not composed of a single stratum of atoms, for it must consist at least of one atom of soap and one of water; the former composed of soda, stearic, margaric, and oleic acids, and the latter of at least one molecule of oxygen and one of hydrogen, and each of these possessing the *essential* properties of impenetrability, extension, and figure.

We proceed now very briefly to sketch the general theory, which we have mentioned, of the atomic doctrine. According to Epicurus, every visible form is made up from matter and space (*corpus* and *inane*), which are equally infinite and unbounded, as well as eternal, and are opposite to one another in every respect. Thus, the solid parts of bodies are matter, and their pores space. Before the formation of the universe, in the state of chaos, these two principles were uncombined, and *atoms* existed floating about in the immense void. These are perfectly solid, indivisible, infinitesimal, infinite in number, and eternal. They possess however various shapes, as round, square, jagged, barbed, &c., though the number of these figures is not infinite. All solids contain more than one kind of figure, for they are formed by the impact of atoms floating downwards and being driven against one another; for the atoms, being all possessed of weight, fall downwards, and being by some cause diverted from their line of motion, impinge, and, according to the force of impact, form dense or rare bodies. This motion is eternal, and some do not impinge, but float about like specks in the sunbeams. They are also supposed to be destitute of heat, cold, and similar affections. These atoms, by their concurrence, produce all the different forms which we see; in fact, the world itself was formed by this fortuitous concourse of atoms, and is continually sustained by fresh tides of atoms flying through all space, and taking the posts of those perpetually flying off. Yet nothing is eternal and immutable but these seeds or atoms themselves. The world itself will be decomposed into its ultimate atoms, and new worlds will arise from its destruction.

ATONEMENT, a certain mode of appeasing anger, and obtaining pardon for an offence. In the act of atonement there is commonly understood to be a substitution of something offered, or of some personal suffering, for a penalty which would otherwise be exacted. The word is, indeed, applied colloquially to any circumstance of suffering, voluntary or involuntary, consequent upon criminal conduct or error of judgment. Thus even the spendthrift is said to have atoned for his folly by the hardships endured in consequence of it, and the murderer for his crime by a public death. But this use of the word is altogether indefensible. In theology, it has respect to offences committed against the Deity; it is in the theological acceptation of the term that it will be considered in the present article. The subject in this view of it is partly connected with that of sacrifice [SACRIFICE]; but it is not identical with it. For it is not certain that all sacrifices had atonement for their object; and sacrifice, as commonly understood, was only one amongst other methods of atonement.

The practice of atonement is remarkable for its antiquity and universality, proved by the earliest records that have come down to us of all nations, and by the testimony of ancient and modern travellers. In the oldest books of the Hebrew Scriptures, without noticing those earlier sacrifices the object of which may be considered doubtful, we have numerous instances of expiatory rites where atonement is the prominent feature, occupying, in fact, a large portion of the four last books of the Pentateuch. In some cases the atonement was made for a specific offence (Levit. iv., Numb. xvi. 46); in others it had reference to a state of transgression, as especially in the case of the scape-goat, on the day of expiation. (Levit. xvi.) The orthodox Jews of modern times have substituted a cock, which is killed and eaten with certain ceremonies. The offender again either atoned by his own personal act, or received the benefit of atonement by the act of another. (Levit. iv.) The Hebrew records contain also notices of the practice of atonement, independent of the Mosaic institutions, and unconnected with the religious opinions of the Hebrew people. The barbarous offerings to Moloch appear in the light of atonements when interpreted by the indignant expostulation of Micah (vi. 7)—"Shall I give my first-born for my transgression, the fruit of my body for the sin of my soul?" When Job is described (i. 5) as offering burnt offerings according to the number of his sons, and accompanying the act with the explanation, "It may be that my sons have sinned, and cursed God in their hearts," we are sure that the author of the book, and those for whom he wrote, were familiar with the notion of atonement.

But the atonement of Christianity is of a different character from any of these. It presupposes a state of sin or transgression, but it does not transfer the sin to an involuntary or unwitting substitute. In the Mosaic directions for atonement the means were generally symbolical of Christ, upon whose coming the former methods wholly ceased, and He became a self-sacrificed and willing means—and the only means—for the atonement of mankind with an offended creator. We can here do little more than state what is understood by the Christian when he speaks of the atonement. He does not consider man, according to the heathen notion mentioned below, to be the object of a capricious and vengeful enmity, but through a sinful nature, and practices and affections conformable to that nature, to have come into a state of alienation from God; in other words, he believes that God is just and holy, that man has sinned, and must therefore be punished. This being his condition, he further believes that the Divine Being, revealed to us under the title of the Son of God, interposed between the sentence and its execution, suffered in our stead, and atoned by His death for our sin; that the immediate consequences were, remission of the original sentence, and restoration to a state which is still probationary, but in which man is made capable of a permanent reunion with his Maker. The believer in the doctrine of the atonement supposes that the sacrifice was necessary according to a law fixed in the counsels of God (which law he also supposes to be revealed to us) that sin must be atoned for before it can be pardoned; but he distinguishes between the necessity of the sacrifice itself, and the further purpose of God in causing it to be publicly made, and providing that it should be universally known. He supposes the knowledge of the fact to be necessary to the formation of the Christian character, and its moral consequences to be, a deeper sense of the turpitude of sin; whereas there might otherwise be danger lest that should be lightly accounted of which appeared to have been lightly forgiven; and also a new and powerful motive to a love of the Supreme Being, supplying a remedy for that selfish principle which might prevail, if the only motives to obedience were the hope of reward and the fear of punishment.

We have endeavoured to state the doctrine of the Atonement in such terms as would be accepted by all, who accepted the doctrine itself on the authority of Scripture. It is well known, however, that among those who would concur in the general statement, there would be found minor differences of opinion, particularly as to the universality of the benefit conferred by the sacrifice. [CALVIN, in BIOG. DIV.] We have also without qualification called the doctrine in question a doctrine of the Christian religion; though we are well aware that there are some whose views of the gospel dispensation and whose interpretation of scripture have led them, whilst fully admitting the divine origin of our religion, to reject as unscriptural the doctrine of the atonement. But these would themselves readily acknowledge, we believe, that they are comparatively few in number.

To atone, according to the vulgar etymology, is to set at one, that is, to reconcile; and hence atonement is etymologically explained at-one-ment. Whether this derivation is right or not, reconciliation seems to have been the primary meaning of atonement with our earlier writers. Hence in the authorised version of the New Testament the same word which in 2 Cor. v. 19, is properly rendered reconciliation, is in Rom. v. 11, rendered atonement. The word, however, soon came to bear the meaning in which it is now used; and such is in fact its ordinary meaning in the authorised version of the Old Testament.

Among the heathen nations the doctrine of atonement was not unfamiliar. At the earliest date to which we can carry our inquiries by means of the heathen records, we meet with the same notion of atonement, with a distinction also in the application, between the removal of anger incurred by particular offences, and of that which was supposed to belong to the jealous character of the Deity. An instance of atonement of the former kind meets us in the very opening of the Iliad. Agamemnon having offended Apollo in the person of his priest, by refusing a ransom for his daughter, is not content with restitution, but proceeds to atone for his fault by an offering, the purpose of which is declared by Ulysses ('Il.' i. 442)—"Agamemnon sent me to sacrifice a sacred hecatomb to Apollo in behalf of the Danai, that we may appease the Sovereign God."

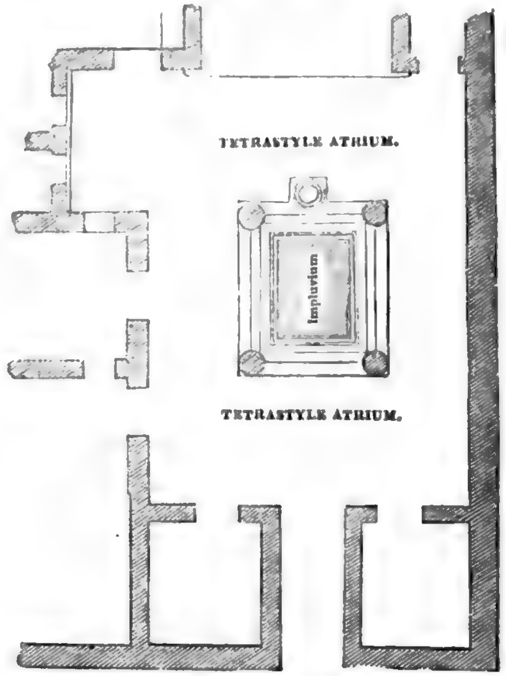
Among the many other instances which will readily occur to a reader of the ancient classics, the sacrifice of Iphigeneia by her father, to appease the wrath of Diana, is distinguished by the remarkable circumstance of the substitution of one victim for another by the offended goddess. It should be observed, however, that although the subject of the legend belongs to the period of the Trojan war, the legend itself is of a later date than the Homeric poems. In the expiatory rites for certain cases of homicide, sacrificial offerings to the deity formed a part of the religious ceremony of purification, in addition to the penalty which the offender paid as a compensation to the avenging party. A singular instance of atonement made to the Diana Orthia of the Lacedæmonians is given by Pausanias (iii. 16). Blood having been shed in a quarrel during a solemn sacrifice to the goddess, human victims were regularly offered to her as an atonement for the offence; till Lycurgus substituted for this cruel ceremony the scourging of youths at the altar with such severity, that the penalty was still paid with blood.

The practice of *general* atonement among the heathen nations, whatever may have been its origin, must have been greatly encouraged by a certain article in the popular creed, which is probably expressed pretty accurately by the saying put into the mouth of Solon by Herodotus, that 'the Deity is altogether a jealous being, and fond of troubling the even course of affairs' (*φθονερὸν τε καὶ ταραχῶδες*, Herod. i. 32). The common notion is remarkably exemplified in a story told by the same historian. Amasis, king of Egypt, having heard rumours of the marvellous and uninterrupted successes of his friend Polycrates, the sovereign of Samos, gave vent to his anxiety on his friend's account in a letter, which is in itself so curious, and so strongly illustrates the matter in hand, that we think it deserves to be presented entire to the reader. "Amasis says thus to Polycrates :—It is pleasant to hear that one's friend prospers ; yet your exceeding good fortunes please me not, knowing as I do that the Deity is a jealous being; and I could wish that both myself and those whom I care for should be fortunate in some of their doings, and in others miscarry; and so pass their lives in changes of fortune, rather than be always fortunate; for I never yet heard talk of any one who with good fortune in everything did not come to his end miserably with an utter downfall. Do you therefore follow my advice, and in respect of your happy chances do as I tell you. Look out well for the most precious thing you have, and that which you would most take to heart the loss of, and then away with it, in such sort that it shall never more come before the eyes of men. And if after this your successes should not take turns and go evenly with your mishaps, still remedy the matter in the way proposed by me." (Herod. iii. 40.) The story goes on to say that Polycrates took the advice of his friend, and flung into the sea a valuable ring; but the object was defeated by an incredible piece of good fortune, which restored to him his lost treasure. Hereupon Amasis formally dissolved his connection with a man so evidently marked out for some signal calamity.

In this case the offence was involuntary; yet it was not the less supposed to excite anger and expose the offender to punishment. Here too is an instance of atonement unaccompanied by sacrifice. The mode, indeed, of atoning admitted an almost infinite variety. Even the repetition on a certain occasion of the great games at Rome was strictly an act of atonement for a rather singular offence described by Livy, lib. ii. c. 36.

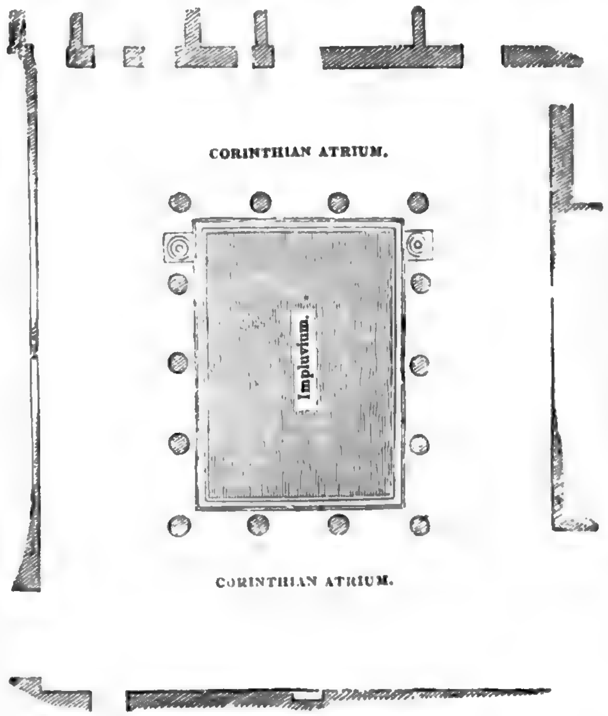
If we pursue our inquiries through the accounts left us by the Greek and Roman writers of the barbarous nations with which they were acquainted, from India to Britain, we shall find the same notion and similar practices of atonement. From the most popular portion of own literature, our narratives of voyages and travels, every one probably, who reads at all, will be able to find for himself abundant proof that the notion has been as permanent as it is universal. It shows itself among the various tribes of Africa, the islanders of the South Seas, and even that most peculiar race, the natives of Australia, either in the shape of some offering, or some mutilation of the person. We should expect to meet with it in India, so fertile in every form of superstition; and it is certain that many of the fantastic and revolting rites of the Hindoos bear testimony to its presence. The favourite practice of torturing the body has often there a different object, that of acquiring the reality or the fame of superior sanctity; but undoubtedly it is also resorted to as a mode of atonement.

A'TRIUM, a hall or room of audience in a Roman house. The two words, Atrium and Cavædium, if not at first synonymous, most probably became so in the course of time; Bekker, however, and some other authorities, consider that they mean different apartments. It appears from a passage in Varro, that the Cavædium, or Cavum Ædium, 'the hollow of the house,' must be the whole area between



Plan of a Tetrastyle Atrium from a house at Pompeii.

the rim of the compluvium from which the rain fell, and the impluvium into which the rain fell. The Atrium, properly so called, and as at first distinguished from the Cavædium, would be the space between the open area and the walls (*parietes*) of the Atrium : thus, the Cavum



Plan of the Corinthian Atrium of the villa of Diomedes at Pompeii.

Ædium would be the hollow space open to the sky and rain, while the Atrium would be the covered part, and would therefore form the hall or room of audience. If our conjectures, founded on this obscure passage of Varro, descriptive of the parts of a Roman house, be correct, we would suggest that the compluvium means rather the rim or gutter from which the rain fell [HOUSE, ROMAN] than the whole area of the open space over the impluvium.

The term Atrium is derived, according to Varro ('Ling. Lat.' iv.), from the Atriates, a people of Tuscany, from whom the pattern of it was taken. It was the most important and usually the most splendid apartment of a Roman house. Here the owner received his crowd of morning visitors, who were not admitted to the inner apartments. Originally the Atrium was the common room of resort for the whole family—the place of their domestic occupations; and such it probably continued in the humbler ranks of life. It consisted of a large apartment roofed over, but with an opening in the centre, called *compluvium*, towards which the roof sloped so as to throw the rain-water into a cistern in the floor called *impluvium*. Vitruvius distinguishes five species of Atria.

1. Tuscanicum, or Tuscan Atrium, the oldest and simplest of all. It was merely an apartment, the roof of which was supported by four beams crossing each other at right angles, the included space forming the compluvium. Many of these remain at Pompeii.

2. The Tetrastyle, or four-columned Atrium, resembled the Tuscan, except that the girders, or main beams of the roof, were supported by pillars, placed at the four angles of the impluvium. This furnished means of increasing the size of the apartment.

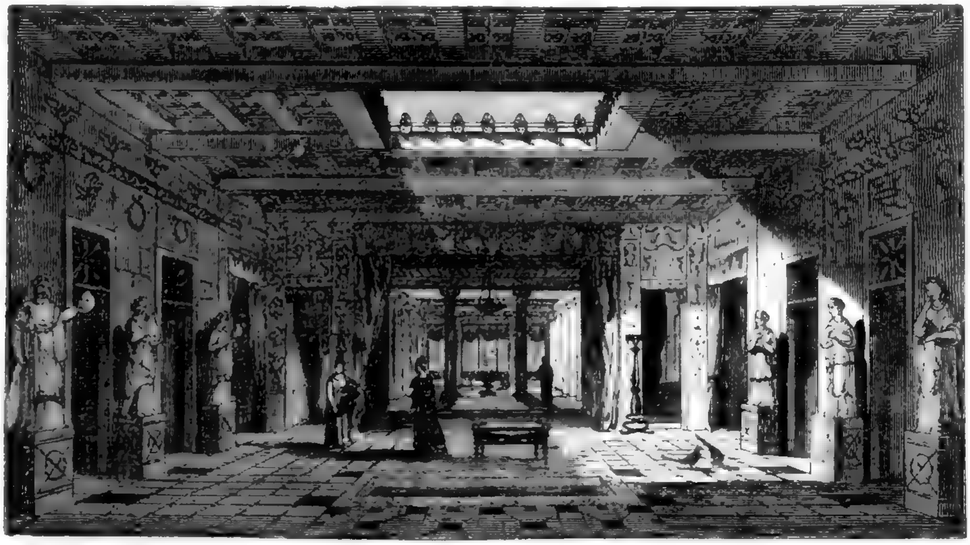
3. The Corinthian Atrium differed from the Tetrastyle only in the number of columns and size of the impluvium. A greater proportion of the roof seems to have been left open.

4. Atrium displuviatum had its roof inclined the contrary way, so as to throw the water off to the outside of the house, instead of carrying it into the impluvium.

5. The Atrium testudinatum was roofed all over, without any vacancy, or compluvium. ('Pompeii,' vol. ii.)

The magnificence of the Atria will be better understood from the annexed representation of the Atrium of the house of Pansa, restored by Mr. Gandy Deering, and published in the second volume of the 'Pompeii,' in the series of the 'Library of Entertaining Knowledge.' The walls (*parietes*) were painted with elegant designs in the style of arabesque painting [ARABESQUE], often surrounding compartments in which were frequently depicted the most celebrated subjects of ancient mythology, and even on the very floors mythological or historical pictures were executed in mosaic. [MOSAIC.]

For the details of the Atria of Pompeii we must refer the reader to Mazois' 'Antiquités de Pompéi,' folio, and to the first and second series of Gell's 'Pompeii,' as well as to the volumes on 'Pompeii' published by the Society for the Diffusion of Useful Knowledge. In the Pompeian Court at the Crystal Palace, Sydenham, there is a very careful restoration of a Pompeian house, which will give a much better idea of the Roman Atrium, with its connected apartments, than can possibly be obtained from engravings or a description.



Atrium of the House of Pansa.

ATROPA BELLADONNA, *Medical uses of*. This species is admitted into the Pharmacopœias of this country, and is employed in the form of dried leaves, or of an extract. Its action on the human system differs according to the quantity taken. If the dose be small, a quickening of the heart's action follows, and an increased quantity of blood is sent to the brain. In this case it has a stimulating effect; but if the dose be larger, though some stimulating action is for a short time apparent, a sedative effect of a very powerful kind ensues. During the first stage, excitement of the heart, the brain, and the intellectual faculties, is manifest; this is succeeded by greatly diminished sensibility, perhaps most markedly observable in the extreme dilatation of the pupil, and the insensibility of the stomach to the stimulus of emetic substances. The spinal cord would appear not to be directly influenced by this agent, but to suffer at last from the impaired state of the function of respiration, and the consequently deteriorated condition of the blood. Convulsions, therefore, only occur late in cases of poisoning by this article. It deserves to be remarked, that the delirium accompanying the action of an overdose of belladonna is always of a gay, elevated kind; a red eruption, or efflorescence, on the skin is also generally observable. The nausea and vomiting are unaccompanied with much pain of the stomach; nor do the stomach and intestines present many traces of inflammatory action. The nausea and vomiting seem to be the result of the condition of the circulation in the brain, the gorged state of the vessels of which is rendered obvious by inspection after death.

The action of belladonna is ascribed to an alkaloid which it contains, called *atropia*, which exists in combination with malic acid.

The cases in which belladonna may be advantageously employed are, diseases of increased sensibility of the nerves, particularly local affections of these, such as tic douloureux and other pains. It has also been recommended for the cure of scrofulous and cancerous tumours, and is employed to dilate the pupil in certain states of diseases of the eye. In the first set of cases, it may be employed either internally or externally. In tic douloureux, given internally along with arsenious acid, it often affords speedy and lasting relief. In the passage of gall-stones through the gall-duct, or of stones from the kidney, applied externally over the painful part, it gives great ease.

Its employment in cases of scrofulous and cancerous enlargement of the glands is likewise either internal or external. That it relieves the pain attendant on such affections is unquestionable; but it cannot be used to effect the cure of these with safety. It undoubtedly changes the process of deposition throughout the whole body, and also in morbid structure, into one of absorption—as is proved by the diminished solidity and increased fluidity of the body, as observed in cases of poisoning by it, where the great quantity of fluids favours the decomposition of the bodies which have died from its influence, and in which putrefaction always takes place very soon. But an equal degree of benefit may be obtained from the employment of antimonial preparations, without the danger which attends the use of this plant.

Its employment in the form of extract rubbed over the eyelids, to dilate the pupil previous to the operation for cataract, is an usual step, but requires caution: the same remark is applicable to its use in the form of solution dropped into the eye during inflammation of the iris. In both these cases it is liable to be absorbed in too great a degree, and to cause alarming symptoms.

Belladonna has been recommended as a useful sedative in the latter stages of hooping-cough. But though it lessens the violence of the spasmodic action, the same degree of benefit may be obtained from hydrocyanic acid, without the liability of inducing that action of the vessels of the brain which ends in hydrocephalus. (See Golis on 'Hydrocephalus.') Belladonna has also been proposed as a preventive of scarlet fever; but it is by no means certain to ward off this disease, while it is almost sure to induce hydrocephalus, on which account its use is to be reprobated. Other preventive measures of a safer kind should therefore be had recourse to.

In case of poisoning by it, if taken into the stomach, the most immediate means should be employed to remove it. For this purpose the stomach-pump is best. Emetics can seldom excite the stomach to any expulsive action; in some instances, fourteen grains of tartrite of antimony have been given without any effect.

Vinegar should not be given so long as any of the belladonna remains in the stomach, as it heightens its power. Vinegar is useful, however, at a later period, in combating the secondary or depressing effects. [ANTIDOTES.]

Bleeding relieves the gorged state of the vessels of the head, from the continuance of which the chief danger is to be apprehended; it should therefore seldom be omitted.

Atropia, the most active alkaloid (if *Belladonium* be another) of the Deadly Nightshade, has been introduced into the Pharmacopœias, and into medical (chiefly surgical) practice, as a substitute for the extract. It possesses the advantage of more uniform strength, being a definite compound, and the dose can be more exactly adjusted. Its combinations are also valuable, particularly the hydrochlorate and sulphate. It admits also of being formed into a tincture, and an ointment. These require, on account of their potency, even greater care in their employment than belladonna, or the extract. The application of one belladonna plaster immediately after another, still more before the previous one has been removed, is fraught with danger. The mistaking the ripe berries of the Deadly Nightshade for black cherries is pardonable, but to confound them with mulberries is a proof of great ignorance or most culpable carelessness, as the mulberries have an irregular, almost warty, surface, while those of belladonna are smooth, somewhat resembling cherries.

A'TROPHY, from the Greek word ἀτροφία, signifying 'want of nourishment,' 'wasting;' deficient nutrition, either of a part or of the whole of the body.

Nutrition, one of the most characteristic of the vital functions by which the living is distinguished from the inorganic body, consists in the conversion of foreign particles into the proper substance of the living being. The exercise of every vital function is attended with a certain expenditure of the substance of the organ by which the function is carried on. To supply this waste a stream of new matter is always flowing through every organ, from which each takes up the quantity required to replace the quantity which it expends. There are thus two opposite sets of actions incessantly going on in the living body; processes of waste, and processes of supply. In the state of health there is an exact balance between these opposite actions. In every morbid condition of the system, this balance is more or less disturbed, in consequence of which the whole body, or particular parts of it, become either too little or too much nourished. The first state, from whatever cause it results, is called *atrophy;* the second, *hypertrophy*.

In considering the phenomena of disease, then, there is one obvious guide as to its seat. If it be attended with decided, steady, and progressive wasting, it must be seated in some organ of supply. For the wasting itself is not disease, but the result and sign of disease; it is never the primary event, and seldom even the second in succession; it is a phenomenon forming part of a train, its place often being low down in a long series; it is the first to become visible, the phenomena which precede it, and on which it depends, not being visible, and frequently requiring careful investigation to detect them.

Wasting may be either general or local—that of the whole body, or only a part of it; and this will depend entirely on the nature of the cause that produces it, according as it is a disturbing influence affecting the system, or only some individual organ.

1. Wasting may of course be produced without disease, by merely withholding the supply of nutritious food. Nutritious food is the only source from which the material can be derived for repairing the waste of the vital functions. If it be inadequate, every function will languish, and every organ waste, in a degree proportionate to the scantiness of the supply.

2. Among the diseases capable of producing wasting, the most important are those which have their primary seat in the organs of nutrition. The stomach and intestines are the organs which produce the first and the most essential changes on the aliment, by which it is converted into nutriment, and prepared for assimilation. If any cause render these organs incapable of performing their functions, the ordinary waste of the body cannot be repaired, and a general atrophy must inevitably follow. Yet it is remarkable that these organs may perform their functions so imperfectly as to produce a great degree of disturbance in the system, without necessarily occasioning any manifest wasting. People sometimes suffer severely during a long life from dyspepsia, in its manifold forms, without getting thin. The reason is, that though the food be not easily and healthfully digested, yet, in the midst of the disturbance, enough of it is converted into nutriment to supply the ordinary waste of the body. Organic disease, however,—that is, disease attended with a morbid change in the structure of an organ,—rapidly tells upon the system, producing a progressive and ultimately an extreme degree of emaciation; and occasionally a single attack of merely functional dyspepsia, lasting only a few days, will render the body manifestly thinner, and cause the loss of many pounds of weight.

3. Next to the diseases of the primary organs of digestion come the diseases of the organs which co-operate with the stomach and intestines in converting the aliment into nutriment; and more especially diseases of the pancreas and liver.

4. But the food, when digested, has a long course to travel before it reaches the blood. It must be taken up by the lacteal vessels, and carried through the mesenteric glands. [DIGESTION, NAT. HIST. DIV.] It is probable that these organs are not mere channels of communication between the stomach and intestines and the lungs, but that they effect some change upon the imperfectly-digested aliment as it passes through them. Certain it is, that disease of these organs powerfully influences the process of nutrition, and produces a great degree of wasting. Examples of this are but too abundant in infants and children, who are cut off in great numbers by diseases which, on examination of the body after death, are found to have their chief seat in these organs. [MARASMUS.]

5. Disease of the organs of assimilation interrupts nutrition just as effectually as disease in the primary organs of digestion. It is not until the digested aliment reaches the lungs that it is converted into blood. The lungs finish what the stomach begins; and the function of respiration is the completion of that of digestion. Anything that impairs the function of respiration must therefore necessarily impair that of nutrition, and produce a proportionate degree of wasting. The lungs have this peculiarity, that they are capable of what may be called progressive destruction, the obliteration of one part after another in successive portions. The parts obliterated of course cease to contribute their share to the conversion of the aliment into blood; but the parts not obliterated continue to do so pretty much as in the state of health. Hence it is possible to breathe with only one lung, or with only half a lung; and the flame of life may, for a short time, be barely kept alive by a portion of even half a lung. The consequence is that, in certain diseases of the lungs, emaciation is carried to the utmost extent which seems to be compatible with the maintenance of the smallest particle of life.

6. But the process of nutrition is not completed even after the aliment is converted into blood. There still remains what may be termed the function of appropriation. After their conversion into blood in the lungs, the new particles are returned to the left side of the heart, whence they are carried out to the system by the larger trunks of the arterial vessels. These tubes terminate in a system of vessels of extreme minuteness, called the arterial capillaries, which are the true appropriators of the new particles prepared for them in the lungs, the architects and masons of the system, by which the new particles are deposited in the room of the old in the respective organs, and by which the waste is repaired. If, then, the capillaries of the system fail to perform their duty, no matter what quantity or what quality of nutrient matter be brought to them, the function of nutrition is suspended, and the body wastes; and, in like manner, if the capillaries of any particular part fail, the nutrition of that particular part must be at an end, and consequently its bulk diminish.

7. It is chiefly in consequence of the disease of these capillary vessels, that acute diseases, such as inflammation and fever, are always attended with so great a degree of wasting, although there is always, combined with this, disturbance of the digestive functions; so that in acute diseases nutrition is interrupted in a two-fold mode, by diminished digestion, and by imperfect appropriation of what is digested.

8. But a due supply of nervous influence is as indispensable to nutrition as a due supply of arterial blood. Whenever, therefore, the capillary vessels do not receive their appropriate nervous stimulus, the parts to which they belong waste. Whatever injures the nerves in such a degree as to impair their functions, is invariably found to occasion atrophy. If the nerves which supply a part waste, that part immediately begins to diminish in bulk; if a part has been long wasted, the nerves distributed to it become so small that they can scarcely be traced. If the head of an unreduced dislocated bone press upon the large trunk of a nerve, the parts to which the nerve is distributed waste. If a poison capable of producing paralysis of the nerves, such as lead, be gradually and slowly introduced into the system, the body wastes; an example of which is seen in the atrophy commonly attendant on the disease termed the *colica pictorum*, the colic of painters. As will be fully shown hereafter, it is the organic, not the sentient, system of nerves that supplies the nervous influence indispensable to nutrition. Injury to the sentient system may indeed occasion atrophy, but it produces this effect indirectly; whereas injury of the organic system produces it directly, by arresting the nutritive functions: and accordingly, the degree of atrophy arising from diseases of the brain and spinal cord is always very much less than that which is consequent on destroyed or impaired function of the organic nerves.

9. Finally, cessation of function, from whatever cause, is manifestly and invariably followed by wasting of the organ in which the function had its seat. The gland that does not secrete diminishes in bulk; the nerve that does not receive and transmit impressions, or convey its wonted stimulus, wastes; and the muscle that does not contract, dwindles away; while increased exercise contributes exceedingly to the augmentation of its volume, as we see in the bulk of the blacksmith's arm, and in the leg of the opera-dancer. From the complete and long-continued cessation of action, the substance of organs is sometimes almost entirely removed; nothing remaining by which its original structure can be distinguished.

Such are the most obvious and common causes of wasting, the detection of which, it is obvious, must precede any rational treatment of the affection. It can be cured only by the application of the appropriate remedy to the morbid state of the organ or organs on which it depends. The detection of this state is sometimes difficult, and the removal of it when discovered often still more difficult. But when it depends only on functional derangement, or on such a kind and degree of organic disease as admits of cure, the physician who succeeds in discovering the cause will easily and surely remove the malady [HYPERTROPHY.]

ATROPINE, *Atropia, Daturine* ($C_{34}H_{23}NO_6$). A vegetable alkaloid discovered by Geiger and Hess in the juice of the deadly nightshade (*Atropa Belladonna*), and in which the well-known poisonous qualities of the plant reside. It is also found in the seeds of stramonium (*Datura Stramonium*), and may be obtained by treating the decoction of either plant with magnesia, and digesting the precipitate in alcohol, which dissolves the alkali in question. Brandes procured it also by adding sulphuric acid to the decoction, filtering the solution, super-saturating with potash, filtering again, dissolving the precipitate in boiling water, and crystallising the solution.

The crystals are long, transparent, colourless, brilliant needles. Atropine is nearly insoluble in cold water, moderately soluble in ether, and easily so in alcohol. It forms with acids peculiar salts, several of which readily crystallise. During the evaporation of a salt of atropine, so great a quantity of it is volatilised, that the vapour occasions an enlargement of the pupils of the eyes of those exposed to its influence, which continues for several hours. Brandes supposes that the atropine exists, in part at least, in the state of malate in the deadly nightshade. When atropine is heated in a solution of potash or soda, ammonia is abundantly evolved.

ATTACHMENT. An attachment is a kind of criminal process which Courts of Record are authorised to issue summarily upon a mere suggestion, or upon the personal knowledge of the judges, without indictment or information. This process is properly granted in cases of contempts, which all courts of record may, in the absence of specific regulation by statute, punish in a summary manner, according to their discretion. Thus, if a contempt be done in the presence of the court by a breach of the peace, an open defiance of its authority, or an interruption of its proceedings, the offender may at once be attached and committed, and afterwards punished to a reasonable extent at the discretion of the presiding judges. On the other hand, if it be suggested by a third person upon oath that one not present in court has committed an action which amounts to a contempt, the court will make a rule upon the offender to show cause why an attachment should not issue against him; or in flagrant and urgent cases, where an immediate remedy is necessary, will grant an attachment on the first complaint without any previous rule to show cause. In modern practice, attachments are chiefly employed in cases of constructive contempts, such as abuses of the administration of justice by magistrates or judges of inferior courts, for corruption or injustice by officers and ministers of the courts in refusing to execute lawful process, for doing it oppressively, corruptly, or extortionately, or for making false returns. Mal-practices in these respects, which bring discredit on the administration of justice, are for that reason construed to be contempt of the courts, and punishable as such by attachment. Upon a similar principle, attorneys, who are officers of the different courts in which they are admitted, may be punished by this summary mode of proceeding for any dishonest practice, for unjust or fraudulent conduct towards their clients, or for not obeying the orders of the court in delivering up papers, paying over money, &c. It is said by Hawkins ('Pleas of the Crown,' book ii. c. 22, s. 30), that barristers, "though not officers of any court, yet inasmuch as they have a special privilege to practise the law, and their misbehaviour tends to bring a disgrace upon the law itself, are punishable by attachment for any foul practice, as other ministers of justice are." Jurors also may be liable to attachment for constructive contempts in their ministerial capacity; for instance, for making default when lawfully summoned, for refusing to be sworn or to give any verdict, or for receiving a bribe or instructions from either of the parties in a suit to be tried by them. In early periods of the history of our law, jurors were sometimes attached for acts done in their deliberative or judicial capacity, as for giving verdicts against evidence or the direction of the court in matter of law. That giving a false verdict should be considered a contempt of court was not so unreasonable as it may at first appear to those acquainted only with the province of juries at the present day. In ancient times the jury were to all intents and purposes witnesses who were sworn to speak the truth (*verum dicere*); and if they gave a wilfully false verdict upon facts, they committed a similar kind of contempt to that of witnesses committing manifest perjury at the present day. Hawkins gives it as the inclination of his opinion, that a jury would be still liable to an attachment for giving a verdict wilfully against the direction of the court in point of law. The absence of an instance, however, in modern times of such a proceeding would afford a strong argument against its legality. Besides the contempts committed by parties and persons as above noticed, there are instances which it would be endless to enumerate, in which all persons may become liable to attachment for offences of this description. Thus, wilful perjury in the presence of the court, disrespectful words or conduct to the presiding judge, counterfeiting writs, refusing to pay money or perform acts according to the direction of an award entered into by rule of court, non-payment of costs taxed by the officer of the court in which a proceeding is pending, are all instances of contempts which subject the persons who commit them to the summary process of attachment.

Attachment of Privilege was a process by which attorneys or other officers, entitled to privilege in the courts to which they belong, might formerly enforce the appearance of another person in their respective courts to answer to an action, but this course of practice has been abolished.

ATTACHMENT, FOREIGN. This is a judicial proceeding, by means of which a creditor may obtain the security of the goods or other personal property of his debtor, in the hands of a third person, for the purpose, in the first instance, of enforcing the appearance of the debtor to answer to an action; and afterwards, upon his continued default, of obtaining the goods or property absolutely in satisfaction of the demand. The process in England is founded entirely upon local customs, and is an exception to the general law of the land, as it exists only in London, Bristol, Exeter, Lancaster, and a few other towns. Indeed, the name of the process may serve to demonstrate its foreign origin, as we find a similar mode of securing the payment of a debt by a proceeding against the debtor's goods in the hands of third persons, forms under different names, a part of the municipal laws of Scotland, Holland, and most European countries in which the civil law prevails. In Scotland this proceeding is called arrestment. In France, the process exists under the name of *saisie-arrêt*. ('Code de Procédure Civile,' I., liv. 5, tit. 7.)

The custom of foreign attachment in London differs in no material respect from the same custom in other parts of England; it is, however, much more commonly resorted to in the Lord Mayor's court of London, than in any other local courts.

The creditor, who is the plaintiff in the action, makes, in the first instance, an affidavit of his debt, which must have been contracted within the city of London or its liberties, and be actually due. An action is then commenced in the usual manner; the only parties named in the first instance being the creditor as plaintiff, and the debtor as defendant. A warrant then issues, or is supposed to issue, to the officer of the court, requiring him to summon the defendant; upon this warrant the officer returns that the defendant "has nothing within the city whereby he can be summoned, nor is to be found within the same," and then the attachment may be made. This return of *non est inventus* to the process against the defendant is of the very essence of the custom, and without it all the subsequent proceedings on the attachment would be invalid; in point of fact, however, where an attachment is intended, the officer never attempts to summon the defendant, or gives him any notice of the action, but merely makes his return to the warrant as a matter of course. After this return, a suggestion is made, or supposed to be made, by the plaintiff to the court, that some third person within the city has goods of the defendant's in his possession, or owes him debts, by which goods or debts, the plaintiff requires that the defendant may be *attached*, until he appears to answer to the action brought against him. The attachment is then effected by a notice or warning served by the officer of the court upon the third party, who is called the garnishee, from an old French word *garnier*, or *garniser* (to warn), from whence *garnisée*, or vulgarly, *garnishee* (the person warned), informing him that the goods, money, and effects of the defendant in his hands are attached to answer the plaintiff's action, and that he (the garnishee) is not to part with them without the leave of the court. After this warning, the effect of which is to secure the property in the hands of the garnishee, the process again returns, or in principle ought to return, to the defendant, who must be publicly called and make default on four successive court-days, before any further proceedings can be taken against his goods. In practice, however, no process is served upon the defendant either at this or any other stage of the proceeding; nor is he ever in fact called,—notice of the action or the attachment being, according to the present practice, never actually given to him. After the four court-days have elapsed, the garnishee may be summoned to show cause why judgment should not be given against him for the goods or debt formerly attached in his hands. He then either appears and pleads, or he makes default; if he makes default, and the subject of the attachment is money, or a debt ascertained, the judgment of the court is final in the first instance, and execution may be issued at once for the sum demanded. But where the subject of the attachment is goods, a formal appraisement is made under a precept from the court by two freemen, sworn for the purpose; and judgment given for the goods so appraised. It sometimes happens that the garnishee has removed the goods before appraisement; in which case the officer returns the fact to the court, and a jury is empanelled to inquire and assess their value; and thereupon judgment and execution follow for the sum so assessed. But before execution can in any case issue against the garnishee, the plaintiff is required to enter into a recognisance with two sureties, obliging himself to return the money or goods taken under the attachment, if the *defendant* appears in court within a year and a day, and disproves or avoids the debt, or shows that it did not arise within the city.

The above is the course of proceeding in the case of a judgment by default. Instead of following this course, however, the garnishee, who is commonly the banker, factor, or agent of the defendant, usually appears and pleads. As matter of defence, he may deny that any debt is due from himself to the defendant, or that he possesses any goods or money of his; he may also show that he has a lien upon the defendant's goods in his own right. The question thus raised between the plaintiff and the garnishee is then tried by a jury, and judgment is given upon their verdict, with or without appraisement, according to the nature of the property attached. It should here be remarked that, according to the custom, the goods can never be actually seized in execution under the attachment; if the garnishee refuse to deliver them, the only remedy of the plaintiff is to arrest him.

A difference of opinion prevails amongst mercantile men with respect to the utility of this proceeding. On the one side, it is said to be important, in a commercial community, to be readily able to apply the property of an absent debtor, wherever it may be found, to the payment of his creditor; and this, it is contended, is particularly advantageous in a city much frequented by foreigners for the purpose of trade, who may contract debts during their abode in England, and then remove themselves to foreign parts, beyond the reach of personal process: on the other hand, it is supposed to embarrass commercial operations, in consequence of the enormous power which it places in the hands of creditors—a creditor for 20*l.* being entitled, if he pleases, to attach property to the amount of 20,000*l.*, or any larger sum, which cannot be applied in discharge of any commercial engagements which the debtor may have formed, until the attachment is disposed of. The apprehension of this process is said to deter foreign merchants from consigning cargoes to London. It does not, however, appear to be likely that the existence of this custom should, under ordinary circumstances, have the effect of deterring the fair merchant from sending his goods to London; though it may well happen that a trader who has contracted debts in London which he does not intend to pay, or who suspects that claims will be set up which he does not wish to afford the claimants any facilities in litigating, would hesitate to send a cargo to a port where, by means of this process, any of his creditors there, real or pretended, might instantly seize it. Nor can much practical inconvenience arise from the power of attaching a large property for a small debt; for the garnishee, who is almost in all cases the agent of the defendant in some shape or other, may at any time dissolve the attachment, by appearing for the latter, and putting in bail to the action; or, if satisfied with the truth of the debt upon which the attachment issues, he may pay the plaintiff's demand, and take credit for the amount in his account with the defendant: for a payment under an attachment would be *pro tanto* an answer to any demand against the garnishee by the defendant. The alleged objections do not, therefore, appear to be so formidable as has been represented; but the advantage of a speedy and safe mode of recovering debts is obvious.

There are, however, many imperfections in this form of proceeding. No costs are recoverable on either side: and therefore where a small debt is contested, if the plaintiff succeeds against the garnishee, his costs may very possibly exceed the sum he can recover; and if the garnishee succeeds in showing himself not to be liable to the attachment, he may incur a considerable expense without the possibility of reimbursement. The efficiency of the custom is also much impeded by the limited extent of its local jurisdiction. Thus, goods in a warehouse in Thames-street may be attached; but if lying in a lighter on the river Thames within a yard of the warehouse, they are exempt. So also, if a merchant keep his cash with a banker in the city, it is liable to the process; but if his banker dwell a few yards beyond the limits of the city, no attachment can be made of his balance—unless indeed the plaintiff should prepare himself with process, and be fortunate enough to serve it upon one of the partners when accidentally within the jurisdiction; in which case, as he is supposed to carry with him all the debts and liabilities of the house to which he belongs, the balance of any customer of the firm might be attached.

Although the procedure of the Lord Mayor's court has been recently improved, the custom and practice of foreign attachment remain as they were. It may be added that when the legislature (Common Law Procedure Act, 1854) conferred on the Superior Courts of law powers of ordering the attachment of debts due to judgment debtors, and compelling their payment to the creditors *after judgment*, it refrained from giving any authority to do so as a preliminary step to an action, which is the nature of the process called foreign attachment, of arrestment in Scotland, and of *saisie-arrêt* in France, and in those countries where a similar procedure is in use. [GARNISHEE.]

ATTACK, or ASSAULT. Assault is taken from the French *Assaut*, which is derived from the Latin *Assilio, Assultum*, to leap against. This word, in military science, is applied to the attack made by a besieging army on a fortress or military post, or more generally to the attack of any strong position. When a regularly fortified place is besieged, the besiegers after pushing their approaches close to the defences, and making breaches in them, either by breaching batteries or by mines, give the assault, which, if successful, places them in possession of the portions of the works immediately about the breach, where they establish themselves by forming lodgments; or, as constantly happens, the attacking party, pushing on, seize the whole place. Such was the case at one of the most remarkable assaults in history, that of San Sebastian in August, 1813. The principal breach was in the sea-face which had been battered down for a length of about 500 feet. The assault was given in the morning, when the tide permitted the Uremea to be forded. For nearly two hours the desperate exertions of the storming parties were unsuccessful. Sir John Jones, in his 'Journals of Sieges,' note 36, says: "Had the struggle been merely that of man to man, the result would not have remained for many minutes doubtful; for the troops mounted the breach, and gained the summit at the first rush, in sufficient numbers and sufficiently formed to have borne down any body of men which could have been formed on the rampart to oppose them. The French foreseeing this had, with their usual skill, trusted their defence to artificial obstacles, which should prevent the assailants advancing beyond the crest of the breach, and to directing a most powerful and close fire on the summit, which was far too confined to admit of cover being established on it, to guard the assailants from the effects of missiles." The interior retaining wall of the rampart and the walls of the ruined houses in the neighbourhood were loop-holed, and had a banquette in rear, so as to obtain a heavy fire on the summit of the breach, while the circulation along the rampart was impeded by means of walls and traverses formed across the terrephin. The assailants, therefore, had either to force over these defences under a close fire, or jump down the retaining wall 24 feet in depth. General Graham, in his despatch to the Duke of Wellington, says: "Everything that the most determined bravery could attempt was repeatedly tried in vain by the troops, who were brought forward from the trenches in succession. No man outlived the attempt to gain the ridge; and though the slope of the breach afforded shelter from the enemy's musketry, yet still the nature of the stone rubbish prevented the great exertions of the engineers and working party from being able to form a lodgment for the troops." "In this almost desperate state of the attack, after consulting with Colonel Dickson, commanding the Royal Artillery, I ventured to order the guns to be turned against the curtain. A heavy fire of artillery was directed against it, passing a few feet only over the heads of our troops in the breach, and was kept up with a precision of practice beyond all example." A column of Portuguese now fording the river at the mouth, attacked and carried the right of the great breach, and a small breach on its right, whilst a British column, taking advantage of the admirable fire on the curtain, advanced again, and fortunately arriving at the breach just at the time when an explosion on the rampart of the curtain (occasioned by the fire of the artillery) created some confusion among the defenders, carried it; and the first column having forced their way into the adjoining houses, the town was gained. Nothing could restrain the impetuosity of the troops, the enemy were driven from their defences in the streets, and after suffering a severe loss, were forced to retreat into the castle, which surrendered after a few days' siege.

This assault is remarkable, not only for the severe contest maintained with unparalleled bravery on both sides, but also from the circumstance of a heavy fire of artillery from forty-seven guns having been directed on the summit of the breach over the heads of the storming party. It was also effected in daylight, a rather unusual circumstance. Sir John Jones says on this head: "daylight is certainly the best time for storming works when the troops can advance under cover to the breach or point of escalade, or have the support of a powerful artillery. But when the garrison have preserved an extensive front of fire, and the trenches have not been pushed very forward, to storm in daylight can be seldom advisable, as the troops would most frequently suffer so much in advancing as to be disabled from any serious effort when arrived at the breach. The most preferable time for such open advances is at the moment of day-break. In the dark the troops are liable to imaginary terrors, and being concealed from the view of their officers, the bravest only do their duty. When it is decided to assault a place immediately before day-break, the utmost attention should be given on the previous morning to ascertain the exact moment of its becoming light; and the most energetic and decided measures must be taken to insure the columns advancing at the instant fixed upon, as it will be equally prejudicial to their success to be too soon, as to be too late." The truth of these remarks was fully borne out by the assaults at the late siege of Sebastopol. In the assault of the 18th of June, which was intended to be given some hours after day-break, so as to allow the artillery to destroy any defences which might have been repaired in the night, the right French column appears to have lost its way, and becoming entangled with the Russian outposts, commenced the assault too soon. Though much before the concerted time, the main French column advanced to the assault of the Malakoff, and the English force had to be ordered forward on the Redan, to support these attacks. They were all unsuccessful. Not only was the garrison on the alert, and the artillerymen standing by their guns ready to pour grape into the heads of the columns immediately they appeared, but also they had, by incredible exertions during the night, repaired their defences and replaced their disabled guns. The fire on the assaulting columns was so severe that they were annihilated almost as soon as they issued from the trenches.

In the successful assault of the 8th of September, the French, rushing from their trenches close to the Malakoff, were in the works, which were not of a nature to offer any obstacle to such an effort, before the garrison could get to their posts. The resistance, however, with which the other French columns and the English column were received, when the defenders had been put on the alert by this attack which had preceded them only by a few minutes, was very different, insomuch that none of them were successful.

ATTAINDER, from the Latin word *attinctus*, "attaint," "stained," is a consequence which the law of England has attached to the passing of sentence of death upon a criminal. Attainder does not follow upon mere conviction of a capital offence; because, after conviction, the judgment may still be arrested, and the conviction itself cancelled, or the prisoner may obtain a pardon; in either of which cases no attainder ensues. But as soon as sentence of death is passed, or a judgment of outlawry given where the person accused flies from justice, which is equivalent to sentence of death, the prisoner becomes in contemplation of law *attaint*, stained, or blackened in reputation. He cannot sue or be a witness in a court of justice; he loses all power over his property, and is rendered incapable of performing any of the duties, or enjoying any of the privileges, of a freeman. The person of a man attainted is, however, not absolutely at the disposal of the crown. It is so for the ends of public justice, but for no other purpose. Until execution, his creditors have an interest in his person for securing their debts; and he himself, as long as he lives, is under the protection of the law. (Macdonald's case, Howell's 'State Trials,' vol. xviii. p. 862.)

We shall consider, first, the subject of attainder as it exists by the ordinary laws of the realm; and, secondly, give some account of those extraordinary enactments of the legislature, commonly known by the name of Bills of Attainder.

1. The principal consequences of attainder, according to the ordinary course of law, are forfeiture of the real and personal estates, and what is technically called corruption of the blood of the offender. The forfeiture of the personal estate dates from the time of his conviction, but extends only to the goods and chattels of which he was actually possessed at that time. Real estate is not forfeited until attainder; but then the forfeiture (except in the case of attainder upon outlawry) has relation to the time when the offence was committed, so as to avoid all intermediate sales and incumbrances. ('Co. Litt.' 390 b.)

The extent and nature of the forfeiture of real estate upon attainder differ in the case of high treason, and in cases of murder or other felony. Attainder for high treason is followed by an immediate and absolute forfeiture to the crown, of all freehold estates, whether of inheritance or otherwise, of which the person attainted was seised at the time of the treason committed. This consequence of attainder for high treason is said by Sir W. Blackstone to have been derived from Anglo-Saxon jurisprudence. Copyholds are in like manner forfeited to the lord of the manor of which they are holden, upon the attainder of the tenant.

By stat. 5 & 6 Edw. VI. c. 11, the dower of the widow of a person attainted for high-treason is also forfeited. But it is to be remembered that there is no forfeiture unless an actual attainder takes place; and therefore if a traitor dies before judgment, or is killed in open rebellion, or is put to death by martial law, his lands are not forfeited, unless a special Act of Parliament is passed for the purpose. It is said, however, that if the Chief Justice of England in person, upon the view of the body of one killed in open rebellion, records the facts and returns the record into the Court of King's Bench, both the lands and the goods of the rebel shall be forfeited.

This absolute and entire forfeiture of the estates of persons convicted of high treason, was often productive of extreme hardships and injustice, by making their families, who were no parties to their crimes, participate in their punishment. In what might be termed, while they existed as such, modern treasons, such as offences relating to the coin, it was expressly provided by the statutes creating them petty treason, that they should work no forfeiture of lands except for the life of the offender, and that they should not deprive his widow of her dower.

In cases of attainder for murder or other felony, the forfeiture of lands to the crown does not extend for a longer term than a year and a day, with an unlimited power of committing waste upon the lands during that period. This is called in our old law-books '*The King's year day and waste.*'

After the expiration of the king's year day and waste, the lands, instead of descending as they naturally would to the heir of the person attainted, were by the feudal law of escheat for corruption of blood, transferred or escheated to the lord of whom they were holden. In order to understand the doctrine of escheat for corruption of blood, we must remember, that, by the feudal law, from which our modern law of real property is chiefly derived, all lands were, or were supposed to be, held by gift from a superior lord, subject to certain services and conditions, upon neglect or breach of which (as well as upon failure of issue of the grantee) the lands reverted, or in feudal language, escheated, that is, fell back to the original giver. Now, by the attainder of a tenant in fee-simple for felony, the compact between him and his lord was totally dissolved; his blood was supposed to be corrupted, and he was disabled not only from inheriting lands himself, but from transmitting them to his descendants. Even though he had no lands in possession at the time of the attainder, and acquired none afterwards upon which the law of forfeiture could operate, the law of escheat might operate after his death to the prejudice of his descendants. For, owing to the corruption of his blood, which completely stopped up the course of descent, it was impossible to derive a title to any lands, either from him directly, or from a more remote ancestor through him. The inevitable consequence was an escheat to the lord. The practical injustice and hardship caused by the doctrine of the corruption of blood in punishing the offences of the guilty by a heavy punishment upon the innocent, frequently attracted the attention of the legislature; and it consequently became usual, where a new felony was created by Act of Parliament, to make an express provision that it should not extend to corruption of blood. By the statute 7 Anne, c. 21 (the operation of which was deferred by 17 Geo. II. c. 39), it was enacted, that after the death of the then Pretender and his sons, no attainder for treason should extend to the disinheriting any heir, nor the prejudice of any person other than the offender. But, both these statutes being repealed by 39 Geo. III. c. 93, the ancient law of forfeiture for treason was restored. By the statute 54 Geo. III. c. 145, corruption of blood was next taken away for attainder, except in cases of treason, petit treason (that is, where a wife had murdered her husband, a servant his master, or an ecclesiastic his superior), and other murders. Finally, the worst consequence of the doctrine of corruption of blood, namely, the impossibility of descents being traced through attainted persons, was removed by the statute 3 & 4 Wm. IV. c. 106, s. 10, which enacts, that no attainder for the future shall prevent descent from being traced through the attainted person.

A dignity descendible to the heirs general is forfeited to the crown both for treason and for felony. An entailed dignity is forfeited for treason, but not for felony. Thus Lawrence Earl Ferrers, whose peerage was limited to the heirs male of the body of his ancestor, being attainted for murder in the reign of Geo. II., was succeeded by Washington Earl Ferrers, his next brother.

The corruption of blood produced by attainder cannot be effectually removed except by authority of Parliament. "The king," says Blackstone, "may excuse the public punishment of an offender. He may remit a forfeiture in which the interest of the crown is alone concerned; but he cannot wipe away the corruption of blood; for therein a third person hath an interest, the lord, who claims by escheat." But it appears from the same author, that the king's pardon is so far effectual after an attainder, that it imparts new inheritable blood to the person attainted, so that his children born after the pardon may inherit from him.

2. Besides the modes of attainder by the common law, as above described, there have been frequent instances in the history of England, of attainders, by express legislative enactment, called bills of attainder. This has happened when, either from the extraordinary nature of the crime, or from unforeseen obstacles to the execution of the ordinary laws, it has been thought necessary to have recourse to the supreme power of the legislature, for the purpose of punishing particular offences. These enactments, either in the shape of bills of attainder or bills of pains and penalties, have been made at intervals from an early period of our history, down to very recent times. The moral justice, as well as the policy of these *ex post facto* laws, has been often questioned; and they have generally occurred in times of turbulence or of arbitrary government; but the number of them is sufficiently large to form a formidable list of precedents for any future suspension of the ordinary law. There were some instances of them under the Plantagenet princes, as the bills of attainder against Roger Mortimer and Edmund earl of Arundel, in the reign of Edward III. Both of these, however, were reversed in the same reign. It was not till the reign of Henry VIII., which was fertile in new crimes and extraordinary punishments, that the proceeding by bill of attainder became so common as almost to supersede trials according to the ordinary process of law. Scarcely a year passed without persons of the highest rank and most distinguished character being brought to the scaffold by bill of attainder. Among them were the celebrated earl of Surrey, Cromwell earl of Essex, who is said to have been the adviser of these measures, and most of those persons who suffered for denying the supremacy of the crown in matters ecclesiastical. All of these were attainted upon mere hearsay evidence; and some not only upon no evidence at all, but without being heard in their defence. In the following reign of Edward VI., the Protector Somerset encouraged a bill of attainder for treason against his brother Lord Seymour of Sudley, the lord high admiral of England and husband of the queen dowager Catharine Parr, which was hurried through both houses of Parliament, without the accused being permitted to say anything in his defence. But, as the nation became better acquainted with the principles of constitutional freedom, parliamentary attainders became less frequent. Under the Stuarts recourse was seldom had to this extraordinary mode of proceeding. It was thought necessary to adopt it in the time of James I., with respect to Catesby, Percy, and several other persons, who were killed in the insurrection that ensued upon the discovery of the Gunpowder Plot, or died before they could be brought to trial, as they, not having been tried, could not have been attainted by the ordinary process of law. It was again adopted by the Long Parliament in Lord Strafford's case, on the ground that he was an extraordinary criminal, who would have escaped comparatively uninjured, if no other penalties than those of the existing laws had been awarded against him. But even Lord Strafford's attainder was reversed after the restoration of Charles II., and all the records of the proceedings cancelled by Act of Parliament. The duke of Monmouth also, on his appearing openly in arms against the government, in 1685, was attainted by statute. A remarkable instance of a proceeding by bill of attainder occurred in the case of Sir John Fenwick, who, in the year 1696, was attainted for a conspiracy to assassinate William III. There is no question that Sir John Fenwick might have been tried by

the ordinary process of law. The excuse urged for resorting to a bill of attainder was, that there was no *moral* doubt of Fenwick's guilt; but that as two witnesses were required by the statute of 7 Will. III. c. 3, in order to convict him; and as one of them had been tampered with, and removed out of the kingdom, *legal* proof of an overt act of treason became impossible.

The effect of this bill of attainder was therefore to suspend the statute of 7 Will. III. c. 3, before it had been two years in operation, in order to destroy an individual. This questionable exertion of legislative power did not take place without a strong opposition, and has been frequently reprobated in subsequent times. Bishop Burnet, one of its most strenuous supporters, allowed that "this extreme way of proceeding was to be put in practice but seldom, and upon great occasions." (Howell's 'State Trials,' vol. xii.)

The legislature, acting in conformity with this sentiment, have seldom, since the accession of the House of Hanover, had recourse either to Bills of Attainder, or Bills of Pains and Penalties. One instance of a departure from this principle occurred during the Irish Rebellion, in 1798, in the case of Lord Edward Fitzgerald, who being arrested on a charge of high treason, and dying in prison before he could be brought to trial, of the wounds which he had received in resisting his apprehension, was attainted by Act of Parliament. But when the violence of party spirit had subsided, the old principle of the constitution, that every man shall be considered innocent of a crime until his guilt has been legally proved, prevailed, and a few years ago the attainder was reversed. There is little reason to apprehend that a practice so obviously unjust, and so dangerous to the fundamental principles of good government, will be adopted in future.

Of late years, the forfeitures resulting from the numerous attainders consequent on the rebellions in 1715 and 1745, have been relieved by acts of grace, and many persons thus enabled to claim and obtain a restitution of their hereditary honours. (M'Queen's 'Reports,' vol. i. p. 786.)

ATTAINT (*attincta*), an old writ, which formerly lay to inquire whether a jury had, or had not, given a false verdict. It at first lay only on the trial of writs of assize, and is said to have been introduced by Henry II., at the instance of Chief Justice Glanville, as a check on the vast power then vested in the recognitors of assize of finding a verdict according to their own personal knowledge, without an examination of witnesses. It was afterwards extended by Edward I. to all pleas of land or freehold, and by statutes in the reigns of Edward I. and Edward III., to all pleas whatsoever, whether real or personal, except writs of right, where the issue was joined on the *mere right*.

The grand jury on the attaint were twenty-four in number, and if they found that the verdict was false, the judgment against the petit jury that had found it was one of extreme severity: namely, to lose their *liberam legem* and be infamous, to forfeit their goods and profits of their lands, to be imprisoned, and their wives and children to be thrown out of doors; their houses to be rased, their trees extirpated, and their meadows ploughed, and the plaintiff to be restored to all he had lost by reason of the unjust verdict. But as this severity had the actual effect of preventing the law from being executed, a much more moderate judgment was afterwards introduced by 11 Henry VII. c. 24, made perpetual by 13 Eliz. c. 25.

This clumsy expedient for controlling the extensive power of a jury was one, however, which could only with great difficulty, and in rare cases, be carried into operation. The jury could only be attainted on the same evidence as that given before them; and either for finding a verdict contrary to that evidence, or for finding one on evidence not sustaining the issue. It was almost impossible to attaint them on the former ground, since they were at liberty to take their own personal knowledge for evidence; as to the latter, the judge had some control over the jury, by giving them directions as to the precise point of the issue to which the evidence was to be applied; and if they found a verdict contrary to the express direction of the judge, they certainly ran great risk of an attaint. So inconvenient and ineffectual, however, was the proceeding, that it gave place, in the time of Elizabeth and James I., to the now existing practice of setting aside verdicts on motion and granting new trials; and very few instances of an attaint appear in the books later than the sixteenth century. By the 6 Geo. IV. c. 50 (consolidating the laws relating to juries) the writ of attaint was abolished; but corrupt jurors may be proceeded against by indictment or information, and punished accordingly. [EMBRACERY.]

(*Blackst.* 'Comm.' Mr Kerr's ed. vol. iii. pp. 377, 418, 438.)

ATTAR, or OTTO OF ROSES, an essential oil obtained in India from the petals of the *Rosa centifolia* and *sempervirens*; for this purpose a cask or glazed earthen jar is filled with the rose leaves carefully separated from the calyxes, and spring water poured in just sufficient to cover them: the vessel with its contents is then set in the sun for two or three days, and taken under cover during the night. At the end of the third or fourth day, small particles of yellow oil will be seen floating on the surface of the water, which in the course of a week will have increased to a thin scum; this is taken up by a little cotton tied to the end of a stick, and squeezed into a small vial. (*Aitkin*, 'Dictionary of Chemistry.')

The attar is now more frequently made by distilling rose leaves with water. At first the attar dissolves in the distillate, but by returning the latter upon fresh quantities of leaves, the attar distils in larger quantity than can be dissolved by the water which comes over with it, and it then forms an oily layer which is removed; the water being again used for the next distillation.

This oil is a well-known perfume; but the odour is agreeable only when diffused, being too powerful when it is concentrated. According to Saussure, the attar is a mixture of two oils, one of which is solid and the other fluid, at the usual temperature of the air: they may be separated by washing with alcohol, which does not dissolve the concrete oil at a low temperature; or by pressure between folds of paper, which absorbs the fluid oil. By the latter process, three parts of the common yielded one part of the concrete oil.

Attar of roses liquefies at about 85° of Fahrenheit, and the solid oil at about 91°; the latter crystallises by cold into brilliant white transparent laminæ of the consistence of bees' wax. The density of attar of roses rendered fluid at about 90°, compared with water at 60°, is 0·832, which, according to M. Saussure, is less than that of any other essential oil that he examined; the concrete oil, when fused, is even lighter than this.

The concrete essence is very slightly soluble in alcohol, 1000 parts of the density of 0·806, taking up only two parts of it at 57° Fahrenheit, while the same quantity of alcohol dissolves seven parts of the attar, and the fluid portion is still more soluble.

Saussure observes that the concrete oil burns in oxygen gas with a sort of explosion, which he has never observed to so high a degree in any other oil. By analysis the attar was found to consist of

Carbon	86·743
Hydrogen	14·889
	101·632

Saussure observes that the most remarkable circumstance attendant upon this analysis, is its close resemblance to that of olefiant gas, which consists of carbon 85·71; hydrogen 14·29.

ATTENDANT TERM. [TERM OF YEARS.]

ATTIC, a term in architecture, comprehending the whole of a plain or decorated parapet wall, terminating the upper part of the façade of an edifice. The derivation of the word is uncertain. It appears to have been a generally received opinion that the word was derived from the circumstance of edifices in Attica being built after this manner. There is at Athens a monument, that of Thrasyllus, with an attic over the order of pilasters which form the basement. In the centre there was a colossal statue. In a note to the second edition of Stuart's

Upper part of the Façade of the Monument of Thrasyllus, with the seated figure restored, from the original in the British Museum.

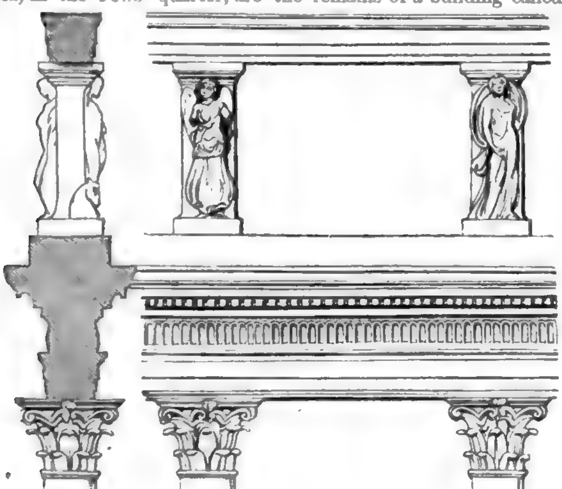
'Athens,' published in 1825, the editor is of opinion that this attic was not contemplated in the original design, but added at the date of the two upper inscriptions when Thrasycles was Agonothetes. (See note, p. 92, vol. ii., second edition of Stuart, 1825.) This example however may be taken as the best type of a Greek attic which is at present known. In the 'Archaiologia Londinensis' there is an ingenious, although, as we think, a wrong derivation of the word attic, unless we suppose the word, as we now use it, to have become corrupted. In vol. xxiii. pp. 412–14, the word attic is said to be compounded of *a* privative, and τεῖχος, a wall, thus signifying "without a wall, or without being in connection with a wall." The example of such an attic, it is said, is found in all Hypæthral temples, for as the naos, nave or space between the inner ranges of the columns, must not be covered, upper ranges of columns, with a wall above them, must be placed over the lower order of columns to catch the end of the rafter at its highest elevation: an example of this kind of attic may be found at Pæstum, in Italy.

Another example, which bears a closer resemblance to the Roman attic, exists in the upper wall of the nave of the Temple of Jupiter Olympius at Agrigentum [ATLANTES], where there is an entire wall with short pilasters at intervals, in the front of which are figures placed above the pilasters of the nave. Vitruvius and Pliny do not make any mention of or allusion to the attic of a building as we understand it at the present day. In the annexed cut we have given a representation of a Roman attic, the only remaining part of a superbly decorated wall

Part of a Building inclosing the Forum of Nerva at Rome.

inclosing the Forum of Nerva at Rome. This wall was of considerable extent, and was divided at intervals by columns projecting from the wall, over which, as may be seen in the drawing, the attic wall is continued at right angles to the wall forming the inclosure. The attic also is a very conspicuous feature in the triumphal arches at Rome, and a necessary one; it was not merely intended as a frame-work for the inscription, nor as a support for statues, but is essential to the proportions of the whole composition. [ARCH, TRIUMPHAL.]

In all the best examples, and especially in the remains of antiquity at Rome, the attic is decorated with a moulded base and cornice, often with pilasters and figures, as in the arch of Constantine. At Thessalonica, in the Jews' quarter, are the remains of a building called the



The Incantada at Thessalonica.

Incantada, drawn and described by Stuart in the 3rd vol. of his 'Athens.' Five Corinthian columns on their pedestals support an entablature: over four of these columns there still exists an attic adorned on each side with figures in alto-rilievo. The spaces between the figures are open, and there is a cornice over the figures with a base at their feet. The design and execution of this work are attributed to the period of Roman dominion, rather than to any other. (Stuart's 'Athens,' vol. iii.) At Bourdeaux, a somewhat similar building existed in the reign of Louis XIV., which was destroyed by Vauban to erect the fortifications constructed at that time. Perrault, the architect, made a drawing of the ruin previous to its destruction, from which circumstance the design is now preserved, and may be seen in the 2nd edition of Stuart's 'Athens' (1825). The most remarkable difference between this building and the Incantada is, that in the former the openings in the attic between the figures are arched, while in the latter they are bounded by the straight line of the cornice. The arch in the former proves it incontestably to have been a Roman work; while from the uncertainty respecting the date and use of the building at Thessalonica, the period of its erection cannot be ascertained.

The Italian architects who had studied the remains of antiquity in Rome, and those who followed in their school, usually employed an attic in their designs, as may be seen by a reference to their works, and more especially to the designs of Palladio, entitled 'Le Fabbriche e i disegni di Andrea Palladio raccolti ed illustrati,' da Ottavio Bertotti Scamozzi, 1776. The attic is in very common use in the public buildings of London. Somerset House, in the view towards the street, may be taken as offering a very good example of this feature of an edifice. Opinions differ as to the attic: some consider it a deformity, and at least only to be tolerated where it is unavoidable. They would accordingly confine it nearly altogether to domestic architecture.

ATTIC, IN BUILDING. Generally speaking, in England the term attic is limited to the sense of a story in the roof of a building; and it is even applied to such stories, when there is a decoration, such as a balustrade or parapet, which completes the elevation and effectually masks the roof itself.

The rules usually observed by architects in settling the proportions, and the details, of an attic may be found in Chambers, 'Civil Architecture,' edition by Gwilt, 1825; or in Quatremère de Quincy, 'Encyclopédie Méthodique,' 1788; Millin, in his 'Dictionnaire des Beaux Arts,' has some long notes upon the subject, mainly copied from those of the 'Encyclopédie Méthodique.'

ATTIC DIALECT, is a term which applied to designate one of the varieties of the ancient Greek language. A close connection and relationship existed between the old inhabitants of Attica and the Ionians; and in conformity with this fact, we find it stated (Strabo, p. 333) that the Ionic form of the Greek language, or the Ionic dialect, as it is generally called, "was the same as the old Attic, for the ancient Athenians were called Ionians." But in course of time the language of Athens, which was improved by a great number of writers, gradually acquired a distinct character, and also a decided pre-eminence, owing to the excellent works which were written in it on almost every branch of literature. Most of the great works of antiquity which have been transmitted to our times are written in the Attic dialect. Some writers have made two, and some three divisions of the Attic dialect, with reference to extant writers; but the general division of the Attic dialect into *old* and *new* seems to be sufficiently exact. To the former division belong Æschylus, Sophocles, Euripides, Aristophanes, Antiphon, Thucydides, &c.; to the latter, Demosthenes, Æschines, and the contemporary orators. The language of Xenophon, Plato, and indeed Aristophanes also, may be considered as possessing a character somewhat intermediate between the two classes, and the name of *middle* may consequently be given to it; but it would be difficult to say exactly how a writer of this middle class is to be distinguished from the writers of the *new* Attic.

After the time of Alexander, when the Greeks were more united as a nation, the superiority of Athenian literature made the language of Athens the common language of those who wrote pure Greek. Aristotle may be considered as the earliest extant writer, not an Athenian by birth, who adopted the language of Athens. The Attic dialect, then somewhat modified under Macedonian influence and by local circumstances, became the common written language of the educated Greeks. We find accordingly, under the successors of Alexander, and afterwards under the Romans, a series of Greek prose writers belonging to various countries, but all attempting to write one common language. These writers no doubt have each some peculiarities; but these peculiarities are not of that kind which distinguish the Ionic Greek of Herodotus, or the Doric Idylls of Theocritus from the language of Thucydides and Euripides. This common language of the learned Greeks was called the common dialect (*ἡ κοινή*, or *ἡ Ἑλληνικὴ διάλεκτος*): Polybius, a native of the Peloponnesus, Strabo of Asia Minor, Diodorus of Sicily, and others, belong to the writers who use the Common Dialect. Some late writers affected rather to imitate the pure old Attic standard than to use the modified Attic, or Common Dialect, as Lucian, Arrian in his Anabasis, Aristides, &c. The name of Atticists (*Ἀττικισταί*) was given to this artificial class of writers, but especially to such imitators as Aristides. [ARISTIDES, ÆLIUS, in BIOG. DIV.] The real characteristics of the Attic dialect can only be known by a careful study of the writers. The reader may consult Maittaire's 'Græcæ Linguæ Dialecti, by Sturz, 1807; Buttmann's 'Greek Grammar;' and Matthiæ's 'Greek Grammar.'

ATTORNEY is a person substituted (*atourné, attornatus,*) from *atourner, attornare,* to substitute, and signifies one put in the place or *turn* of another to manage his concerns. He is either a private attorney authorised to make contracts, and do other acts for his principal by an instrument called a letter of attorney; or he is an attorney at law, practising in the several courts of common law. The latter description only will be treated of under this head. As to the former, see LETTER OF ATTORNEY.

An attorney at law answers to the *procurator*, or proctor, of the civil and canon law, and of our ecclesiastical courts. Before the statute 13 Edward I., c. 10, suitors could not appear in court by attorney without the king's special warrant, but were compelled to appear in person, as is still the practice in criminal cases. The authority given by that statute to prosecute or defend by attorney formed the attorneys into a regular body, and so greatly increased their number, that several statutes and rules of court for their regulation and for limiting their number were passed in the reigns of Henry IV., Henry VI., and Elizabeth: one of which, the 33 Henry VI. c. 7, states, that not long before there were only six or eight attorneys in Norfolk and Suffolk, '*quo tempore magna tranquillitas regnabat;*' but that their increase to twenty-four was to the vexation and prejudice of the counties; and it therefore enacts, that for the future there shall be only six in Norfolk, six in Suffolk, and two in Norwich—a provision which has been since signally evaded, though not repealed. It will be convenient to consider—

1st. The admission of attorneys to practise, their enrolment, and certificates.

2d. Their duties, functions, privileges, and disabilities.

3d. The consequences of their misbehaviour.

4th. Their remedy for recovering their fees, &c.

1st. *The admission of attorneys to practise, their enrolment, and certificates.*—The earlier regulations as to the admission of an attorney (see 3 Jac. I. c. 7, s. 2, and rules of courts in 8 Car. I., and 1654) required that he should serve for five years as clerk to some judge, serjeant, counsel, attorney, or officer of court; that he should be found, on examination by appointed practisers, of good ability and honesty; and that he should be admitted of, and reside in, some inn of court or chancery, and keep commons there. These were superseded by the 2 Geo. II. c. 23, and subsequent statutes; but all of them (except the Stamp Acts) were repealed by and consolidated in the 6 & 7 Vict. c. 73, by which the control of the profession, from the period of admission, and so long as the attorney continues in practice, is confided to the Incorporated Law Society, which is appointed registrar of attorneys and solicitors. The Commissioners of Stamps are not to grant any certificate until the registrar has certified that the person applying is entitled thereto; and the commissioners are annually to deliver to the registrar all such certificates, with the date when they were granted. Persons who previously to this Act had discontinued their certificates to practise in the superior courts, but who were in the habit of practising in the inferior courts, and at the sessions and assizes, are now obliged to take out certificates, and are thus brought under the controlling power of the Incorporated Society. No person can practise as an attorney in the superior courts unless he has been bound by contract in writing to serve for five years as clerk to a regular attorney, and has continued five years in such service, and has been afterwards examined, sworn, admitted, and enrolled in the manner provided by the Act, under a penalty of 50*l.* and an incapacity to sue for his fees. This provision is extended to practising in the county court or the quarter sessions; and by 34 Geo. III. c. 14, s. 4, any person practising as an attorney, without due admission and enrolment forfeits 100*l.*, and is disabled from suing for his fees. By the 6 & 7 Vict. persons having taken the degree of bachelor of arts, or bachelor of law, in the university of Oxford, Cambridge, Dublin, Durham, or London, and having served under contract in writing for *three* years with an attorney, and having been actually employed during the three years by such attorney or his agent in the business of an attorney, shall be qualified to be admitted as fully as if they had served five years; provided the degree of bachelor of arts was taken within six years after matriculation, and the degree of bachelor of law was taken within eight years after matriculation: the binding to the attorney must also be within four years after the taking of the degree. An affidavit must be made within six months from the date of the articles of the execution thereof by the attorney and by the clerk, which affidavit must be filed in the court where the attorney is enrolled, and be read in open court before the clerk is admitted and enrolled an attorney. By the last Stamp Act a duty of 80*l.* is imposed upon the articles of clerkship of attorney, and 5*s.* on the counterpart. No attorney is allowed to have more than two articled clerks at once, and these only during such time as he is actually in practice on his own account, and not at any time during which he himself is employed as clerk by another attorney. The clerk, in order to be admitted an attorney, must actually serve five years under his articles; but in case the attorney dies, or discontinues to practise, or the articles are by mutual consent cancelled, then the clerk may serve the residue of the time under articles to any other practising attorney, and the new articles are not subject to stamp, 34 Geo. III. c. 14, s. 5, except the duty of 1*l.* 15*s.* The articled clerk may serve one year, but not a longer time, with the agent of the attorney to whom he is articled: a plan generally adopted by country clerks, who thus acquire a year's experience of the practice in London, without delaying their admission: and an articled clerk who becomes *bonâ fide* a pupil to a barrister, or certificated special pleader, *for one whole year*, may be admitted in the same manner as is done if he serves one year with the agent of the attorney to whom he is bound. Before the clerk can be admitted an attorney, he must be examined according to the Rules of Court of Hilary Term, 1853, at the Hall of the Incorporated Law Society, before one of the Masters of the Courts of Common Law, and four out of sixteen attorneys annually appointed by the Common Law judges. In conducting this examination, 75 questions are prepared and printed, arranged under the following heads:—1, Common and statute law, and practice of the courts; 2, conveyancing; 3, equity and practice of the courts; 4, bankruptcy and practice of the courts; 5, criminal law and proceedings before justices of the peace. There are some preliminary questions, two of which are for the purpose of ascertaining what law-books have been read and studied, and if the person under examination has attended lectures upon the law. Being found duly qualified, the clerk must also cause an affidavit of the actual service under the articles, sworn by himself or the attorney with whom he has served, to be filed in the court to which he seeks admission; and he must make oath (or affirmation, if a Quaker) that he has duly paid the stamp duty on the articles, and that he will truly and honestly demean himself as an attorney; he must also take the oath of allegiance, or, if a Roman Catholic, the declaration and oath prescribed by the Roman Catholic Relief Act. The attorney pays a stamp duty on his admission of 25*l.* His name is then enrolled without fee by the officer of court, in books appointed for the purpose: to which books all persons have free access, without payment of any fee. When the attorney is admitted, he subscribes a roll, which is the original roll of attorneys, of which the court takes notice as the recorded list of its officers, and from which the names are copied into the books. An attorney duly sworn, admitted, and enrolled in any of the superior courts of *law*, may be sworn and admitted in the courts of *equity* without fee or stamp duty; and so a solicitor in any court of equity at Westminster may be sworn, admitted, and enrolled an attorney of her Majesty's courts of law; and an attorney in a superior court at Westminster is capable of being admitted in any inferior court of record. An attorney admitted in one court of record at Westminster, may, by the consent in writing of any other attorney of another court, practise in the name of such other attorney in such other court, though not himself admitted in such court. But if any sworn attorney knowingly permit any other person, not being a sworn attorney of another court, to practise in his name, he is disabled from acting as an attorney, and his admittance becomes void.

In addition to the examination, swearing, admission, and enrolment, an attorney, in order to be duly qualified for practice, must take out a certificate at the Stamp-office every year between the 15th November and 16th December for the year following, the duty on which is 9*l.* if he reside in London or Westminster, or within the delivery of the two-penny post, or within the city of Edinburgh, and has been in practice three years; or 4*l.* 10*s.* if he has been admitted a less time; and if he reside elsewhere, and has been admitted three years, 6*l.*; or if he has not been admitted so long, 3*l.*; and if he practise without certificate, or without payment of the proper duty, he is liable to a penalty of 50*l.* and an incapacity to sue for his fees. (55 Geo. III. c. 184, s. 27.) But by the 44 Geo. III. c. 98, s. 10, these penalties can only be sued for by the Attorney-General, like other stamp penalties. The omission by an attorney to take out his certificate for one whole year incapacitates him from practising, and renders it necessary to obtain leave of the court to renew his certificate on payment of the arrears of certificate duty, and such penalty as the court thinks fit.

2. *The duties, functions, privileges, and disabilities of attorneys.*—The principal *duties* of an attorney are care, skill, and integrity; and if he be not deficient in these essential requisites, he is not responsible for mere error or mistake in the exercise of his profession. But if he be deficient in proper skill or care, and a loss thereby arises to his client, he is liable to a special action on the case: as, if the attorney neglect on the trial to procure the attendance of a material witness; or if he neglect attending an arbitrator to whom his client's cause is referred; or if he omit to charge a defendant in custody at the suit of his client, in execution within the proper time. When an attorney has once undertaken a cause, he cannot withdraw from it at his pleasure, since this would injure his client; and though he is not bound to proceed if his client neglect to supply him with money to meet the necessary disbursements, yet before an attorney can abandon the cause on the ground of want of funds, he must give a sufficient and reasonable notice to the client of his intention. When deeds or writings come to an attorney's hands in the way of his business as an attorney, the court, on motion, will make a rule upon him to deliver them back to the party on payment of what is due to him on account of professional services and disbursements, and particularly when he has given an undertaking to re-deliver them: but, unless they come to his hands strictly in his business as an attorney, the court will not make a rule, but leave the party to bring his action against the attorney.

An attorney duly enrolled and certificated is considered to be always personally present at court, and on that account has still some *privileges*, though they are now much narrowed. Till lately he was entitled to sue by a peculiar process, called an attachment of privilege, and to be sued in his own court by bill; but the Act for uniformity of process, 2 Will. IV. c. 39, abolished these distinctions, and an attorney now sues and is sued like other persons. By reason of the supposed necessity for his presence in court, an attorney is exempt from offices requiring personal service, as those of *sheriff, constable, overseer of the poor*, and also from serving as a juror. These privileges being allowed not so much for the benefit of attorneys as of their clients, are confined to attorneys who practise, or at least have practised within a year.

An attorney is also subject to some disabilities and restrictions. By rule of Michaelmas Term, 1854, no attorney can be bail for a defendant in any action. By 5 Geo. II. c. 18, s. 2, no attorney can be a justice of the peace for a county while in practice as an attorney; and no practising attorney can be a commissioner of the land tax without possessing 100*l*. per annum. No attorney who is a prisoner in any prison, or within the rules or liberties thereof, can sue out any process, or commence or prosecute or defend any action or suit; and if he so commence, prosecute, or defend any action or suit, he will be punishable as for a contempt of court and be incapable of recovering his fees.

3. *The consequences of an attorney's misbehaviour.*—The court which has admitted an attorney to practise treats him as one of its officers, and exercises a summary jurisdiction over him, either for the benefit of his clients, or for his own punishment in case of misconduct. If he is charged on affidavit with fraud or malpractice, contrary to justice and common honesty, the court will call upon him to answer the matters of the affidavit; and if he do not distinctly deny the charges imputed to him, or if he swear to an incredible story in disproof of them, the court will grant an attachment. If the misconduct of the attorney amount to an indictable offence, the courts will in general leave him to be indicted by the party complaining, and will not call upon him to answer the matters of an affidavit. If the attorney has been fraudulently admitted, or has been convicted of felony or any other offence which renders him unfit to practise, or if he has knowingly suffered his name to be used by a person unqualified to practise, or if he has himself acted as agent for such a person, or if he has signed a fictitious name to a demurrer purporting to be the signature of a barrister, or otherwise grossly misbehaved himself, the court will order him to be struck off the roll of attorneys. But striking off the roll is not a perpetual disability; for in some instances the court will permit him to be restored, considering the punishment in the light of a suspension only.

4. *The attorney's remedy for recovering his fees.*—An attorney may recover his fees from his client in an action of debt or *indebitatus assumpsit*, which he may maintain for business done in other courts as well as in that of which he is admitted an attorney. But an attorney cannot recover for conducting a suit in which, owing to gross negligence or other cause, the client has had no benefit whatever from the attorney's superintendence. By the 6 & 7 Vict. c. 73, s. 37, no attorney shall sue for the recovery of his fees or disbursements till the expiration of one calendar month after he has delivered, or sent by post, to his client a bill of such fees or disbursements, and subscribed with his own hand, or accompanied by a letter so subscribed; and on application of the party chargeable by such bill, the court, or a judge of the court in which the business is done, may refer the bill to be taxed by the proper officer; and if the attorney, or the party chargeable, shall refuse to attend such taxation, the officer may tax the bill *ex parte*, pending which reference and taxation no action shall be commenced for the demand; and on the taxation and settlement of the bill, the party shall pay to the attorney, or as the court shall direct, the whole sum due on the bill, or be liable to attachment or process of contempt; and if it is found that the attorney has been overpaid, then he shall forthwith refund. The statute applies not only to fees and disbursements for business done in a court of law or equity, but to conveyancing or other business not transacted in any court of law or equity.

The solicitor is by the statute also enabled to obtain the taxation of his own bill without the expense and delay of an action. The certificate of the taxing-master is final; and it is provided that a bill shall not be taxed after a verdict or writ of inquiry, or after twelve months from the delivery of the bill, except under special circumstances, and under no circumstances after twelve months' payment.

To assist an attorney in recovering his costs, he has a *lien* for the amount of his bill upon the deeds and papers of his client which have come to his hands in the course of his professional employment; and till his bill be paid, the court will not order them to be delivered up, nor can an action be maintained for them. The attorney has also the same *lien* on any money recovered by his client which comes to his hands in the character of his attorney. As a further security to the attorney, his client is not permitted to discharge him and substitute another without obtaining the leave of the court or a judge's order for that purpose, which is never granted except upon the terms of paying the first attorney's bill. (See Bac. *Abridgment*, tit. *Attorney*, 7th ed.; Archbold's *Practice*, by *Chitty*.)

ATTORNEY, LETTER OR POWER OF. [Letter, or Power of Attorney.]

ATTORNEY-GENERAL. The attorney-general is a ministerial officer of the crown, specially appointed by letters-patent. He is, in principle, nothing more than the attorney for the sovereign, and occupies precisely the same relation that every other attorney does to his employer. The addition of the term 'general' to the name of the office probably took place in order to distinguish him from attorneys appointed to act for the crown in particular courts, such as the attorney for the Court of Wards, or the master of the Crown Office, whose official name is 'coroner and attorney for the queen' in the Court of Queen's Bench. By degrees the office, which has usually been filled by persons of the highest eminence in the profession of the law, has become one of great dignity and importance. The duties of the attorney-general are to exhibit informations and conduct prosecutions for such heinous misdemeanours as tend to disturb or endanger the state; to advise the heads of the various departments of government on legal questions; to conduct all suits and prosecutions relating to the collection of the public revenue of the crown; to file informations in the Exchequer, in order to obtain satisfaction for any personal wrong committed in the lands or other possessions of the crown; to institute and conduct suits for the protection of charitable endowments, in which the sovereign, as *parens patriæ*, is entitled to interfere; and generally to appear in all legal proceedings, and in all courts, where the interests of the crown are in question.

The precise rank and precedence of the attorney-general have frequently been the subject of discussion and dispute; the early history and origin of this office, upon which the question in a great measure depends, being matter of great obscurity. There is no doubt that at all times the king must have had an attorney to represent the crown in the several courts of justice; but in early times he was probably not an officer of such high rank as the attorney-general of the present day. There are no traces of such an officer till some centuries after the conquest; and it is clear that, until a comparatively late period, the king's serjeant was the chief executive officer for pleas of the crown. (Spelman, 'Gloss.' tit. 'Serviens ad legem.') In the old form of proclamation upon the arraignment of a criminal, the king's serjeant was, till very lately, always named before the attorney-general; and previously to the Commonwealth he invariably spoke before him in all criminal prosecutions, and performed the duty of 'opening the pleadings,' which since the Commonwealth has always been done by the junior counsel. In the reign of James I. a curious altercation between Sir Francis Bacon, who was then attorney-general, and a serjeant-at-law, upon this subject, is related in Bulstrode's 'Reports,' vol. iii. p. 32, upon which occasion Lord Coke, who was then chief justice, said that "no serjeant ought to move before the king's attorney, when he moves for the king; but for other motions any serjeant-at-law is to move before him." He added, that when "he was the king's attorney, he never offered to move before a serjeant, unless it was for the king."

All questions respecting the precedency of the attorney-general and the serjeants were terminated in 1811 by a special warrant of his late majesty, George IV., when Prince Regent, by which it was arranged that the attorney-general and the solicitor-general should have place and audience at the head of the English bar.

A discussion arose in 1834, at the hearing of a Scotch appeal in the House of Lords, upon the question of precedency between the attorney-general and the lord advocate of Scotland, which was finally decided in favour of the former.

There is an attorney-general for each of the Duchies of Lancaster and Cornwall, and for the County Palatine of Durham.

ATTORNMENT is defined by Lord Coke to be 'an agreement of the tenant to a grant of a seigniory, rent, or manor, or of the donee or lessee to a grant of the reversion or remainder.' For originally, as the tenant could not alien without consent of the lord, so the lord could not alien without consent of the tenant. An attornment, as this consent was called, was, therefore, necessary in all conveyances of a manor, services, remainder or reversion which operated by the common law: for in such case, if there was no attornment, the grant was void. But by the statute 27 Hen. VIII. c. 10, an attornment was not necessary where the estate passed by way of use: and now, by the statute 4 & 5 Anne, c. 16, ss. 9, 10, and 11 Geo. II. c. 19, s. 11, both the necessity and efficacy of attornments, as regards the lord's estate, have been almost entirely taken away. It is a forfeiture for a tenant for years to attorn or pay rent to a stranger. (Comyn, *Digest*; Co. Litt. 309, a; Blackst. *Comm.*, Mr. Kerr's ed. vol. ii. 71, 269.)

ATTRACTION (from two Latin words *ad* and *traho*, signifying *to draw towards*), a term the meaning of which has been obscured by the verbal disputes of a century and a half. It denotes, generally, the power or principle by which all bodies mutually tend towards each other, without regard to the cause or kind of action, which may be the means of producing this effect. We shall here confine ourselves to the *general* action of attraction, and for *particular* cases, refer to articles Electrical Attraction, Capillarity, Osmose, &c.

Anaxagoras, B.C. 500, is said to have been the first who applied the idea of attraction to the heavenly bodies, supposing that they all revolve round the earth; and in this he was followed by the chief atomists [Atoms]. The first of the moderns, who had correct ideas on this subject was Copernicus, the restorer of the Pythagorean system of the universe, who considered *gravity* as "a certain natural *appetence* impressed on matter." Kepler, too, calls gravity "a corporeal and mutual *affection* between bodies," adding that the tides are caused by a *virtus tractoria quæ in luna est*. The first person in this country who revived the doctrine of attraction was Dr. Gilbert of Colchester, and the next was Lord Bacon. It was Dr. Hooke, however, who, before Newton's time, perfected most the theory of this subject, showing not only the facts, but in a general way the law also, of attraction (which he called a *conatus accedendi*). The true law however, that of the inverse square of the distance, was discovered by Newton, who about the year 1666, being driven from London by the plague, was led by circumstances to discover it by mathematical investigation.

Attraction may be divided into two kinds (1), that which acts only at insensible or *infinitesimal* distances; this kind of attraction existing between atoms manifests itself in several ways, (i.) as Chemical Affinity [CHEMICAL AFFINITY]; (ii.) as CRYSTALLIZATION, which may be considered as a *polarity* in molecular aggregation, (iii.) as ADHESION and COHESION, under which may be included the phenomena of CAPILLARITY; and (2) that which acts at *all* distances however great; this is manifested chiefly in the phenomena of GRAVITATION, but also in ELECTRICAL, MAGNETIC, and other attractions. In the present article we shall speak chiefly of *Adhesion* and *Cohesion*, referring to other articles for the rest.

All attractive forces, whether exerted between atoms or masses, obey the general law mentioned above, namely,—the attractive force is inversely as the *squares* of the distances between the attracting bodies. This is exemplified by the following table:—

Distance.	1	2	3	4	5	6	7	8	9	10	&c.
Intensity of attraction.	1	$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{16}$	$\frac{1}{25}$	$\frac{1}{36}$	$\frac{1}{49}$	$\frac{1}{64}$	$\frac{1}{81}$	$\frac{1}{100}$	&c.

When two smooth surfaces of the *same* substance are pressed together, they *cohere*. This *cohesion* is very evident, if we take plates of lead, or of glass, which will remain so firmly united, that in many cases they may be worked as one single piece. *Adhesion*, on the contrary, is said to take place between two surfaces of *different* substances, such as a solid and a liquid. Thus, when a liquid *wets* a cup, &c., it is said to *adhere*, and *not* to *cohere* to the cup. The force of this adhesion may be measured approximately by the method of Guyton and Quetelet, who, with Gay-Lussac, have studied this subject. They formed discs of various substances, and placed them as counterpoises to one scale-pan of a balance. They then allowed the disc to fall gently on the surface of some liquid, to which it adhered with some force, this force being then measured by placing weights in the opposite scale-pan until the force of adhesion was just neutralised, and the disc flew up from the liquid. By this process they obtained the following results:—

Metal Discs, 1 in. in diameter.	Force of adhesion to Mercury in grs.	A Glass Disc, 4·6 in. in diameter adhering to	Force of adhesion in grains.
Gold	446	Water	414·7
Silver	429		
Tin	418	Alcohol of	
Lead	317	(i) Sp. gr. = ·8196	477·4
Bismuth	372	(ii) Sp. gr. = ·8595	505·1
Zinc	204	(iii) Sp. gr. = ·9415	569·8
Copper	140		
Antimony	126	Turpentine Sp. gr. = ·8695	523·6
Iron	115		
Cobalt	8		

The force of *Cohesion*, on the other hand, has been approximately measured by observing the size and weight of the *drop* which any liquid forms when suspended on the end of a rod.

When two bodies, both of them capable of motion, attract one another, it is easily demonstrable by mathematical reasoning, that they will mutually move towards one another, and will meet in their centre of gravity; this point being, of course, nearer to the larger body, if they are homogeneous. Hence the smaller body will have a greater velocity communicated to it by the attractive force, and we shall find that the law of attraction may be expressed as depending not only on the distance, but also that it varies *directly* as the product of the masses of the bodies; so that, if M and m be the masses, and r the distance between them, the force of attraction will be $= \frac{\text{M}m}{r^2}$.

In order rigidly to test these laws, various experiments have from time to time been instituted. Thus, it is plain that any large body brought near to a smaller one, must cause, according to this law, a motion in the smaller body much greater than that in the larger one. This is well seen in the celebrated experiment of Cavendish, described in the 'Phil. Trans' for 1798. It was this: If we balance one ball of lead by another on a horizontal lever, no horizontal oscillation takes place; but any little disturbance makes the lever turn completely round again and again, till friction restores the equilibrium. Cavendish balanced two balls of lead very nicely on a lever, which he suspended by a thread. A firm stand was provided, and the whole was inclosed in a wooden case, to prevent agitation by the air, inserting only a telescope and a lamp on one side. When the apparatus was firm and no motion was perceived in the interior pendulum, other leaden balls of considerable size were suddenly presented, outside the case, to each end of the lever, whereupon horizontal oscillations immediately began in the lever like those of a pendulum upon the earth—such oscillations as would take place if the balls attracted one another. He observed the duration of these oscillations; and thence, knowing the duration of the oscillation which the earth creates in a pendulum, and also knowing the relative densities of lead and water, he ascertained that if the commonly received law of attraction be correct, the earth's average density must be $5\frac{1}{2}$ times as great as that of water. Hutton, on recalculating his result, found reason to think the $\frac{1}{2}$ should be $\frac{1}{10}$.

It is evident that if matter attract matter, a mountain contiguous to a plumb-line or a spirit-level will, in a slight degree, alter the position of the former, or the surface of the latter. We can hardly expect to measure the trifling displacement by direct means; but since the instruments alluded to are the *regulators* of some astronomical instruments, it is plain that a false plumb-line or level may show itself by giving false positions to the stars. And it is well known that the mean of a number of observations detects very small instrumental errors. Bouguer, in Peru, suspected that the proximity of Chimboraço affected his plumb-line; and even detected an error of a few seconds which he could in no other way explain: but his results remain unverified. In 1772, Maskelyne (one of the best observers of his time) proceeded to Scotland, to try the effect of Schehallien. He made a great number of observations both north and south of the mountain; for he argued that since the plumb-line, if disturbed, must tend towards the mountain in both cases, the discordance he sought would be doubled, and more easily perceptible. He found in this way, that the north plumb-line and the south plumb-line made an angle of $11\frac{1}{2}''$ more than could be explained by the difference of latitude of his two stations. Hutton, on calculating the mean density of the earth from this result, found it five times as great as water: a result very nearly that afterwards produced by Cavendish, when it is considered that both the mean density and form of such a mass as Schehallien could not be very accurately determined.

In 1810, Baron Zach undertook a similar labour, in which he employed a different instrument, and a different method of verification. He was carrying on a trigonometrical survey in the neighbourhood of Marseille, and he had three small observatories near Mount Mimet, north of that town. He measured on the earth their position with respect to other stations too distant from the mountain to be sensibly affected, and he then obtained the latitude of his observatories by astronomical observation on the spot. All three, without exception, gave a difference of $2''$ between the geodesical and astronomical latitudes, and in all the observed latitude was greater than the measured, being the sort of effect which would be produced by attraction in the mountain. M. Zach published the fullest detail of his method, and all the observations, in his 'Attraction des Montagnes,' Avignon, 1814. For details of Maskelyne's measurements, see Hutton's 'Tracts,' vol. ii., and 'Phil. Trans.' 1778.

According to the common notion entertained of matter, it is solid, or at least composed of particles which come into absolute contact. If we could substantiate the first supposition, it would still be apparent that the term *force of solidification* must take the place of *force of cohesion*, and give rise to inquiries into its quantity and mode of action: and even if we could imagine absolute contact of particles, we should find it necessary to append a notion of some force by which particles in contact remain in contact when some of them are put in motion, so as to draw the rest after them. But the balance of probabilities is very strong indeed against the supposition that matter is composed of particles in contact; so much so, that we are almost entitled to conclude it to be composed of particles separated by interstices of much greater dimensions than the particles themselves. If any one should assert the particles of the densest matter to be as far apart in proportion to their bulk as the bodies of the solar system, it would be impossible to bring any direct evidence in contradiction.

Such being the case, we may ask—1. What is the force of cohesion? for such a force there certainly is. 2. What is that law of action by which the particles of bodies are not drawn into absolute contact, but compelled to remain separate, and yet prevented from separating indefinitely?

With regard to the first question, it is most probable that as two bodies approach each other, a strong repulsive force is the cause of the first phenomenon which is perceived. When one billiard ball strikes another, we have no evidence, except that of our senses, of absolute contact taking place; that is to say, we only know that the first visible action takes place when the distance of particles is too small for the eye to perceive. All the evidence which is at all conclusive, is against the supposition of such contact being produced: and we are obliged to admit that our explanation must end in the statement that, arise from whence it may, there is a power in matter by which other matter is repelled, and which begins to act before contact has taken place. But if two pieces of solid matter be pressed together with great force, it would seem as if the particles would thereby be brought within a degree of nearness at which an attractive force begins to act. Two bits of lead pressed together remain in coherence even in a vacuum; and metal plates can be hammered together until the cohesion is as strong as if they had been naturally united.

The cohesive force is an absolute phenomenon, but if we suppose the particles of matter not in contact, it then becomes necessary to admit a new repulsive force, of which the sphere of action is interior to that of the cohesive force. Complete interstices can only exist upon the supposition that, at a certain distance, the cohesive force is destroyed, or at least overcome, by a counterbalancing repulsion. From the known effects of heat, it is supposed that *caloric*, a name which indicates the cause of heat, plays a prominent part in the production of the repulsion. Nothing positive, however, has yet been established on this subject: we can only make use of phenomena as they exist, to overturn the common impressions, by means of which *force*, the great agent of the universe, meaning the cause of visible display of motion excited or motion prevented, is postponed to notions of *matter*, or *impenetrability*, or similar words, which, if made accurate by close attention, and freed from such latent assumptions as arise from the unassisted senses, will be found to amount to the same idea.

The arguments against absolute contact are almost insuperable: if we yield to them, we are immediately obliged to admit that particles really act on each other at a distance. Nor will any suppositions as to caloric afford us the means of avoiding such a conclusion. If caloric be matter, we must first explain *its* cohesion or repulsion before we can apply it to explain that of other matter: if caloric be not matter, we gain nothing in the way of avoiding difficulty; for an agent which is not matter, but something else, with new properties superadded to the common and visible properties of matter, is as difficult as ordinary matter with the express addition of power over other matter at a distance. And it must be observed, that if we are rationally compelled to allow such power to a particle upon a particle, there is no new difficulty in the attraction of *gravitation*. If A can act upon B at the millionth part of an inch, there is no *à priori* difficulty in the notion that two A's together can act on B at twice the distance with as much visible effect as a million of A's collected can act at a million of times the distance, and so on. It must not, however, be supposed that we mean to infer that gravitation and cohesion are both referable to the Newtonian law of attraction, although this has been since reduced to more than a possibility. This remarkable addition to the nascent theory of molecular forces is the work of O. F. Mossotti, and was published in a pamphlet entitled 'Sur les Forces qui régissent la constitution intérieure des corps, aperçu pour servir à la détermination de la cause et des lois de l'action moléculaire,' Turin, 1836, 4to. This paper is translated in Taylor's 'Scientific Memoirs,' vol. i.; and Mr. Pratt, in the second edition of his 'Mechanical Philosophy,' observing that Mossotti's analysis, though conducted with an ultimate view to complex application, is really, for the present, only applied to simple cases, has given the mathematical view necessary to include those simple cases and no more, in a perfectly sufficient manner.

The observed facts are, that particles which are very nearly in contact with one another repel each other in a manner which certainly depends, among other things, on the temperature; but that at a certain distance they cease to repel, and begin to attract each other, and that with considerable force; at a still greater distance that attraction becomes comparatively feeble, and coincides with what is called the attraction of gravitation, varying inversely as the square of the distance. That this attraction of gravitation, and no other, exists at ordinary sensible distances, is fully proved by the Cavendish experiment.

Many hypothetical laws might be constructed which fulfil all these conditions; but the great interest of Mossotti's investigation, and perhaps much of its value, consists in his having taken a theory actually existing, imagined upon grounds with which his views had no necessary connection, and upon his having given a basis of the utmost simplicity to the numerical law on which he proceeded. This basis is no other than that all molecular attractions and repulsions vary inversely as the squares of the distances.

When Æpinus explained Franklin's electrical theory, his hypothesis was that the particles of matter repel one another, and also the particles of the electrical ether, which he supposed to exist and to be attached to particles of ordinary matter. But he supposed the particles of ether to attract the particles of matter; so that of the two species of particles, called matter and ether, each repels the particles of its own kind and attracts those of the other. Æpinus even went so far as to suppose that the attraction of gravitation might be a necessary consequence of such a theory, on the supposition that the attraction of the matter and ether was a little greater than the repulsions. So far Mossotti has adopted his views; but, by applying mathematical analysis, he has shown what Æpinus could not have had the least reason to suppose, namely, that attraction of cohesion, the repulsion which takes place when the distance is smaller than that of cohesion, and the attraction of gravitation, which exists at distances too great for cohesion, are all to be found among the consequences of this theory.

If there exist in space molecules of matter which repel each other, in a fluid or ether of which the particles also repel each other, while the particles of the matter attract those of the ether, it is obvious that each of the particles of matter will, by its attraction, collect about it a condensed atmosphere of ether. If the attractions and repulsions be all inversely as the squares of the distances, Mossotti finds that, in consequence of the atmospheres of ether, two molecules at a distance r (the attraction of the particles of matter for those of ether being presumed a little, and but a little, greater than the repulsion of the particles of matter from each other) will repel each other with a force represented with great approximation by the formula

$$\frac{A(1+\alpha r)\epsilon^{-\alpha r}-B}{r^2},$$

where A, α, B, are certain positive constants. To make the results agree with observed facts, α must be considerable, and A much greater than B. When the formula is positive, repulsion is represented; when negative, attraction. When r is very small, the formula is positive, and represents repulsion; when r increases to a certain value, it vanishes, and afterwards becomes negative: at the value of r just mentioned there is stable equilibrium. As r still increases the attraction increases, becomes a maximum at another certain value of r, and afterwards, if α be considerable, diminishes as the inverse square of the distance, or in a ratio incomparably near to it. All this agrees with the facts of observation, and with the numerical law of the facts as far as we know it; to which it must be added that an increase of the density of the ether would increase the distance at which particles are in equilibrium, which is generally done by increase of temperature.

We may also make it apparent to the mathematician that laws of attraction may very easily be expressed which shall combine the leading circumstances connected both with gravitation and cohesion in one formula. Let us suppose, for instance, that at the distance r, the accelerating force of two equal particles on each other is expressed by

$$\frac{a}{r^m}\left(1-\frac{b}{r}\right)\left(\frac{c}{r}-1\right)+\epsilon^{-\frac{m}{r}}\,\frac{n}{r^2}$$

positive values denoting attraction, and negative values repulsion. If a and m be made sufficiently small, the first term may be made insensible at all finite distances, and the second as near as we please to the Newtonian law. But when r is very small, the second term becomes insensible, and such a value may be given to n that the first term shall be of sensible value, as follows: Let c be greater than b, both being quantities of that order of smallness at which the Newtonian term becomes insensible. Then when r is little greater than c, the first term is negative; when r lies between c and b, it is positive; and when r is less than c, it is negative again.

The solid, fluid, and gaseous states of matter show the rise and progress of a repulsive force generally produced by the action of heat. In the first, the particles absolutely attract, in the third they absolutely repel, each other; but in the second the repulsive force almost counterbalances the attractive force, leaving only enough to create that weak degree of cohesion which exists in fluids, or at most that semi-cohesion which is observed in bird-lime, in gum-water, and the like. The transition from complete solidity to the gaseous state appears to be made through various degrees of fluidity, and the gradual hardening of melted sealing-wax is a familiar instance of a part of the gradation.

We now come to the question how the attraction of the particles of one heavenly body on those of another is established. For details of this very extensive subject, see GRAVITATION. The *resumé* of the argument is this: the phenomena which *do* take place in the heavens are those which common and undisputed mechanical and mathematical reasoning show *would* take place if the Newtonian law be true. This law is, that the force of attraction is *inversely* as the squares of the distances between the attracting bodies. Now, every phenomenon of importance has been gradually brought under the consequences of this law by various analysts. To recount instances would be to make a summary of astronomical terms; but we will select one, which, in one sense, is the most dubious, namely, the phenomena of the tides. For, whereas the place of the moon or a planet is predicted within from half a second to a second of time, the time of high water cannot yet be predicted within some minutes, at least in a port. How much this phenomenon may be affected by winds or the nature of the coast, is not difficult to conceive; but the following result is a striking specimen of accordance between theory and fact. If the tides proceed from Newtonian gravitation, the mean *tide-day*, or interval between successive times of high water, must be equal to the time between the moon's coming on the meridian above and below the horizon, or, roughly speaking, two tide-days make a lunar day. It is found by analysis, that if the Newtonian theory be true, the average tide-day must be exactly equal to half the average lunar-day, though particular instances of the two may differ many minutes. This is found to be the fact: for if the tide-day were more than half the lunar-day by as much as one-tenth of a second on the average, that is, if the tides lagged, one with another, by $\frac{1}{10}''$ daily, two thousand years would have seen high water at every possible part of the lunar-day. But for two thousand years it has never been denied that high water takes place at every port within a certain time (usually less than four hours) of the moon's coming on the meridian. Again, a permanent retardation would, in course of time, bring high water when the moon was precisely on the meridian, for a long succession of days together: a result which never has been observed, and which, according to the Newtonian theory, is impossible. [ACCELERATION OF TIDES.]

An immense number of accordances between theory and observation, and there being no assignable discrepancy whatsoever, of any considerable amount, form the nature of the proof of the Newtonian law. And it must be observed that this has not been done in a day, or by one person, but during more than a century and a half, and by philosophers of several countries—not by men prejudiced in favour of Newton, but the contrary; for it was long before his doctrines found their way over to the continent, and the dispute about the invention of fluxions had laid the foundations of a strong anti-Newtonian prejudice. We may observe, also, that England, where the veneration of Newton amounted almost to idolatry, has done much less towards the development of his system than either France, Germany or Italy; so that the Newtonian system was really fully established by those who had every national and personal bias to endeavour to overturn it. This it is necessary to state, because it is frequently asserted that the prevailing system is sustained by the name and authority of Newton.

We shall now give some account of the disputes about the word attraction; but, first, we shall show how it was used by Newton. In his 'Optics,' he says, "*attraction* may be performed by impulse, or some other means. I use that word, to signify any force by which bodies tend towards one another." In his 'Principia,' he thus speaks of *gravity:* "Thus far I have explained the phenomena of the heavens and the sea by the force of gravity; but I have *not yet* assigned the cause of gravity . . . . The reason of these properties I have *not yet* deduced from phenomena, and I do not invent hypotheses. For whatever is not deduced from phenomena is called *hypothesis;* and hypotheses, be they metaphysical, physical, of occult qualities, or mechanical, have no place in experimental philosophy . . . . It is enough that gravity really exists, and acts according to laws laid down by us; and suffices to explain all the motions of the heavens and the sea."

The repeated use of the words *not yet* (*nondum*), would lead us to suppose that Newton thought that the cause of attraction might be discovered; and the sentence next following our preceding quotations shows that he leaned towards the notion of a highly subtle fluid, which was afterwards the *hypothesis* of those who constituted him their opponent: "Something might be added about that most subtle spirit which pervades and lies hid in all dense bodies; by force and action of which the particles of bodies mutually attract at the smallest distances, &c. . . . But this cannot be explained in few words; neither is there a sufficient number of experiments by which the laws of action of this spirit can be accurately determined and shown." ('Principia,' Schol. Gen. at the end).

Again, in the Optics, Newton dwells upon the same distinction between a phenomenon and its cause, and says that attraction may be caused by an impulse or some other unknown cause. But once for all, both against Newton and his opponents, we must observe, that an invisible fluid leaves the difficulties of the question where it found them. If this fluid have the common properties of matter, what is there to explain the mutual repulsion of its particles? Must they have a fluid to cause that phenomenon, and so on *ad infinitum,* or must an unknown cause of repulsion take the place of an unknown cause of attraction?

Leibnitz called attraction an *occult quality,* and *a miracle.* The first term was the horror of the continental philosophers about his time. Their predecessors had attributed various properties to matter which could not be proved by experiment, which were justly called *occult* (or hidden). In their desire to be rid of all such, succeeding philosophers would not only abolish the qualities of matter which they had invented, over which of course they had absolute power, but they tried also to abolish their own ignorance of the causes of the *sensible* qualities of matter. They would not have *occult* causes, and Leibnitz plainly confounds *occult* quality with *occult* cause. But it is needless to dwell upon the fact that the ultimate causes of all qualities are occult. When Newton adopted the word attraction, he did not take up and fix the meaning of a word which till his time had been ambiguous; still less, as some have asserted, did he retain a mystical meaning, which his followers afterwards cleared from absurdity. At and before the time of Newton, the word attraction was frequently used; for example, in the English translation of J. B. Porta, 1658, where to "attract" is used for to "draw forth," in opposition to "compound" or "lay together." But the philosophic use of the word is more conspicuous in Sir K. Digby's 'Treatise on Bodies,' 1669, where it is said that wherever "the first cause of the motion proceeds from that body towards which the motion is made," the effect is "properly called attraction," which is illustrated by the case of fire and air, in which, though there is an intermediate cause assigned by himself—namely, that the fire rarefies the contiguous air, which therefore ascends, and the surrounding air rushes in to supply its place—the author says that the fire *attracts* the air.

The objections made to the Newtonian attraction have been, with one or two exceptions, the work of those who had obviously not read Newton, or any geometrical work on the subject. We must take them in classes, and describe them as far as our limits will allow us to do.

1. We have those contained in axioms, which are either unproved or unmeaning, such as "*matter* cannot *act* where it *is* not." Those who bring this forward should explain the three hard words which they have put in italics; and we should then see whether this be self-evident or not. They should also remember that the celebrated immaterialism of Berkeley is, in several ways, an attack upon the word *matter* of exactly the same kind of argument as their own upon *attraction;* so that, in fact, they must assume a principle as to *matter* which they immediately proceed to oppose as to *attraction.* [BERKELEY, in BIOG. DIV.; IMMATERIALISM.] Again, in speaking of the place where matter *is,* they assume that the boundary of impenetrability is the same as the boundary of colour; a thing not only unproved, but from several circumstances unlikely.

2. We have those who would substitute pure hypothetical causes, such as Newton declines entering into, to explain the phenomenon of attraction. One writer requires no more than that all bodies should be composed of two distinct sets of particles, the one set of water, the other of some volatile fluid from which he thinks he deduces attraction; another is satisfied with an efflux and reflux of a fluid from and to the sun, to cause what he denominates the centripetal and centrifugal forces: evidently confounding the nature of the two in a manner which could not have been done by any person who had read Newton. A third fills the whole universe with streams of matter which are always passing through every point in every direction. On all these we shall only observe, that, in their attempts to produce an explanation of the phenomenon, they admit the phenomenon itself, which is all that Newton contended for.

3. We have those who leave out of view the main fact, that Newton explains phenomena as they really are, and who treat the *results* as hypothetical, as well as the *principle.* "Let the idea," says one writer, "of particles of matter attracting each other be impressed upon the mind, and it will then dilate upon their mutual actions, calculate the density of substances composed by them, whirl them at pleasure in empty space, and show in what manner their motions will be disturbed by the actions of each upon the other." But it is here forgotten that the "whirls" alluded to were not made "at pleasure," but they were "whirls" actually taking place, which were examined in order to see how they did whirl. Newton laid by his theory of attraction for years, as a forgotten thing, because he found that, with the received notions of the earth's magnitude, it would not give the moon the motion which she is actually found to possess: it was only when he received the more accurate measurement of Picard that he resumed his inquiry. Did he whirl his planets "at pleasure?"

4. Another class of objectors cannot conceive how attraction can be, and therefore they reject it. This argument is wholly unanswerable, because it is impossible to see on what part of the subject it bears, or how it is shown to be unreasonable to admit nothing as proved, except what can be conceived and accounted for. Nothing, except an absolute contradiction in terms, can be rejected on this ground.

5. All the above objections have been at one time or other advanced by men of knowledge: there remains one class more, namely, that of men, who, being ignorant of mechanics, deduce from wrong reasonings results which are not found in the heavens, on which they deny the truth of the principle. To this class, we are happy to say, personal aspersion, and imputations of intentionally misleading others, have been for the most part confined. The common mistake is a confusion between the words *velocity* and *force;* being much the same as if they confounded the drops which are pouring into a cistern for the time being, with the whole body of rain in the cistern itself. We quote another instance. A certain traveller remarks that it cannot be that the sun attracts a planet, at the very time when the planet is flying off from it. "What more could it do, if it were really repelled?" He does not see that the same argument applies to a stone thrown up into the air; and moreover, that what it could do more, if really repelled, would be to describe a *convex* curve, instead of one always *concave* towards the centre of force. To those who have any acquaintance with mechanics it is unnecessary to say anything upon such objections: to others who have not, we recommend, if they form an opinion upon this question, which it is noways necessary they should do, to follow either those who have studied it, or those who have not, whichever they have found most advantageous in the common business of life.

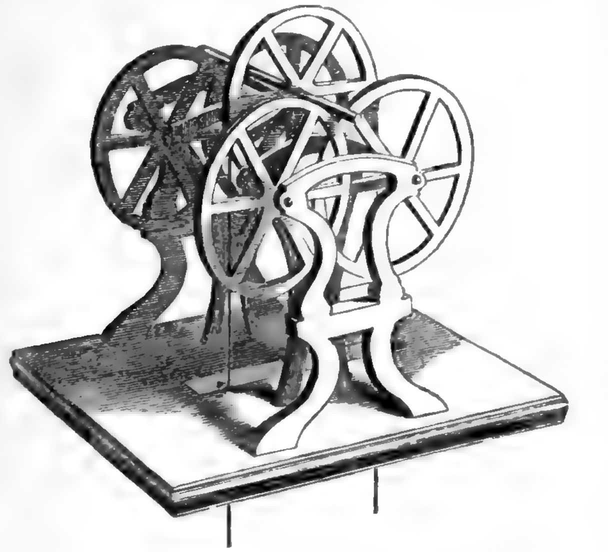
ATTRACTION, ELECTIVE. [CHEMICAL AFFINITY.]

ATTRACTION, ELECTRICAL. [ELECTRICITY.]

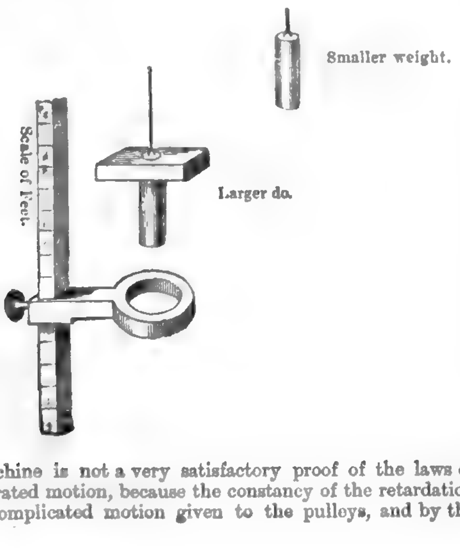
ATTWOOD'S MACHINE. When a constant or uniform force acts upon a mass, it produces equal accessions of velocity in equal times, and the whole distances described are as the squares of the times; that is, whatever length is described in the first second, four times as much is described in the first two seconds, nine times as much in the first three seconds, and so on; that is, the length described during the first second being called 1, that described during the second second is 3, that during the third 5, and so on. [ACCELERATING FORCE.] Where the weight of a mass is the pressure applied, and the *mass itself only* is moved,—that is, where a body falls freely *in vacuo,*—the velocity created in every second is found to be $32\frac{1}{6}$ feet, and the spaces described in successive seconds are $16\frac{1}{12}$ feet, three times $16\frac{1}{12}$ feet, five times $16\frac{1}{12}$, &c. These are distances too great on which to try experiments; and Attwood's machine is a method of contriving systems which shall move under constant forces of less amount, so that the space described during four or five seconds shall not require a very great fall. The principle made use of is one which is well known in mechanics, namely, that if a pressure A, acting uniformly upon a mass B, produce a certain velocity per second, it will only produce half that velocity when acting on a mass twice as great as B, &c., and will produce twice as much velocity in a mass half as great as B, &c. Suppose, for instance, weights of six and seven pounds hang over a pulley, the weight and friction of which are for the present neglected; if both weights were six pounds, the machine would not move: therefore, the moving pressure is the one pound by which the one weight exceeds the other. This weight, if it had only its own mass to move, or if it fell freely, would generate $32\frac{1}{6}$ feet of velocity per second; but before this system can move, $6+7$ or 13 pounds must be stirred by 1 pound, and there will only be the 13th part of $32\frac{1}{6}$ feet of velocity produced in one second—that is, about $2\frac{2}{5}$ feet. Therefore, in one second, the heavier weight will fall only $1\frac{1}{5}$ foot; and in 5 seconds, 25 times as much, or 30 feet. And the velocity acquired may be reduced in any proportion, by making the weights more nearly equal.

Attwood's machine is a pulley, the pivots of which, instead of being placed in a block, are sustained on FRICTION WHEELS (which see), to diminish the friction. Two weights are hung over this by a string, and the mass moved consists of the two weights, the pulley, and the friction wheels. But it is proved in mechanics that the effect, both of having the mass of the wheels to move, and of the friction, is a constant retarding force: for instance, in the preceding illustration, the machine might be so constructed that the effect should be to make the system move as if the larger weight were $6\frac{1}{4}$ pounds instead of 7, and the pulley were without density and friction. The velocity can be so far reduced as to render the resistance of the air insensible.

The length described in any time is measured by a vertical scale of feet, placed close to the line of motion of one of the weights. There is also a pendulum beating seconds in an audible manner. To measure the velocity acquired at any point, the moving pressure (the excess of

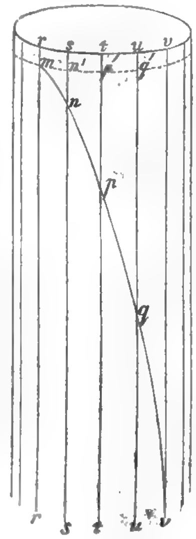


one weight above the other) must be taken off, in order that there may be no fresh accession of velocity, or that the system may proceed only with the velocity acquired. This is effected by making the larger weight in two parts, one part equal to the smaller weight, and the other of course to the excess or moving pressure. The latter is so formed that it cannot pass through a certain ring, while the former can. By fixing this ring to any required point of the scale of feet, the moving pressure is taken off when the larger weight passes through it.



Attwood's machine is not a very satisfactory proof of the laws of uniformly accelerated motion, because the constancy of the retardation caused by the complicated motion given to the pulleys, and by the friction, is a more difficult experimental fact than the one to be proved. Of the four principles,—1, the law of uniformly accelerated motion; 2, the constancy of the retardation caused by the having to communicate every acceleration also to the pulley and friction wheels; 3, the constancy of the retardation arising from friction; 4, the smallness of the resistance of the air to small velocities,—this machine may be made to prove any one to a spectator who admits the other three.

In Attwood's machine, a body falling freely is not observed, but one in which the descent is diminished in a known proportion. In an apparatus constructed by Morin, the actual descent of the falling body is exhibited and analysed in an ingenious manner. This apparatus consists of a cylinder moving on a vertical axis at a uniform rate by means of clockwork. Parallel with the axis of the cylinder are two wires, which serve as guides to a small cylindrical weight, which carries a pencil with its point pressing gently against the surface of the cylinder. There is a contrivance for detaching the weight, and also for letting it fall. Now it is evident that if the cylinder were at rest, the pencil in descending would simply trace a vertical line on its surface, while if the cylinder revolve and the pencil be at rest, it would trace a horizontal circle round it. If, however, while the cylinder is revolving on its axis at a uniform rate, the weight carrying the pencil be allowed to fall, the pencil will trace a curved line round the surface of the cylinder, and if the surface of the cylinder be divided into equal parts by the vertical parallel lines *r r*, *s s*, *t t*, &c., the intervals between the moments at which these parallels pass under the pencil will be equal, since the motion of the cylinder is uniform. Hence the vertical space through which the weight falls in the first interval will be *n' n*, in the first two intervals *p' p*, in the first three intervals *q' q*, and so on.



AUBAINE, the name of the prerogative by which the sovereigns of France formerly claimed the property of a stranger who died within their kingdom, not having been naturalised. It also extended to the property of a foreigner who had been naturalised, if he died without a will, and had not left an heir; as likewise to the succession to any remaining property of a person who had been invested with the privileges of a native subject, but who had quitted, and established himself in a foreign country. (See Merlin, 'Répertoire de Jurisprudence,' tom. i. p. 523.) It is called in the French laws, the 'Droit d'Aubaine.' Authors have varied in giving its etymology. Nicot ('Thresor de la Langue Françoyse tant ancienne que moderne,' fol., Paris, 1606) says it was anciently spelt Hobaine, from the verb *hober*, which signifies to remove from one place to another; Cujacius ('Opera,' fol., Neap. 1758, tom. ix. col. 1719) derives the word from *advena*, a foreigner or stranger; and Du Cange ('Glossar.,' v. Aubain) from *Albanus*, the name formerly given to the Scotch, who were great travellers. Ménage ('Dict. Etym.,' fol., Paris, 1694) says, some have derived the word from the Latin, *alibi natus*, a person born elsewhere, which seems the best explanation. (See also Walafridus Strabo, 'De Vitâ S. Galli,' l. ii c. 47.)

This practice of confiscating the effects of strangers upon their death was very ancient, and is mentioned, though obscurely, in one of the laws of Charlemagne, A.D. 813. ('Capitularia Regum Francorum, curante P. de Chiniac, fol., Paris, 1780, col. 507, § 6.)

The Droit d'Aubaine was originally a seignorial right in the provinces of France. Brussel, in his 'Nouvel Examen de l'Usage général des Fiefs en France pendant le xi., le xii., le xiii., et le xiv. siècle,' 4to, Paris, 1727, tom. ii. p. 944, has an express chapter, 'Des Aubains,' in which he shows that the barons of France, more particularly in the 12th century, exercised this right upon their lands. He especially instances Raoul, Comte de Vermandois, 1151.

Subsequently however it was annexed to the crown only, inasmuch as the king alone could give the exemption from it, by granting letters of naturalisation.

Various edicts, declarations, and letters patent relating to the Droit d'Aubaine, between the years 1301 and 1702, are referred to in the 'Dictionnaire Universel de Justice' of M. Chasles, 2 tom. fol., Paris, 1725; others, to the latest time, are given or referred to in the 'Code Diplomatique des Aubains,' par J. B. Gaschon, 8vo, Paris, 1818. The Duc de Levis, in his speech in the Chamber of Peers, when proposing its final abolition, 14th April, 1818, mentioned St. Louis as the first monarch of France who had relaxed the severity of the law (compare 'Etablissemens de S. Louis,' l. i. c. 3); and Louis le Hutin as having abolished it entirely in 1315 (compare the 'Recueil des Ordonnances du Louvre,' tom. i. p. 610), but, as it turned out, for his own reign only. Exemption from the operation of the Droit d'Aubaine was granted in 1364 by Charles V. in favour of persons born within the states of the Roman Church. Louis XI., in 1472, granted a similar exemption to strangers dwelling at Toulouse; and Francis I., in 1543, to strangers resident in Dauphiné. Charles IX., in 1569, allowed exemption from it to merchant-strangers frequenting the fairs at Lyon. Henry IV., in 1608, granted exemption to the subjects of the republic of Geneva. Louis XIV., in 1702, to the subjects of the Duke of Lorraine. (Chasles, 'Dict.,' tom. i. pp. 265, 267.) The Swiss and the Scotch of the king's guard had been exempted by King Henry II. (Bacquet, 'Traité de Droit d'Aubaine,' p. i. c. 7.)

Partial exemptions from the Droit d'Aubaine were frequently conventional, and formed clauses in treaties, which stipulated for reciprocal relief to the subjects of the contracting parties; these exemptions, it is probable, continued no longer than the peace which the treaty had procured, and some related to moveable goods only.

In the treaty of commerce between England and France, in 1606, the 'Jus Albinatûs,' as it is termed, was to be abandoned as related to the English: "ita ut in posterum aliquo modo jure Albinatûs fisco addici non possint." (Rhym., 'Fœd.,' tom. xvi. p. 650.) Letters-patent of Louis XIV., in 1669, confirmed in the parliament of Grenoble in 1674, exempted the Savoyards; and this exemption was confirmed by the Treaty of Utrecht in 1713. The inhabitants of the Catholic cantons of Switzerland were exempted by treaty in 1715. The particulars of numerous other conventional treaties are recorded in M. Gaschon's work, in the speech of the Duc de Levis already referred to, and in the 'Rapport' from the Marquis de Clermont Tonnerre to the French Chamber of Peers, printed in the 'Moniteur' for 1819, pp. 96–98.

Louis XV. granted exemptions, first to Denmark and Sweden; then, in the treaty called the 'Family Compact,' to Spain and Naples; to Austria, in 1766; to Bavaria, in 1768; to the noblesse of Franconia, Suabia, and the Upper and Lower Rhine, in 1769; to the Protestant cantons of Switzerland, in 1771; and to Holland, in 1773. In Louis XVI.'s reign, other treaties of the same kind were made with Saxony, Poland, Portugal, and the United States. The abolition of the Aubaine, as it related to Russia, was a distinct article of another treaty; and finally, by letters-patent, dated January 1787, its abolition was pronounced in favour of the subjects of Great Britain.

The National Assembly, by laws dated August 6, 1790, and April 13, 1791 (confirmed by a constitutional Act 3rd of September 1791), abolished the Droit d'Aubaine entirely. It was nevertheless re-established in 1804. ('Moniteur' for 1818, p. 551.) The Treaty of Paris, 30th of April, 1814, confirmed the exemptions from the Aubaine as far as they were acknowledged in existing treaties. The final abolition of the Droit d'Aubaine, as already mentioned, was proposed by the Duc de Levis, April 14, 1818, and passed into a law July 14, 1819, confirming the laws of 1790 and 1791. Foreigners can now hold lands in France by as firm a tenure as native subjects.

The Droit d'Aubaine was occasionally relaxed by the kings of France upon minor considerations. In the very early part of the 14th century, an exemption was obtained by the University of Paris for its students, as an encouragement to their increasing numbers. Charles V. granted the privilege in 1364 to such Castilian mariners as wished to trade with France. In 1366 he extended it to Italian merchants who traded to Nismes. The fairs of Champagne were encouraged in the same manner; and exemptions to traders were also granted by Charles VIII. and Louis XI. Francis I. granted the exemption to foreigners who served in his army; Henry IV. to those who drained the marshes, or worked in the tapestry-looms. Louis XIV. extended the exemption to the particular manufacturers who worked at Beauvais and the Gobelins; then to the glass-manufacturers who had come from Venice; in 1662 to the Dunkirkers, whose town he had acquired by purchase from England; and, lastly, to strangers settled at Marseille, that city having become the entrepôt of products from the Levant.

Ambassadors and persons in their suite were not subjected to the Droit d'Aubaine; nor did it affect persons accidentally passing through the country. Still, it was no small disgrace to the French law, that this barbarous custom should have so long remained among a people so highly civilised. Bouteiller, one of their own jurisprudents, who wrote as early as the 15th century, calls it "un Droit hayneux." ('Somme Rural,' fol., Lyon, 1500, fol. ii.)

That the Droit d'Aubaine existed in Italy, in the Papal States, in the 11th, 12th, and 13th centuries, seems established by Muratori, 'Antiq. Ital. Medii Ævi,' fol. Mediol. 1739, tom. ii. col. 14.

An extensive treatise on the Droit d'Aubaine has been already quoted in the works of Jean Bacquet, avocat de Roi en la Chambre de Thresor, fol., Paris, 1665. See also 'Memoires du Droit d'Aubaine,' at the end of M. Dupuy's 'Traitez touchant les Droits du Roy très Chrestien,' fol., Par., 1655; and the 'Coutumes du Balliage de Vitry en Perthois,' par Estienne Durand, fol., Châlons, 1722, p. 254. But the most comprehensive view of this law, in all its bearings, will be found in the 'Repertoire Universel et Raisonné de Jurisprudence,' par M. Merlin, 4to, Paris, 1827, tom. i., p. 523, art. 'Aubaine;' tom. vii., p. 416, art. 'Heritier.' The 'Moniteurs' of 1818 and 1819 contain abstracts of the discussions while the abolition was passing through the two chambers at Paris. See the latter year, pp. 314, 315, 509, 510, 728, 729. The chief passages in the former year have been already quoted.

AUCTION, a method employed for the sale of various descriptions of property. This practice originated with the Romans, who gave it the descriptive name of *auctio*, an increase, because the property was sold to him who would offer most for it. In more modern times, a different method of sale has been sometimes adopted, to which the name of auction is equally, although not so correctly, applied. This latter method, which is called a Dutch auction, thus indicating the local origin of the practice, consists in the public offer of property at a price beyond its value, and then gradually lowering or diminishing that price until some one among the company consents to become the purchaser.

The first-described mode of sale by auction was established by the Romans for the disposal of military spoils, and was conducted *sub hastâ*, that is under a spear, which was stuck into the ground upon the occasion. This expression was continued, and sales were declared to be conducted *sub hastâ* long after the spear was dispensed with. In the same manner, a company is in the present day invited to a 'sale by the candle,' or 'by the inch of candle,' with as little regard to actual practice. The origin of this expression arose from the employment of candles as the means of measuring time, it being declared that no one lot of goods should continue to be offered to the biddings of the company for a longer time than would suffice for the burning of one inch of candle; as soon as this rude kind of measure had wasted to that extent, the then highest bidder was declared to be the purchaser.

It is a common rule in law that no contract is binding without the assent of both parties. In sales by auction, the assent of the buyer is given by means of his bidding, while the assent of the seller is signified by the fall of a hammer; and until this declaration has been made, the intending purchaser is at liberty to withdraw his bidding.

It is a common practice for the owner of property offered for sale by auction to reserve to himself the privilege of bidding, and, as it is termed, buying in his goods, if the price offered by others should not suit his convenience. This practice was held by the civil law to be illegal, and even to partake of the nature of a fraud; and so lately as the time of Lord Mansfield, private biddings at auctions were so considered. In the present day, however, they are not only allowed by the law, but the legislature so far recognised the propriety of the practice, that in cases where the property had been bought in either by the proprietor or by his declared agent, who is in general the auctioneer, no auction duty was chargeable.

It has been laid down, that the buyer of goods at an auction cannot be held to the performance of his contract, in cases where he was the only *bonâ fide* bidder at the sale, and where *public* notice was not given of the intention of the owner of the goods to bid, even though his agent was authorised to bid only to a certain sum. This rule is intended to act as a protection to the public against the practice commonly resorted to by disreputable auctioneers, of employing persons to make mock biddings with the view of raising the price by their apparent competition: the persons thus employed are aptly called *puffers*. In many large towns, and more especially in London, many persons make a trade of holding auctions of inferior and ill-made goods; persons called *barkers* are generally placed by them at the door inviting strangers to enter, and puffers are always employed, who bid more for the articles than they are worth, and thus entice the unwary. Many ineffectual attempts have been made to put a stop to these practices.

The auctioneer is considered the agent of *both* parties, vendors and purchasers. In the language of the judges in a late case, "a bidder, by his silence when the hammer falls, confers an authority on the auctioneer to execute the contract on his behalf." He can therefore bind the parties by his signature according to the requisition of the Statute of Frauds, which renders it necessary in contracts of sale of 'lands or any interest in or concerning them,' and of goods above the value of 10*l*., that some 'note or memorandum should be signed by the parties or their agents lawfully authorised.' And such signature is *now* held sufficient even in an action brought by the auctioneer against the vendor in his own name. It has been doubted therefore, whether a bidder may not retract (in cases within the statute) at any time before the actual written entry. The auctioneer also stands in the situation of a stakeholder of the deposited part of the purchase-money, which he is not at liberty to part with till the sale has been carried into effect; and he cannot, at least after notice, discharge himself by paying over the amount to the vendor. From this peculiarity of his position it results that he is now not held liable for any interest on, or advantage which he may make from, the money in his hands. In this respect his situation differs from that of a mere agent, and also from that of one of the contracting parties (the vendor), from whom "interest is recoverable in the nature of damages for a breach of the original contract on the part of the vendor, by whose failure to make a good title the vendee has for a time lost the use of his money."—(Mr. Justice James Parke.) An auctioneer (like any other agent and trustee concerned in the sale of property) is forbidden to buy on his own account. And where he sells without disclosing the name of his principal, an action will lie against himself for damages on the breach of contract.

The conditions of sale constitute the terms of the bargain, and purchasers are bound to take notice of them. The late Lord Ellenborough said, that "a little more fairness on the part of auctioneers in framing particulars would avoid many inconveniences. There is always either a suppression of the fair description of the premises, or something stated which does not belong to them; and in favour of justice, considering how little knowledge the parties have of the thing sold, much more particularity and fairness might be expected." The conditions usually contain a provision that "any error or mis-statement shall not vitiate the sale, but that an allowance shall be made for it in the purchase-money." But this clause is held only to guard against unintentional errors, and not to compel a purchaser to complete the contract if he has been designedly misled.

The duties formerly levied upon goods and property sold by public auction, were repealed by the stat. 8 & 9 Vict. c. 15.

AUCTIONEER, a person whose profession or business it is to conduct sales by auction. It is his duty, previously to the commencement of every sale, to state the conditions under which the property is offered; to receive and to notify the respective biddings, and to declare the termination of the sale: for this purpose he commonly makes use of a hammer, upon the falling of which the biddings are closed.

The law holds that an auctioneer is authorised by the highest bidder or purchaser to sign for him the contract of sale; and that his writing down in his book the name of such purchaser, shall be sufficient to bind the latter to the purchase, provided no objection be made by him previous to such entry. The law also recognises the right of an auctioneer to act as the agent of persons wishing to purchase, who may intrust him to make biddings for them. The auctioneer thus being the agent of both parties, his signature of the buyer's name in the catalogue to which the conditions of sale are annexed, opposite to the lot purchased, together with the price paid, has been considered a sufficient note or memorandum in writing of the bargain within the Statute of Frauds; but where the conditions of sale are not annexed to the catalogue, nor expressly referred to by it, the signature of the buyer's name in the catalogue is not a compliance with the statute.

If an auctioneer declines or omits at the time of sale to disclose the name of his employer, he makes himself responsible toward the buyers for all matters in regard to which the responsibility would otherwise lie with the owner of the property sold. He is also responsible to his employer for any loss or damage that may be sustained through his carelessness or want of attention to the instructions given; and if by his gross negligence the sale becomes nugatory, he can recover no remuneration for his services from his employer. If he receives money as a deposit on the sale of an estate, and knowing that there is a defect in the title, pays that deposit over to his employer, he is answerable for the amount to the purchaser; and if he pay over the produce of a sale to his employer, after receiving notice that the goods of right belong to another, the real owner may recover the value from the auctioneer.

Every person acting as an auctioneer in the United Kingdom is required to take out a license, which must be renewed on the 5th of July in every year, and for this licence the charge of ten pounds is annually made. No licence, however, is required for the sale of goods under a distress for rent or tithes to a less amount than 20*l.*, or for the sale of goods by bailiffs under process of the county courts, or on sales by order of the Court of Chancery.

AUDIANS, or AUDEANS, a sect of heretics, so called from their founder Audius, or Audæus, who is said to have been a native of Mesopotamia, and who lived in the 4th century. Having begun, as usual with religious reformers, by attacking the manners of the clergy, and perhaps also the government of the church, he proceeded in this line till, persecuted by the orthodox, he separated from the church, with many followers, among whom were some bishops, by whom he was, on their own authority, ordained to the episcopal office himself. The sect appears to have arisen in Cœle-Syria. In his old age, on the accusation of some of the bishops that he induced the people to withdraw from the church, Audius was banished by the emperor to Scythia, about A.D. 338, where he occupied himself in introducing Christianity on his own principles, and is supposed to have died there some time previous to A.D. 372. Among various erroneous opinions and practices attributed to Audius and his followers are the celebration of Easter after the usage of the Jews, the admission of all descriptions of persons indiscriminately to the Lord's Supper, the doctrine of the eternity of fire, water, and darkness, and especially that of anthropomorphism, or the resemblance of the Deity to the human form, resting his belief on the expressions that God made man "in his own image," and those where the eyes, ears, &c., of God are mentioned. This last heresy in particular, which, as a Christian article of faith, appears to have originated with Audius, spread extensively. "The pilgrim Cassian," Gibbon writes, "who visited Egypt in the beginning of the 5th century, observes and laments the reign of anthromorphism among the monks, who were not conscious that they embraced the system of Epicurus." ('Dec. and F. of Rom. Emp.,' chap. 47, note.) But we have no account of the tenets of Audius, either from himself or any of his followers: we are dependent for all we know of him upon the statements of the orthodox theological writers of that and the next age, Athanasius, Augustine, Epiphanius, and Theodoret. He is admitted to have been a person of learning, and Epiphanius acknowledges that in his exile he exerted himself with great success in converting the barbarians, and says that he was chargeable with "defection and schism, but not with heresy," and that the Audians were remarkably strict in their morals.

AUDITOR, an officer or agent of the king, or of a private individual or corporation, who examines periodically the accounts of under-officers, tenants, stewards, or bailiffs, and reports the state of their accounts to his principal.

Auditors of the Imprest.—Ancient officers of the Exchequer, abolished in 1785.

Auditors of Public Accounts, or, more strictly, 'Commissioners for auditing the Public Accounts,' are public officers, originally established by the 25 Geo. III. c. 52, in place of the patentees of the office of *auditors of the imprest* (Lord Sondes and Lord Cardiff), whose patents were vacated with compensation by that Act, and their functions and powers transferred to the commissioners above mentioned. The Queen is authorised by the stat. 46 Geo. III. c. 141, to appoint ten of these commissioners, who hold their offices during good behaviour, with salaries of 1500*l.* per annum to the chairman, and 1200*l.* per annum to the other commissioners. They are incapacitated from sitting in Parliament, and are sworn to execute the duties of their office faithfully and impartially. There is a provision in the statute, that no vacancy which may arise by death or otherwise in the number of commissioners after the first appointment shall be filled up without the express authority of Parliament, until the number is reduced to five, in which case the Queen may, from time to time, appoint new commissioners, so as to keep their numbers always to six. Two of the number are, by the 1 & 2 Geo. IV. c. 121, s. 17, empowered to examine parties on oath, and do all acts concerning the audit of public accounts.

By the 46 Geo. III. c. 141, s. 8, all public accountants are to transmit to the commissioners within three months after 31st December, or within three months of such day as the lords of the treasury shall order (see 2 & 3 Will. IV. c. 104), accounts duly attested, in manner pointed out by the Act, of all sums received and paid by them for the public service within the preceding year, together with proper vouchers for such receipts and payments, and a schedule of the same; which schedule is to be compared with the vouchers by an officer in the Audit-office. The commissioners may call on all public accountants, whenever they think fit, to account to them for the receipt, expenditure, or issue of all moneys or stores intrusted to them, and on failure they are to certify the defaulters' names to the remembrancer of the exchequer, and the attorney-general of England or Ireland, and lord-advocate of Scotland, in order that proceedings may be taken to compel them to account; unless, on the defaulter's application, the lords of the treasury think it proper to stay the proceedings for a reasonable time. By the stat. 1 & 2 Geo. IV. c. 121, it is enacted, that at the four quarter-days, the 5th day of January, 5th day of April, 5th day of July, and the 10th day of October, general imprest certificates shall be made out at the exchequer, specifying all moneys and exchequer bills issued at the receipt of the exchequer within the preceding quarter, and these certificates are transmitted to the commissioners of audit within thirty days after each quarter-day; and by the 10th section of 46 Geo. III. c. 141, the paymaster of the forces, the treasurers of the navy and ordnance, and all other public officers, who issue to any persons money for public services by way of imprest or on account, are required within three months after the 31st December in every year (or at shorter periods if ordered by the lords of the treasury, see 1 & 2 Geo. IV. c. 121, s. 6) to transmit to the commissioners of audit a certificate of such moneys, with the names of the persons to whom paid, and the commissioners are forthwith to take them into consideration. By the above-mentioned statute, 1 & 2 Geo. IV. c. 121, various regulations have been made respecting the mode of conducting the business of the commissioners of audit, by which the ancient and inconvenient system of keeping the public accounts has been superseded. The whole of the arrangements in the Audit-office are now subjected to the control of the lords of the treasury, who are authorised to make such orders and regulations for conducting the business of the office as they may think expedient, and best calculated to ensure the efficient discharge of the duties of the commissioners and other officers. By the 2 Will. IV. c. 26, the above commissioners are authorised to audit the accounts of receipt and expenditure of the colonial revenues; and the 2 & 3 Will. IV. c. 99, transfers the powers and functions of the commissioners of public accounts in Ireland to the commissioners for auditing the public accounts of Great Britain. By the 9 & 10 Vict. c. 92, the accounts of the receipt and expenditure of the naval and military departments are also referred to the Audit commissioners, whose reports thereon are to be laid before the House of Commons on the 31st of January and the 1st of June in each year.

AUGER. The auger is an instrument for boring holes in wood, larger than can be made with an awl or a gimlet. In its simple form, this instrument is too well known to need description. A few years ago a new kind of auger was invented, and introduced into some of our manufacturing establishments; it differs from the common auger in having a spiral like that of a corkscrew, which empties itself of the fragments of wood without having need to be withdrawn from the bore.

In 1854 an English patent was taken out by Mr. Ransom Cook, for an auger which had been patented in America a year and a half earlier. The construction had been suggested to him by a careful study of the mode of working adopted by certain insects. It consisted in giving to the lips or cutting edges of boring tools a curved or gouge shape at their extremities; also in the under-cutting or back-sloping of those edges, in order to give them a sliding or drawing movement in cutting. The improvement was very marked. In comparison with the common instruments, this auger possessed superior ease in boring holes through hard wood, at any angle with the fibres; the hole, too, is more truly cylindrical, and is produced without tearing or bruising the fibre.

AUGMENTATION, in old music, was an increasing of the value of the notes above their common and essential value. The term has long been known only to musical antiquaries.

AUGMENTATIONS, THE COURT OF, was established by 27 Hen. VIII. c. 27, for managing the revenues and possessions of all monasteries under 200*l.* a year (which by an act of the same session had been given to the king), and for determining suits relating thereto. It was called 'the Court of the Augmentations of the Revenues of the King's Crown,' and was a court of record with one great seal and one privy seal; the officers being a chancellor, who had the great seal, a treasurer, a king's attorney and solicitor, ten auditors, seventeen receivers, with clerk, usher, &c. All the dissolved monasteries under the above value, with some exceptions, were in survey of the court, the chancellor of which was directed to make a yearly report of their revenues to the king. The records of the Court are now at the Public Record Office, in the keeping of the Master of the Rolls (1 & 2 Vict. c. 94), and may be searched on payment of a fee.

AUGSBURG, CONFESSION OF. [CONFESSIONS.]

AUGUR. The earliest inhabitants of Italy, like all rude nations, imagined that they saw in every unusual occurrence a manifestation of the will of heaven. The power of interpreting the signs thus furnished by the gods was thought to depend upon a peculiar talent conferred upon the favoured mortal from his birth, but a certain discipline was necessary to give to the talent its full development. A superstition so deeply seated in the minds of the people was turned to account in the political constitution of Rome, by the establishment of a college of augurs, whose duty it was on all occasions of importance, whether of a public or private nature, by certain arts to ascertain and report the pleasure or displeasure of the gods. Romulus himself was said to have been skilled in the arts of divination from his earliest youth, and at the foundation of the city the claims of the rival brothers were decided by augury. The story of Tanaquil, of Servius Tullius, and still more the contest between the elder Tarquin and Attus Navius, afford additional evidence of the peculiar nature of this Roman superstition.

The institution of the college of augurs may be referred to the very earliest period of Roman history; for the assertion of Livy (i. 18, and iv. 4), that there were no augurs in the reign of Romulus is not merely opposed to the general tenor of the history of Rome, but directly contradicted by Cicero. ('De Republica,' ii. 9.) The original number of augurs is again differently reported. Cicero, himself an augur, says that Romulus associated three others with himself, and that Numa added two. (*Ibid.* 14.) Livy reports that in the opinion of the augurs of his time the number of the college was necessarily related to the number of the ancient tribes, and that consequently there must have been at the beginning either three or six; so that each of the three tribes should have either one or two augurs. On the other hand, the same author found it recorded in the annals of Rome that, prior to the Ogulnian law, there were but four members of the college. In these different accounts Niebuhr has pointed out strong reasons for giving the preference to the last. The notion of there having been three or six seems to have been a mere inference from the number of the tribes; and if all the tribes had stood on an equal footing, the argument would have had much weight. But the same writer has fully established the fact that the first two tribes possessed higher privileges than the third, and this in a more marked manner in the offices of a religious character, so that the number four, two for each of the privileged tribes, seems to point to a similar distinction in the highly-important powers of the augurate. On the other hand, though Cicero's evidence is in favour of the number six, his mode of accounting for that number is wholly at variance with the reasons of the augurs as reported by Livy. Again, if, as Cicero implies, Romulus was a member of the college, his successors in the regal power must have succeeded likewise to the augural office, a supposition in no respect confirmed by history, and scarcely compatible with what is reported of Tarquin's dispute with Attus Navius. Moreover, if such a power had passed through the hands of the kings, it remains to be asked what course was pursued at the change of the government from the regal to the consular form. At that revolution the political powers of the king devolved upon the consuls, or prætors as they were at first called, those of a religious character upon the priest, called *rex sacrificulus*; but there is no trace of evidence to show that the authority of the latter ever included the powers of the augurate. Under this view of the subject, Niebuhr is of opinion that originally the Ramnensian tribe possessing the chief powers of the state had its two augurs; that at a later period, when the Titienses were admitted to a share of these privileges, two others were added. This is confirmed by the statement of Cicero that Numa added two to the college, for the name of that king is always connected with the privileges of the second tribe. Livy, in his wish to reconcile the different accounts, has been driven to the supposition that when the Ogulnian law was brought forward, there may have been two vacancies by death; but it is not probable that the patricians would allow themselves to lose two seats in the college through such an accident, especially as even after the law was brought forward it was not too late for the remaining augurs to fill up the supposed vacancies—for in them the election resided. The Ogulnian law, which was brought forward by Q. and Cn. Ogulnius, and passed in the year B.C. 307, opened the pontifical and the augural colleges to the plebeians. (Liv. x. 6, 9.) In the latter, five plebeians were associated with the four patricians; and this number remained to the time of Sulla, B.C. 81, who increased it to fifteen. (Liv. 'Epit.' 89.) Lastly, among the many extraordinary powers conferred upon Augustus in B.C. 29 was the right of electing augurs at his pleasure, whether there was a vacancy or not; so that from that period the number of the college ceased to be definite. (Dion. xli. 20.)

But a more important point than the number of the augurs was the mode of election. At first, the augurs, like the other priests, were elected by the patrician assembly of the Curies, called the Comitia Curiata: but no election was complete without the sanction of the augury; so that the college possessed a virtual veto upon the admission of all members into it. (Dion. ii. 22.) This power was not unlikely to lead to a gradual usurpation of the elective right; and thus, as early as the year B.C. 452, we find it the practice of the college to fill up vacancies by co-optation as it was called, that is, by the votes of the existing augurs. (Liv. iii. 32.) This mode of election continued to the third consulship of Marius, B.C. 103, when the tribune Cn. Domitius Ahenobarbus carried a law, that in case of any vacancy in any of the sacred colleges, seventeen out of the thirty-five tribes chosen by lot should, by a majority of the votes of the said seventeen tribes, nominate a successor, whom the college should be bound to elect. (Cic. contra 'Leg. Agrar.' ii. 7, &c.) The return of Sulla to power restored the election to the colleges; but in the consulship of Cicero (B.C. 63) T. Attius Labienus, with the support of Cæsar, procured the reversal of Sulla's law. (Dion. xxxvii. 37.) After the death of Cæsar, Antony restored the old law, at least in the election of the chief pontiff, and therefore, most probably, in that of the other priests. (Dion. xliv. 53.) We have already mentioned that the emperors had the privilege of appointing augurs at their own discretion.

The ceremonies and superstitions which constituted the supposed science of the augurs would be tedious to enumerate; but that which especially characterised the augural office was the pretended power of ascertaining the divine will from the flights of birds. For this purpose the augur selected some elevated spot, on which he sat with his head veiled and his face turned towards some particular quarter of the heaven, varying perhaps according to the occasion; for the accounts differ so much that, while Livy says it was the east, we have the authority of Varro for the south, and Frontinus for the west. Then the augur, with a bent wand or crook, free from knots, called a lituus, marked off a certain portion of the heavens and of the earth, within which his observations were to be made, and again divided this portion into two parts—the right and left. The space so defined in the mind of the augur was called a *templum*, and the steadfast observation of the augur directed upon it may probably account for the meaning of the Latin word *con-templa-ri*, to contemplate, which has been adopted into our own language. The gods then signified their approbation by the appearance of birds on the left, and the augury was complete. For some purposes the whole circumference of the heavens, together with the corresponding parts of the earth, were divided, according to the rules of the art, by lines directed to the cardinal points, and others parallel to these. (Liv. i. 18, Dion. ii. 70, and the appendix to the translation of Niebuhr, vol. ii.) So prominent a place did the feathery creation hold as the interpreters of the divine will, that *av* or *avi*, the Latin for bird, is the chief element in the term *augur*, as it is also in the nearly equivalent word *auspex*. In the latter, the second syllable is deduced from *spec*, look, so that the word signifies bird-observer. The second element of the word augur does not admit of satisfactory explanation from any existing word in the Latin language. We have called the terms nearly equivalent, and if Plutarch's authority had been sufficient ('Romaica,' c. 72), we might have dropped the qualifying adverb. But a Roman antiquary would have pointed out many distinctions between them. The most important of these is, that the leading magistrates of Rome possessed the auspices (Cic. 'De Leg.' iii. 3) by virtue of their office, while the term augurium never refers to any other than an augur. The name auspex does not appear to have been in early times a technical word, and indeed was but rarely employed; but the derivatives from it were frequently used, and applied with considerable latitude to the augurs as well as to the magistrates. The objects of the auspices and auguries were nearly the same, and the means employed of a similar nature. Moreover, all legal disputes about the auspices of the magistrates seem to have been referred to the augurs. Under all these circumstances, we shall not attempt to draw a very nice line between them.

There were, as we have already stated, besides the movements of birds, a variety of other occurrences in the physical world which, as expressive of the will of heaven, came under the cognisance of the augurs. We shall not attempt to give a catalogue of all the forms which the superstitions of man may take; but absurd as these forms may have been, the political power of the augurs was most substantial. The election of a king, a consul, a dictator, a prætor, a curule ædile, of the various priests, pontifex, augur, vestal, flamen, &c., all were void unless the auspices were favourable. A general could not cross the pomœrium, or sacred boundary of Rome, the frontier of the state, or even a river, without the sanction of his birds. To engage an enemy in defiance of these interpreters of the will of heaven was sure to entail present or future defeat. In the assignment of public lands the science of the augur was required to mark out the different allotments. Among the patricians, the presence of an augur was necessary to render valid many of the proceedings of private life, as marriage and adoption; and the same political body found in the auspices a powerful argument against the rising claims of the plebeians. The auspices, they said, were their peculiar privilege, and as the leading magistrates could not fulfil their duties without such divine assistance, there was an insuperable bar to the election of plebeians. Of the three comitia, or legislative assemblies, that of the curies, being the special assembly of the patricians, was of course subject to the auspices; the same was the case with the mixed assembly of the centuries; but that of the tribes was free from such control. Of the two last (for the comitia curiata became obsolete) the assembly of the centuries was the most important, as possessing the election of the leading magistrate; and so complete was the veto of an augur in this assembly, that if he but heard a clap of thunder, nay, if he but said he had heard one, and that falsely, the proceedings of the assembly were void. Such was the power of the augural office; and it was strengthened by the law that a man once created an augur was an augur for life, no matter what crimes he might commit. (Plin., 'Ep.' iv. 8; Plutarch, 'Romaica,' 97.) On the pecuniary advantages of the office there are no very definite statements. That they received money in some shape from the public treasury is indeed positively stated (Dionys. ii. 6); and the poet Attius has made a bad pun at their expense, charging them with extracting *aurum* (gold) from the *aures* (ears) of those who believed in them; and the public money may perhaps be traced in the dinners given by the augurs on their election, which were celebrated in the annals of Roman gastronomy. (Cic., 'ad Fam.' vii. 16; Varro, 'R. R.' iii. 6; Plin., 'H. N.' x. 23.) In the latters years of the republic many of the duties of the augurs were performed in the most lax manner. At the inauguration of a magistrate, says Dionysius (ii. 6), speaking of his own time, the ceremony is a mere shadow of what it was. The candidate takes his seat, rises, repeats a set prayer in the open air, an augur then declares he hears thunder on the left, when in fact there was none, and the candidate forthwith enters upon his magistracy.

AUGUST. The month of August was originally called Sextilis, being the sixth month in the Alban or Latin calendar; and this name, as is stated, it retained in the calendars of Romulus, Numa Pompilius, and Julius Cæsar. Since Numa's reform, however, it has held only the eighth place in the series of months. In the Alban calendar, Sextilis consisted of twenty-eight days; in that of Romulus of thirty; Numa reduced the number to twenty-nine; Julius Cæsar restored it to thirty; and Augustus Cæsar, from whom it derived its new name of August, extended the number of days to thirty-one, which has continued ever since.

It was originally proposed that September should bear the name of Augustus, from the emperor having been born in that month; but he preferred Sextilis, not only as it stood next to July, which had been recently named after his predecessor Julius, but for the same reasons which influenced the decree of the Senate detailed by Macrobius, in his 'Saturnalia' (edit. Bipont. i. 261), viz., that since it was in this month that the Emperor Cæsar Augustus had entered upon his first consulship—had celebrated three triumphs in the city—had received the allegiance of the soldiers who occupied the Janiculum—had subdued Egypt, and put an end to civil war—it appeared that it was, and had been, propitious to the empire; and the Senate therefore ordained that Sextilis should thenceforward bear the name of Augustus.

Gassendi ('Kalend. Romanum,' apud Græv. viii. col. 164) says that Commodus wished to have had the month Sextilis called by his own name.

The Flemings and Germans have adopted the word August for Harvest; *Oogst maand* is the harvest-month. (Hadr. Junius 'de Annis et Mensibus,' apud Græv. Thesaur. viii. col. 217.) So the German *Augst-wagen*, a harvest-waggon (Wachter 'Glossar. German.'); and the Dutch *Oogsten*, to reap or gather corn from the field (Sewel's 'Dutch Diction.'). The Spaniards also have the verb *Agostàr*, to gather in harvest; and both French and Spaniards have phrases for making harvest, *faire l'Aoust*, and *hazer su Augusto*.

Our Anglo-Saxon ancestors named August Ƿeoꝺ monaꝺ, the weed-month, as abounding in noxious and useless herbs. ('Saxon Menolog.,' Lye's 'Saxon Dict.' in voce, and Bosworth's 'Anglo-Saxon and English Dictionary.')

Lammas Day, the first of the month, is also called the Gule of August (Brand's 'Popular Antiq.' i. 275), probably from the Gothic HIOL or IUL, a *wheel*, indicating that revolution of season which brought the return of harvest. This day, called by our Anglo-Saxon ancestors Hlaþ-mæſſe, that is, loaf mass, was the feast of thanksgiving for the first fruits of the corn.

(Compare Pitisci 'Lexicon Antiq., Græc. et Roman.,' v. Augustus; the different treatises printed in Grævius's 'Collection;' and Brady's 'Clavis Calendaria,' i. 76.)

AUGUSTINE (ST.), CANONS OF THE ORDER OF, usually called AUSTIN CANONS. Regular Canons, says Bishop Tanner (Pref. to 'Notit. Monast.'), were such as lived under some rule; they were a less strict sort of religious than the monks, but lived together under one roof, had a common dormitory and refectory, and were obliged to observe the statutes of their order.

The chief rule for these canons was that of St. Augustine, who was made Bishop of Hippo, A.D. 395. But they were little known till the 10th or 11th century, were not brought into England till after the Conquest, and appear not to have obtained the name of Augustine or Austin Canons till some years after. (Bingham, 'Antiq. of the Christ. Church,' b. vii. c. 2. s. 9.)

Bale ('Script.' cent. xiii. 4) and Sir Robert Atkyns ('Antiq. of Glouc.') say, that these canons were brought into England by St. Birinus in the beginning of the 7th century; A.D. 630 or 640, as Fuller, quoting the 'Chronicon Augustin' of Joseph Pamphilus, states in his 'Church History (b. vi.); but those were certainly secular canons whom he placed at Dorchester in Oxfordshire; and all other historians agree that we had no regular canons here till the 11th, or probably till the 12th century. For though they differ about the place of their first settlement, yet the general opinion is, that they came in after king Henry I. began his reign. Jos. Pamphilus, according to Fuller ('Ch. Hist.' ut supr.), says they were seated in London, in 1059; but this is not believed. Somner says that St. Gregory's in Canterbury, which was built by archbishop Lanfranc in 1084, was their first house ('Antiq. Canterb.'); but Leland's saying ('Collectan.' vol. i.) that Archbishop Lanfranc placed secular canons at St. Gregory's, and that Archbishop Corboyl changed them into regulars, makes the authority of that judicious antiquary in this case doubtful. Reyner says ('Apostol. Benedict.' tr. i.) that they were first brought into England by Athelwulphus or Adulphus, confessor to king Henry I., and had their first house at Nostell in Yorkshire; but they seem not to have been settled there till Thurstan was archbishop of York, and that was not till 1114. Thurstan was elected in 1114, but not consecrated till 1119. (Willis's 'Cathedrals,' vol. i.) Stow ('Surv. of London') mentions that a gift of lands was made to Norman, the prior, and to the canons of the Holy Trinity, or Christ Church within Aldgate, London, in 1115, but he does not say that it was the first establishment of the order, and that house was not built till R. Beaumeis was bishop of London; whereas the house of these canons at Colchester was founded before the death of Bishop Maurice his predecessor, which happened Sept. 26, 1107. (Godwin 'de Præsul;' Newc. 'Rep. Eccl.' vol. i.) And therefore Bishop Tanner thinks that John Rosse ('Mon. Angl.' vol. vi.) and Pope Paschal II. (Ibid.) are right in placing them first at Colchester, though it could not be in Rosse's year, 1109, but was rather in 1105, in which Fuller ('Ch. Hist.' b. vi., s. i., c. 6.) places the coming of these canons into England.

Stevens tells us, in his Continuation of Dugdale (vol. ii.), that though there were regular canons who embraced the rule of St. Austin, taken from his 109th epistle, in the 11th century (as particularly at the Abbey of St. Denis, at Rheims, about 1067), yet the regular canons did not make solemn vows till the 12th century; and did not, in general, take the name of "regular canons of St. Austin" till Pope Innocent II. ordained, in the Lateran Council, in 1139, that all regular canons should submit to that rule of St. Austin in his 109th epistle. So that these regular canons certainly fall short of the time of their pretended founder; and therefore when black or regular canons are mentioned before 1105, the reader must thereby understand secular canons; for it was usual in those days to call the secular canons of cathedral and collegiate churches "canonici regulares," to distinguish them from the common parochial clergy, though probably many of those societies might become Austin canons afterwards. In 1244, the rules were sanctioned by a bull from Pope Innocent IV., and in 1532 the 'Barefooted Augustines,' a sort of reformed order, was established.

Their habit was a long black cassock, with a white rochet over it, and over that a black cloak and hood. The monks were always shaved, but these canons wore beards, and caps on their heads.

The nuns of the order were probably the elder of the two, as there certainly was a society of females who lived apart under the spiritual direction of the Bishop of Hippo himself; and a cloister was founded at Venice in 1177 by Pope Alexander III.; these wore black garments, which in 1632 were changed to violet.

Tanner says he found above 175 houses of these canons and canonesses in England and Wales.

By the rules of the order, among many other ordinances, the vows of chastity and poverty were to be taken by all persons joining the order, to which all property whatever was to be relinquished by the individual; alms might be solicited; on any business requiring members of the fraternity out of the house, two were always to be sent together; concord and implicit obedience were inculcated; and talking was forbidden. Of the habit, it was only directed that it should not be conspicuous.

The separate societies in England and on the Continent were extremely numerous, and many, no doubt, were marked by some peculiarity; but the four great branches which sprung from the parent root were the Præmonstratensians, Trinitarians, Dominicans, and the Knights Hospitallers, with more or less of variation according to circumstances.

Copies of the rule of the Augustine order will be found among the Harleian manuscripts in the British Museum, Numbers 2939, 3392, 3995, and 4053. Wilkins, in his 'Concilia,' vol. ii., and Spelman, 'Concil.' vol. ii., have given the Constitutions of Pope Boniface XII. for the reformation of this order in 1339; and the Cottonian Manuscript, Vespasian D. I. contains, 1. The proceedings at various general and provincial chapters of the Order, held within the province of

Canterbury from 1325 to 1404, fol. 41, b. : 2. The details of the great chapter held at Leicester in 1518, fol. 63. This last chapter was held preparatory to the promulgation of the reformed rules of the order for the houses in England, set forth by Cardinal Wolsey in the following year. The cardinal's regulations are preserved in the Cottonian Manuscript, Vesp. F. IX. 'Ordinationes et Statuta per Thomam Wolsey, titulo S. Ceciliæ Cardinalem, per singula Monasteria Canonicorum Regularium S. Augustini observanda: composita xxij° Martii, A°. Dom. MDXIX. et Regis Henrici Octavi xj.'

AULIC COUNCIL (Reichshofrath), was the title of the second chamber or tribunal under the old German empire, the first being the Imperial chamber or Reichskammergericht, which was the supreme tribunal of the German empire. [IMPERIAL CHAMBER.] It was instituted by the Emperor Maximilian in 1501, originally as a personal council for the sovereign, but it soon acquired a jurisdiction over a variety of affairs. The Aulic Council consisted of a president, a vice-president, the vice-chancellor of the empire, and eighteen councillors, six of whom were required to be protestants: the votes of these six, when unanimous, were considered equal to those of all the rest. The nomination of the Aulic Councillors belonged to the emperor, who paid them, with the exception of the vice-president, who was appointed by the archbishop of Mainz; they were drawn from two classes, nobles and civilians. The affairs which were under the exclusive jurisdiction of this court were of three sorts: 1. Feudal processes concerning the immediate feudatories of the emperor; 2. Those called *reservata Cæsaris*, including appeals from the hereditary dominions of the emperor; 3. All matters concerning the imperial jurisdiction in Italy, as the emperor was styled King of the Romans. The investitures of counties of the German empire were given by the Aulic Council. The Aulic Council did not interfere in the political or state affairs of the empire. The council ceased at the death of every emperor; and the new emperor made a fresh appointment. The decisions of the Aulic Council were submitted to the emperor for his approbation, by which they became law. Pöllnitz, in the first volume of his 'Memoirs,' compares the Aulic Council to the old French Parliament, with this difference, that the former could not make remonstrances to the sovereign, and did not register any other acts but its own decisions.

At the extinction of the German empire by the renunciation of Francis II. in 1806, and the establishment of the Confederation of the Rhine under the protection of the Emperor Napoleon, the Aulic Council ceased to exist. There is, however, a council at Vienna for the affairs of the war department of the Austrian empire: it is called *Hofkriegsrath*, of which the president possesses the powers of a minister of war, subject of course to the will and directions of the sovereign.

AURANTIIN. [HESPERIDIN.]

AURATES. [GOLD.]

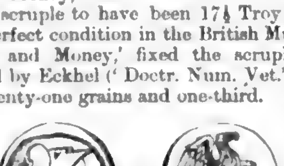
AUREOLE. [NIMBUS.]

AU'REUS, or DENARIUS AUREUS, the ordinary Roman coin of gold, was equivalent to twenty-five silver denarii, or a hundred sestertii.

Gold was first struck at Rome in the year of the city 547, or 207 before Christ, in the consulship of C. Cl. Nero and M. Liv. Salinator, sixty-two years after the introduction of the coinage of silver. The earliest coin of gold at this time was named a scruple (scrupulum), and

Scrupulum.
Brit. Mus. Gold. Actual size.

went for twenty sesterces of that age. (Plin. 'Nat. Hist.' lib. xxxiii. c. 3; edit. Dalecampii, et Variorum. In other editions, c. 13.) It had the head of Mars on one side, and an eagle standing on a thunderbolt upon the other, with the word 'ROMA' below; and was marked XX at the back of the head of Mars. Raper ('Inquiry into the value of ancient Greek and Roman Money, Philos. Transact.' lxi. p. 508,) determines the weight of the scruple to have been 17¼ Troy grains, which is the weight of one in perfect condition in the British Museum; but Hussey 'Ancient Weights and Money,' fixed the scruple at 18·06 grains. Nauzeus, as quoted by Eckhel ('Doctr. Num. Vet.' tom. v. c. 4), makes the true weight twenty-one grains and one-third. These, as it appears,



A triple Scrupulum.
Brit. Mus. Gold. Actual size.

are Paris grains (Eckhel, v. 4); 17¼ Troy grains being about equivalent to 21⅓ Paris grains. Its double was marked XXXX, or forty sesterces; and its triple ⊥X, or sixty, which weighed 52 grains. The symbol which precedes the X on this triple scruple, indicates L or 50: Eckhel shows, that on the denarii of Tib. Claudius, and in other cases, the Romans represented 50 by a symbol very like an inverted T. The aurei preceding the empire were heavier than they were afterwards. Mr. Hussey states the weight of that of Sulla as 130·1 grains, but had seen none heavier than one of Pompey, which weighed 128·2 grains; and Mr. Noel Humphreys says the Aureus of Lucullus weighed 206 grains, while he had seen none weighing more than 167 grains.

Pliny proceeds to say that it was afterwards usual to coin forty pieces out of the pound of gold (larger in size, of course), bearing the general name of Aurei, and that the Roman emperors by degrees made them forty-five to the pound. In a passage, the corruptness of which is more than suspected, some of the texts ascribe this last change to Nero.

Alexander Severus coined pieces of one-half and one-third of the aureus, called *Semissis* and *Tremissis* (Æl. Lamprid. in 'Alex. Severi Vita,' c. 39), whence the aureus came to be called *solidus* or *solidus aureus*, as being the integer.

Soon after the reign of this prince the coinage became very irregular, till Constantine entirely new-modelled it by coining aurei of seventy-two to the pound of gold ('Codex Theod. de Ponderatoribus,' § 1. 'Cod. Justin.' l. x. tit. 70, de Susceptoribus, § 5); a more convenient number than either forty or forty-five, as it divided the ounce and half ounce without a fraction.

Eckhel ('Doctr. Num. Vet.' ut supr.) divides the variations of weight of the aurei between the year 547 of Rome and Caracalla's time into eight epochs, varying in the respective coins from 153 to 128 (Paris) grains. That the estimates are correct may be gathered from the following facts, ascertained from aurei, or gold denarii, all in a state of high preservation in the British Museum. An aureus of Julius Cæsar weighed 123 grains, which is exactly the weight of an English sovereign. Out of twenty-five gold denarii of Augustus, one weighed 115 grains, five weighed 120 grains each, three 120½, four 121 grains, four 122, and one 127. In Meyer's 'Grosse Conversations Lexikon,' mention is made of an aureus of Augustus, found at Herculaneum, weighing 540 grains, of which a representation has been published by Kehl; and one of Valens, now in the Vienna cabinet, still heavier. Mr. Noel Humphreys calls the first a medallion, and the second is no doubt of a similar character. Of fifteen aurei of Nero, four weighed 113 grains, two 114, two 116, two 118, one 119, one 120. An aureus of Maximianus II. weighed 81 grains, Carausius 67, and Maxentius 79. The coin of Carausius, of which a copy is here given, is believed to be unique. The

Brit. Mus. Gold. Actual size.

Rev. Mr. Cracherode, who bequeathed it to the British Museum, bought it at the price of 150*l*. Of the aurei of Constantine in the Museum, one weighed 66 grains, three 67, three 69½, one 73½, and one 81½. The highest weights are possibly of coins struck before Constantine's re-arrangement of the coinage. All here mentioned, as far as can be ascertained, are of gold without alloy. The town of Cæsarea possessed a mint at one time as well as Rome; and there is no doubt there were also many fraudulent aurei. Macrobius states ('Sat.' 552) that a Jewish coin of precisely the same value as an aureus was in his time current at Ephesus.

The average weight of the aurei of Augustus, then, appears to have been nearly 121 grains; that of Nero's aurei nearly 117.

Raper says the Consular aurei weighed at a mean 126 grains. Some of the Family aurei in the Museum weigh 122, 124, and 125 grains.

The following is Letronne's table of the mean weight of Aurei, transferred into Troy grains:—

	French gr.	Troy gr.
J. Cæsar	153·25	125·73
Augustus	148·71	121·97
Tiberius	145·7	119·53
Caligula	144·5	118·55
Claudius	144·6	118·63
Nero	139·5	114·44
Titus	137·3	112·64

(Letronne, 'Considérations générales sur l'Evaluation des Monnaies Grecques et Romaines,' &c. 4to. Paris, 1817.)

Victors in the chariot races were usually rewarded with aurei. (Suetonius, 'Claud.' cap. 21, § 10; Juv. 'Sat.' vii. 243.) The Scholiast observes that no more than five were allowed to be given in such cases. (Buleng. 'de Circo,' c. 55.) The fee (probably the maximum) to a lawyer was *centum aurei*, see Ulpian (D. i. 12, 'de extr. cognit.') A single aureus was all that Justinian permitted to be risked at dice. (Cœl. Calcagninus 'de Talorum Tess. et Calc. Ludis,' ap. Græv. 'Thesaur,' tom. vii. col. 1228.)

The reader who wishes for information upon the aureus beyond what is here given, may consult Pitiscus, 'Lexicon' i. *in voce*; Eckhel, 'Doctr. Num. Vet.' tom. v.; Pinkerton, 'Essay on Medals,' vol. i.; Raper's 'Inquiry,' already referred to; Böckh's 'Untersuchungen über

Gewichte, Münzfüsse, und Masse des Alterthums in ihrem zusammenhange,' Berlin, 1838; Hussey, 'Ancient Weights and Money,' and H. Noel Humphrey, 'Coin Collector's Guide.'

AURIC ACID. [GOLD.]

AURI'GA, the Charioteer, a constellation situated between Perseus and Gemini. It is represented as a man holding a bridle in the right hand and supporting a goat and kids on the left arm. The star in the body of the goat, called Capella (and Alioth by the Arabs) is of the first magnitude, and presents the best guide to the constellation. There is no satisfactory account of the mythology of this figure. It is said to have been the Horus of the Egyptians; among the Greeks, the human figure is by different writers called Erichthonius, Bellerophon, Hippolytus, &c.; while the goat is Amalthæa, the foster-mother of Jupiter. But this explanation is even more unsatisfactory than most others, owing to the want of apparent connection between the figures of the group.

The following are the principal stars in this constellation :—

Character.	No. in Catalogue of Flamsteed.	No. in Catalogue of British Association.	Magnitude.
ι	3	1520	4
ε	7	1540	4
ζ	8	1541	4
α	13	1613	1
δ	33	1885	3·5
β	34	1895	2
θ	37	1900	4
κ	44	2001	4

AURIPIGMENTUM. [ARSENIC, TERSULPHIDE OF.]

AUROCYANIDES. [GOLD.]

AUROHYDROCYANIC ACID. [GOLD.]

AURORA. [EOS.]

AURORA BOREALIS. [POLAR LIGHTS.]

AUSCULTATION, from *ausculto* to listen, the method of distinguishing the states of health and disease by the study of the sounds produced by the organs in the movements which they make in the performance of their functions. When air rushes by the wind-pipe into the lung in the action of inspiration; when it is expelled through the same tube in the action of expiration; when it is acted upon in the larynx by the organs of the voice; when the heart beats, that is, when the different chambers of which it is composed forcibly contract; when the blood flows through the great arterial trunks; when air is contained in the intestines and is acted on by these organs in their natural movements,—in all these cases sounds are produced which can be heard, often by the unassisted ear; and still more distinctly by the aid of an acoustic instrument. When attention is paid to these sounds, it is found that they differ greatly from each other. The sound of the air in the wind-pipe during inspiration is different from that in the same tube in expiration; the sound of the air in the larynx during the act of speaking is different from both; while the sound produced by the action of the heart, and even by the action of its different chambers, may be discriminated the one from the other. By the study of these sounds, it is obvious that it may be possible to become acquainted with those which are natural to the different organs in the state of health: but when these organs become disordered, their movements are modified in a great variety of modes, each modification of movement being attended with a corresponding modification of sound; consequently, these modified sounds are capable of affording indications of various states of disease, the difference between the healthy and the morbid sound being the sign and the measure of the deviation of the organ from the state of health. The physician, carefully studying the sounds produced by the organs during life, makes himself familiar with those which are natural to them: in a particular case he hears sounds which he knows to be altogether different from those that are natural: the patient dies; the physician examines the organs after death; he finds that a certain organ is diseased in a certain mode; this morbid condition of the organ, which he has been taught by inspection after death, he associates in his mind with the peculiar sound which he observed that the organ emitted during life. Another case, attended with the same sound, is proved by inspection after death to be connected with the same disease of the same organ: and every time that he hears this peculiar sound, he finds the same organ diseased in the same mode. A peculiar sound may thus become the sure and certain indication of a particular disease; in this manner, by persevering attention during life and careful examination after death, it may be possible to discriminate the morbid states of all the organs that give, when in action, a distinguishable sound. Extended and repeated observation has shown that the detection and discrimination of disease by this mode may be effected with a minuteness and precision that could not possibly have been credited previous to the practical demonstration of the fact; and modern science has elicited, and almost matured, a new mode, an *inventum novum*, as one of the first suggestors of the method justly termed it, of discovering the morbid states of several of the most important organs of the body.

To the philosophical mind nothing is more interesting and instructive than to trace the history of useful discovery. It is clear that the idea on which the modern art of auscultation is founded, had occurred to Hippocrates upwards of two thousand years ago. "You will know by this," says this first recorded observer of disease as denoted by sound, "that the chest contains water and not pus, if, on applying the ear for a certain time to the side, you hear a sound like that of boiling vinegar." The non-existence of dissection in the age and country of Hippocrates prevented all accurate and extended observation; and consequently rendered it impossible to follow out to any sure and useful result the idea which had occurred to the most ancient writer on physic. Accordingly, the suggestion of Hippocrates seems to have attracted no attention for many centuries, and the mode of studying disease founded upon it, if it had ever been carried to any extent in remote ages, had long sunk into oblivion.

About the middle of the 17th century, a distinguished philosopher and mathematician, who was not of the medical profession, and who does not appear to have been acquainted with the writings of Hippocrates, had the penetration to see that advantage might be taken of the sounds produced by the motions of the internal organs to discover the nature of their diseased states, and he even predicted that artificial means would some day be employed to assist the ear in the pursuit of that object. "There may be a possibility," says Hooke, in his posthumous works, "of discovering the internal motions and actions of bodies by the sound they make. Who knows but that, as in a watch, we may hear the beating of the balance, and the running of the wheels, and the striking of the hammers, and the grating of the teeth, and multitudes of other noises;—who knows, I say, but that it may be possible to discover the motions of internal parts of bodies, whether animal, vegetable, or mineral, by the sounds they make: that one may discover the works performed in the several offices and shops of a man's body, and thereby discover what engine is out of order,—what works are going on at several times, and lie still at others, and the like. I have this encouragement not to think all these things utterly impossible, though never so much derided by the generality of men, and never so seemingly mad, foolish, and fantastic; that, as the thinking them impossible cannot much improve my knowledge, so the believing them possible may perhaps be an occasion for taking notice of such things as another would pass by without regard as useless. And somewhat more of encouragement I have also from experience, that I have been able to hear very plainly the beating of a man's heart; and it is common to hear the motion of the wind to and fro in the guts and other small vessels: the stopping in the lungs is easily discovered by the wheezing. As to the motion of the parts one amongst another, to their becoming sensible, they require either that their motions be increased, or that the organ be made more nice and powerful to sensate and distinguish them as they are; for the doing of both which I think it is not impossible but that in many cases there may be helps found."

This prediction has been realised: helps have been found. About a century after this passage was written, Leopold Avenbrugger, a German physician then residing at Vienna, fell upon an artificial method of producing sounds in various regions of the body [PERCUSSION; AVENBRUGGER, BIOG. DIV.] by which the physician might judge of the state of the subjacent parts. This method, announced to the world in a small volume in Latin, first published in the year 1761, attracted little attention either among the countrymen of the inventor or among foreign nations for the space of half a century. It was translated into French by Rozière in 1770. In the year 1808, the celebrated Corvisart again translated it, and made his method known to all the countries of Europe. From that period the practice of percussion has been pretty general, and it soon became attended, in skilful hands, with results far more precise and certain than had been anticipated.

The attention of physicians having been thus distinctly directed to the method of studying disease from sounds produced in the body whether naturally or artificially, a number of young French physicians, disciples of Corvisart, about the commencement of the present century, took up the subject with extraordinary zeal. Among the most distinguished of these young men were MM. Double, Bayle, and Laennec. Speaking of the signs furnished by respiration, and of the sounds produced by it within the chest, M. Double, in his work on Semeiology, published two years before the discovery which led to the establishment of auscultation as an art and science, says, "In order to hear distinctly the sounds within the chest, we must apply the ear closely to every point of all its aspects, by which means we can distinguish not merely the kind and degree of the sound, but even its precise site. I have frequently derived great benefit from this mode of investigation, to which I was naturally led by the employment of the like method in exploring the pulsation of the heart."

At the very time when this was written, Laennec and several of his fellow-pupils, under the guidance of their master, Corvisart, while diligently studying chest diseases by means of percussion, met occasionally with cases in which this method afforded them little or no assistance; and in the hope of obtaining further aid, they accustomed themselves in such cases to apply the ear closely to the chest. Little practical benefit resulted for some time: but at length it led to a discovery of inestimable advantage; a discovery which may be said to have enabled the physician to see into the chest almost with as much clearness as if its walls were transparent. The following is the account of this discovery in the words of the remarkable man who made it, and who in the course of a few years, with a diligence scarcely ever exceeded, developed, matured, and systematised the highly-important practical results which it has afforded.

"In the year 1816," says Laennec in his great work 'De l'Auscultation Médiate et des Maladies des Poumons et du Cœur,' "I was consulted by a young woman affected with the general symptoms of diseased heart, and in whose case percussion and the application of the hand were of little avail, owing to her being extremely lusty. The immediate application of the ear being inadmissible for obvious reasons, I happened to recollect a simple and well-known fact in acoustics, and fancied it might be turned to some use on the present occasion. The fact I allude to is the great distinctness with which we hear the scratch of a pin at one end of a piece of wood on applying our ear to the other. Immediately on this suggestion, I rolled a quire of paper into a kind of cylinder, and applied one end of it to my patient's chest and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of the ear. From this moment I imagined that means might be found to ascertain the character, not merely of the action of the heart, but of every species of sound produced by the motion of all the organs within the chest."

Diligently applying himself to improve and perfect the rude instruments which he employed in his first trials, Laennec at length constructed that which is now in general use, called the Stethoscope (from στῆθος, *breast* or *chest*, and σκοπέω, *to examine* or *explore*), by the aid of which he was at once impressed with the conviction that he should be enabled to discover "a set of new signs of diseases of the chest, simple and certain, and such as might probably render the diagnosis of these diseases as positive and circumstantial as that of many affections which come within the immediate reach of the hand or the instrument of the surgeon." And this conviction, to a great extent, has been realised, for a new, clear, steady, and certain light has, by the aid of this instrument, been thrown on almost all the diseases of all the organs contained in the chest.

The art of distinguishing disease by sound comprehends then two distinct methods, that of *auscultation* and that of *percussion*. The study of auscultation may be pursued either by the unassisted ear, or through the medium of instruments; the first is called immediate or direct, the second mediate auscultation. In like manner percussion may be performed either on the natural surface of the body, or through the medium of some solid or tense substance firmly applied to it. The first is termed direct, the second mediate, percussion. [PERCUSSION.] See also Double, 'Séméiologie Générale;' Forbes's Translation of Corvisart's 'Avenbrugger;' Laennec, 'De l'Auscultation Médiate;' arts. 'Auscultation,' in 'Cyclopædia of Practical Medicine,' and in the 'Dictionary of Practical Medicine,' by Dr. Copland.

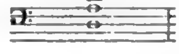
AUSONIANS (AU'SONES), an ancient people of the Italian peninsula, who appear to have been a branch of the great Opican or Oscan nation, originally settled in Bruttium, and thence driven by the Œretri into Campania. They were either an identical or nearly related people with the Aurunci. Niebuhr maintains that Ausones is the Greek form of the native name Auruni, from which the adjective form Aurunicus, shortened into Auruncus, would come. This interchange of *s* and *r*, in certain positions, is not at all uncommon. Suessa Aurunca, near the Liris, was in the centre of the country which the Ausones occupied. Cales (Livy, viii. 16), Ausona, Minturnæ, and Vescia (ix. 25) were Ausonian cities. Livy (viii. 15, 16) seems to speak of the Aurunci of Suessa and the Ausones of Cales as two different people; the former were the enemies, the latter the allies of the Sidicini. The explanation must be, that the Ausones of Cales, and the Aurunci of Suessa, were both Ausones or Aurunci (it is indifferent which term we use), and that one part of the nation, at the period referred to, was hostile to the Romans, and the other part friendly to them. (See Niebuhr, i. 63, &c., English translation; and OSCI.) Lower Italy, and sometimes even all Italy, is designated by the term Ausonia. Cowper uses it in this sense—

"Nor for Ausonia's groves
Of golden fruitage and her myrtle bowers."

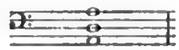
AUSPICES (*Auspicia*). For a brief view of the Roman superstition upon which the ceremony of the auspices was founded, the reader is referred to AUGUR. It is there stated that the greater part of the Roman magistrates, before they entered upon their office, went through the ceremony of inauguration, which was supposed to confer upon them the protection of heaven. When the Roman empire had greatly extended itself, it was no longer possible for the small body of augurs on all occasions to perform their duties in person; and it was therefore conducive to the public service that the magistrates themselves who had been inaugurated should be supposed to have received from that ceremony some share in the divine privilege. Thus they too were able to deduce the pleasure of heaven from the movements of birds and the other signs which belonged to the sacred science. Originally, this power was peculiar to the patrician members, and the privilege was employed as an argument for excluding the plebeians from the higher magistracies; but eventually, when the plebeians had acquired a right of admission to the consulate, prætorship, &c., they also necessarily had the privilege of the auspices attached to these magistracies. Still, to the very last, those offices which in their origin were purely of a plebeian character, as the tribunate, had no connection whatever with the auspices. There were many niceties in the law of auspices, which were matters of dispute among the Romans themselves, and were referred from time to time to the college of augurs, or sometimes to a single member of that body. The most important distinction was that which existed between the greater and the less auspices: thus the auspices of a consul were superior to those of a prætor; and consequently the latter, it was ruled, could not preside at a consular election.

In an army the commander-in-chief received the auspices with the *imperium*, and so completely was any success attributed to this privilege, that if any part of his army under any inferior officer, in any part of the world, gained a victory, that success was attributed to the commander-in-chief, who perhaps might have been the whole time in the neighbourhood of Rome, and he alone was entitled to the honours of the triumph. In this case the lieutenant was said to fight under the auspices of the commander-in-chief. As the ceremony of the auspices was originally employed to sanction the commencement of every important undertaking, whether public or private, the word *auspicari*, 'to take the auspices,' came at last to bear the signification of commencing any matter of importance.

AUTHENTIC, in music, a term used in the ancient ecclesiastical modes [MODES], but unknown in modern music. When the octave is divided harmonically, as in the proportion 6, 4, 3,—that is to say, when the fifth is below and the fourth above, for example,



then the mode is called *authentic*. When the octave is divided arithmetically, in the proportion 4, 3, 2,—that is, when the fifth is above the fourth, for example,



the mode is then called *plagal*.

Dr. Pepusch says, "When the fugue is in the fifth above or below, or in the fourth above or below, then one of the parts is in the *authentic*, the other in the *plagal* mode of the key we compose in." Handel's chorus, 'He trusted in God,' in the 'Messiah,' may be adduced as an example of this, where the subject is in the authentic mode, the answer in the plagal.

AUTHENTICA, a barbarous Latin version of the Novellæ of Justinian [JUSTINIAN'S LEGISLATION], so called by early writers on the civil law, from its being a literal translation from the original Greek. (Ducange, 'Gloss. ad verbum.')

AUTO-DE-FE' (Act of Faith), or, as it is termed by the Spaniards, with whom it was most in use, AUTO-DA-FE', was the public and solemn reading of extracts from the trials promoted by the Inquisition, and of the sentences pronounced by the judges of that tribunal. At this form or act the offenders themselves were present, or in case of their death or unavoidable absence, their bones or effigies were substituted for them; there were also present the civil authorities and corporate bodies of the town where it was performed, particularly the criminal judge, into whose hands the offenders were delivered, that he might inflict upon them the punishment prescribed by the laws; the fire, gallows, and executioners having been previously prepared by order of the inquisitors. When this execution was performed with the highest pomp and ceremony, it was called *auto público general*, general and public act. There was also an *auto particular*, private act, at which the inquisitors and criminal judge only were present; the *autillo*, held in the halls of the Inquisition, in the presence of such persons as the inquisitors invited, and of the ministers of the tribunals alone; and, finally, the *auto singular*, held in the church, or in the public square, against a single individual. The punishment was inflicted for what had been decided to be heresy by the Inquisition. On May 21, 1559, 31 persons were thus executed at Valladolid, and 37 were remitted to prison for a subsequent auto-da-fé, which took place on Sept. 24, at Seville, when 24 persons were burnt, and 80 subjected to other punishments, nearly all on charges of Lutheranism.

In the different autos-de-fé which have been celebrated in Spain, from the first which took place at Seville in 1481, to the abolition of the tribunal by Napoleon Bonaparte in 1808, no less than 34,658 persons were executed, either publicly or secretly; 228,214 victims suffered various other punishments; and 18,049 were executed in effigy. The last auto, according to Llorente, was the *auto singular*, celebrated in December, 1815, at Mexico, against a certain ecclesiastic named Morellos, accused of heresy. He was absolved from the charge of heresy, but was afterwards hung by order of the viceroy for high treason, as being concerned in a plot to effect the emancipation of Mexico from Spain.

The suppression of the Inquisition was confirmed by the Cortes in 1813, but it was reinstated by Ferdinand VII. in 1814; there were, however, no public executions under it, though many imprisonments, and in 1820 the Inquisition was again formally abolished by the legislature.

AU'TOGRAPH, from the Greek αὐτόγραφον, *written with one's own hand*, an original manuscript; the handwriting of any person.

This word, in relation to manuscripts, is used in opposition to an apograph, or copy.

Collections of autographs, as the handwritings of individual persons, had their origin about the middle of the 16th century in Germany, where the gentry, and especially persons who travelled, carried about with them white-paper books, to obtain and preserve in them the signatures of persons of eminence, or new acquaintance; when such a book received most generally the name of Album; though it was sometimes called 'Hortus,' or 'Thesaurus Amicorum.' Persons who travelled, it is to be observed, showed, by such means, what sort of company they had kept. (See the facts mentioned in Izaak Walton's 'Life of Sir Henry Wotton,' Reliq. Wotton. edit. 1651; and Wanley's 'Account of the Harleian Manuscript 933, in his Catalogue.') These albums are frequently found in the manuscript libraries of Europe. Several are preserved in the British Museum, and some are adorned with splendid illuminations, one, which is now exhibited to the public, is the 'Album Amicorum' of Christopher Arnold of Nuremberg, containing a collection of German and English autographs, among which is one of John Milton, with a sentence in Greek, dated London, November 19, 1651. The oldest (MS. Sloan. 851) bears a date as early as 1578, and appears to have belonged to a lady: others will be found in the MSS., Sloan. 2035, 2360, 2597, 3415, 3416. There is one also in the same repository, preserved in the library which belonged to George III., evidently made for Charles I., with whose and his queen's mottoes and signatures it opens. "1626. Si vis omnia subjicere, subjice te rationi, Carolus, R." "En Dieu est mon espérance, Henriette Marie, R." The other signatures with short sentences, English and foreign, are numerous, all upon paper, but with alternate leaves of vellum, bearing rich illuminations of the arms of the respective parties inserted. Amongst them are the signature and arms of Charlotte de Trémouille, countess of Derby, afterwards the celebrated defendress of Latham House.

The earliest royal autograph of England, now known, is the small figure of a cross, made by the hand of king William Rufus, in the centre of a charter, by which the manor of Lambeth was granted to the church of Rochester. This charter is preserved amongst those which were bequeathed some years ago to the British Museum by Lord Frederick Campbell. The next royal autograph known is *Le Roy R. E.*, the signature of Richard II., affixed to two documents, one preserved in the archives of the Tower of London, the other relating to the surrender of Brest, among the Cottonian manuscripts. From his time the royal signatures of England continue in uninterrupted succession.

We sometimes read of the signing of Magna Charta, which really means the sealing; a signature at that period was not the authentic attestation of an instrument, or even of a letter.

Autographs possess some interest, but not in themselves as historical documents; such an interest is independent of the autograph; but the handwriting of an eminent person, as the production of his mental and bodily powers, is the most peculiarly his own, and therefore, perhaps, the most interesting relic of his former life. Lavater, and others since his time, have believed that the character of an individual was shown by his writing. It may be true to some extent; and there is a general character in the writing of different nations and of different periods. The vivacity and variableness of the Frenchman, and the delicacy and suppleness of the Italian, are perceptibly distinct from the slowness and strength of pen discoverable in the writing of the German, Dane, and Swede; and it may be that when we are in grief we do not write as we do in joy. But numerous causes must always counteract or obstruct that analogy which many think the handwriting of an individual bears to his character; and none more than that close imitation which the hand of an assiduous scholar is likely to bear to that of his instructor. The form and fashion of Roger Ascham's handwriting is clearly perceptible in the autographs of Edward VI. and Queen Elizabeth.

In later times, collections of autographs have been formed far more extensive than those which the Germans made in the 16th and 17th centuries. There is a very numerous assemblage of them in the British Museum, where many of the most interesting are exhibited under glass to the general public in the large saloon known as the King's Library; among them are not only letters and signatures, but MS. volumes, such as the Iliad and Odyssey of Pope, written chiefly on the backs of letters, and the original draft of Dr. Johnson's 'Irene.' There are also many extensive private collections of autographs in England. The interest attached to autographs and the desire to possess them, has much increased in modern times. The autograph of Shakspere, now in the British Museum cost 100*l.*, and that in the Library of the City of London, 158*l.* In general the value set upon an autograph, and the price it brings when sold by auction, depends on the eminence of the individual and the scarcity of specimens of his handwriting. To furnish individuals desirous of possessing such, but the rarity of which precluded the chance of obtaining them, the 'Autograph Miscellany' was begun in 1855, and continued for some time. The work consisted of a collection of autograph signatures, letters, and documents, lithographed in folio, by F. Netherclift.

The first English work in which a series of fac-similes of autographs appeared, was Sir John Fenn's 'Original Letters from the Archives of the Paston Family,' published in 1787; followed by 'British Autography,' a collection of fac-similes of the handwriting of royal and illustrious personages, with their authentic portraits, by John Thane, 3 vols. 4to, 1789—1791. Another work, more extensive and more correct, will be found in 'Autographs of Royal, Noble, Learned, and Remarkable Personages, conspicuous in English History, from the Reign of Richard II., to that of Charles II.,' by John Gough Nichols, fol. Lond. 1829; from the preface to which some of the preceding particulars have been derived. See also Fontaine's 'Manuel de l'Amateur d'Autographes,' Paris, 1836; the Essay on 'Die Autographensammlungen,' in the 'Deutschen Vierteljahrsschrift' for 1842; and Paignot, 'Recherches sur les Autographes.'

AUTO'MATON, derived from two Greek words, meaning *self-moved*, is a name generally applied to all machines which are so constructed as to imitate any actions of men or animals. We may pass over the pigeon of Archytas, the clock of Charlemagne, the automaton made by Albertus Magnus to open his door when any one knocked, the speaking head of Roger Bacon, the fly of Regiomontanus, and several others, not knowing whether their performances may not have been exaggerated. They serve to show, however, that the idea of applying machinery to imitate life is of very ancient date, and that considerable success was not deemed impossible.

In the 'Memoirs of the Academy of Sciences' for 1729, a description is given of a set of actors representing a pantomime in five acts. But previously to this, M. Camus had described an automaton group which he had constructed for the amusement of Louis XIV., consisting of a coach and horses, &c. The coachman smacked his whip, and the horses immediately set off, moving their legs after the manner of real horses. The carriage turned at the edge of the table on which it was placed, and when opposite to the king it stopped, a page got down and opened the door, on which a lady alighted, presented a petition with a curtsey, and re-entered the carriage. The page then shut the door, the carriage proceeded, and the servant, running after it, jumped up behind it. (Hutton, 'Mathematical Recreations,' vol. ii. p. 95.) This is nearly inconceivable, and requires strong corroborative testimony.

The flute-player of Vaucanson is fully described in the 'Enc. Meth.,' article 'Androide.' It was exhibited at Paris, in 1738, where it was seen by M. D'Alembert, who wrote the above article. It really played on the flute, that is, projected the air with its lips against the embouchure, producing the different octaves by expanding and contracting their opening; forcing more or less air, in the manner of living performers, and regulating the tones by its fingers. It commanded three octaves, the fullest scale of the instrument, containing several notes of great difficulty to most performers. It articulated the notes with the lips. Its height was nearly six feet, with a pedestal, in which some of the machinery was contained.

Two automaton flute-players were exhibited in this country some years ago, as perfect as the preceding, except in the articulation. They were of the size of life, and performed ten or twelve duets. That they really played the flute, any bystander could prove, by placing the finger on any hole which for the moment was unstopped by the automaton.

The automaton trumpeter of Maelzel, the inventor of the metronome, exhibited at Vienna, is thus described in the 'Journal des Modes' for 1809. From a tent M. Maelzel led out a martial figure, in the uniform of a trumpeter of the Austrian dragoon regiment Albert, his trumpet being at his mouth. After having pressed the figure on the left shoulder, it played not only the Austrian cavalry march, and all the signals of that army, but also a march and an allegro by Weigl, which was accompanied by the whole orchestra. After this, the dress of the figure was completely changed into that of a French trumpeter of the guard; it then began to play the French cavalry march, all the signals, and lastly, a march of Dussek, and an allegro of Pleyel, accompanied again by the full orchestra. The sound of this trumpet is pure, and more agreeable than that which the ablest musician could produce from that instrument, because the breath of the man gives the inside of the trumpet a moisture which is prejudicial to the purity of the tone. Maelzel publicly wound up his instrument only twice, and this was on the left hip."

In 1741, M. Vaucanson produced a flageolet-player who beat a tambourine with one hand. The flageolet had only three holes, and some notes were made by half-stopping these. The force of wind required to produce the lowest note was one ounce; the highest, fifty-six pounds (French). Its construction was altogether different from that of the flute-player.

The same year, M. Vaucanson produced a duck, which has been considered as the most ingenious of his performances. It dabbled in the water, swam, drank, and quacked like a real duck; and the peculiar motions of the animal were very successfully imitated. It raised and moved its wings, and dressed its feathers with its bill. It extended its neck, took barley from the hand and swallowed it; during which the natural motion of the muscles of the neck was perfectly perceptible. It digested the food it had swallowed by means of materials provided for its solution in the stomach. The inventor made no secret of the machinery, which excited great admiration at the time.

Several other automata are described by Hutton; in particular one constructed by M. Droz, which drew several likenesses of public characters. A machine which wrote and drew, and another which performed on the pianoforte, were also exhibited some years ago in London.

The celebrated chess-player, once regarded as an automaton, is now a solved mystery. A boy was concealed inside the figure. The great difficulty existed only so long as it was imagined that the player was outside the figure; nevertheless, the machinery by which the hands were regulated must have been ingenious.

The passion for making automata has not yet quite passed away. A recent example was Mr. Faber's *Euphonia*. It consisted of a draped bust and waxen-faced figure, which articulated language with a certain degree of intelligibility. The sounds were produced by pressing on sixteen keys. A small pair of bellows was worked with the nozzle in the back part of the head of the figure; and in the head were various arrangements of India-rubber and other materials, calculated to yield a particular sound in each part or section. When the exhibitor wished to produce a sentence or word, he first mentally divided it into as many parts as there are actually distinct sounds—not necessarily coinciding with the syllables or the single letters; since the various phonographic systems far more correctly represent distinct sounds. Having determined the first word, the operator pressed his finger on a particular key, which admitted a blast of air to a particular compartment, in which the mechanism was of the kind to produce the sound required. Other keys were similarly pressed, until all the required sounds of the word or sentence were produced. The sounds were sufficiently analogous to those of the human voice to convey the meaning intended, but they had an unpleasant effect on the ear. By a modification of the action, whispering was imitated.

A remarkable machine was the *Automaton Latin Versifier*, introduced in 1845, by Mr. John Clark, of Bridgewater, after a labour of thirteen years. At the first thought such an invention seems inexplicable, owing to the mental character of the process; but a little inquiry shows that it is only a system of permutations, such as a machine can easily be made to produce. The specimens given in the 'Athenæum' and other public journals at the time are all Latin hexameters, and moreover have all the same grammatical formula and scansion, in respect to dactyls and spondees. The following nine specimens were given, each complete in itself as an hexametric line, but having no connection with the others:

1. Horrida sponsa reis promittunt tempora densa.
2. Sontia tela bonis causabunt agmina crebra.
3. Bellica vota modis promulgant crimina fusca.
4. Aspera pila patet depromunt prælia quædam.
5. Effera sponsa fere confirmant vincula nequam.
6. Barbara tela reis præmonstrant nubila dura.
7. Horrida vota bonis progignunt jurgia crebra.
8. Sontia castra modis prositant somnia fusca.
9. Trucida regna quidem conquirunt opera cara.

The exterior of the machine which composed these lines resembled in size and shape a small bureau bookcase; in the frontispiece of which, through an aperture, the verses appeared in succession as they were composed. Mr. Clark, in a communication to the 'Athenæum' (No. 923) made the following observations on his machine:—"The machine is neither more nor less than a practical illustration of the law of evolution. . . . . The machine contains letters in alphabetical arrangement; out of these, through the medium of numbers, rendered tangible by being expressed by indentures on wheel-work, the instrument selects such as are requisite to form the verse conceived: the components of words suited to form hexameters being alone previously calculated, the harmonious combination of which will be found to be practically interminable."

Mr. A. J. Cooley, in the same journal, pointed out the existence of a forgotten pamphlet, a century and a-half old, in which the author showed how, from a table given, a person might produce millions of hexameter lines. But these were produced by accumulations of words; whereas Mr. Clark's machine, if we rightly understand his description, actually builds up the lines letter by letter.

In 1856 a strange automatic group was exhibited in London. A figure representing a monkey held a violin, moved a bow across the strings, pressed the fingers alternately on them, and clapped its jaws together in token of satisfaction. A hare browsed, or seemed to browse, at a cabbage. A goat uttered an audible cry. A doll-child, that had been quietly reposing in its cradle, woke up uneasily, and screamed aloud for its "Pa" and "Ma." The doll was a failure, in regard of resemblance to a living child; but the monkey, hare, and goat were cleverly constructed, the internal machinery being covered with the real skin of the animals; the form of each animal being well imitated by padding within the skin; and the slight movements of each animal, such as the twinkle of the eye and the twitch of the tail, being reproduced with great exactness.

It affords matter for regret that so much ingenuity should be expended on the production of automata leading to no useful results. There are, however, many machines—for calculating, numbering, registering, stamping, pageing, &c.—which illustrate the application of automatic action to useful purposes. Some of these will be noticed under CALCULATING MACHINES.

AUTOPHON, a kind of barrel-organ, the tunes of which are produced by means of perforated sheets of mill-board, instead of pins or studs, as in the ordinary barrel-organs.

AUXILIARY VERBS are distinguished from other verbs in the following way. Verbs express the notions of *action:* auxiliary verbs, though they originally expressed notions of action, only express *relations of action* when considered as auxiliary verbs, and are accordingly employed, in connection with other verbs, to give to them certain relations called by grammarians tense, mood, and voice. The modern languages of Europe, and our own more particularly, abound in such forms; but they are likewise found in the languages of Greece and Rome, sometimes altogether undisguised, more commonly so completely blended with the main verb as to pass for a mere arbitrary suffix, which the grammarian does not attempt to explain. It is in the very nature of a particle which plays a secondary part, that it should not occupy too large a share of the attention; and thus those verbs which in course of time are used as auxiliaries, though originally as significant as any other verbs, lose something of their distinctive character; so that if the fuller form happen to disappear from a language, the corrupted auxiliary presents anomalies which it is not easy for the philologist to explain. This difficulty is increased by the circumstance, that verbs used as auxiliaries generally throw off much of the distinctive meaning which they originally possessed.

Among the auxiliaries, the most important is the substantive verb signifying *to be;* and, as might be expected, no word has passed through more variations of form. Grimm and other grammarians, indeed, have laid down, that there are three, or even more, distinct roots combined in the conjugation of this verb. But when allowance is made for the known changes that take place in the letters of the alphabet, there will appear, we think, some reason for supposing that all the varying forms of this verb are derived from a common origin.

As the ultimate form from which all the rest appear to us to have flowed, we will propose the root *wes;* and we are inclined to assign to this root, as its primary meaning, the notion of *eating.* Such a form appears in the Latin *vescor* (pronounced wescor), *I eat*, and in the German *wes-en, to be.* The initial *w*, it is well known, sometimes assumes the form of *g*, and hence we have *ge-gess-en, eaten.* Again, as the German verb *lesen* to read forms a past tense, *er las* he read, so *wesen* accounts for the form *was*, common, as the past tense, to English and German. Still more commonly the *w* is altogether dropped, and then we have the root *es*, which is the basis of the Greek substantive verb *es-mi* (the original form), *es-si, es-ti* (still existing in this form in the Lithuanian language), of the old Latin verb *es-um, es, es-t, es-umus, es-tis, es-unt, es-to, es-se*, and with a slight variation of the Sanskrit *as-mi*, &c. With the same form of the Latin we may connect *es-t, he eats, es-se, to eat, es-ca, es-culentus*, &c., and the German *ess-en, to eat.* After the word has thus been stripped of its initial consonant, the short vowel also was apt to disappear, at least in the longer forms. Thus from the old Latin forms *esum, esunt, esim*, &c., there arose the shorter forms *sum, sunt, sim*, &c.; *prae-es-ens, ab-es-sens*, were reduced to *praesens, absens;* and in German we find *sein, to be, sind, they are*, in place of *es-ein, es-ind.*

In the second place, the consonant *s* interchanges with the letter *r*, so that *were* exists by the side of *was*, and *art, are*, with *is.* Thus in the Latin too we have *er-am, er-o.* where more regular forms would have been *es-am, es-o.* Again, the same letter *s* is interchangeable with the dentals *t, d.* Hence, while the Germans have *ess-en, ich ass*, the English express the same notions by *to eat, I ate;* and the Latin tongue uses indifferently *ed-it* or *es-t, he eats, ed-ere* or *es-se, to eat.*

The form *be* is evidently the parent of the German *bin, I am, bist, thou art*, and of the English *be-ing* and *be-en.* With the short vowel changed, it appears in the Lithuanian *bu*, as *bu-ti, to be, buwau, I have been;* and as *b* in English generally corresponds to *f* in Latin, we must claim the Latin *fu-vi* or *fu-i, fu-am, fu-turus*, &c. That these forms are all related among themselves is generally allowed; but the question now proposed is, whether they are not also radically connected with the root *wes.* If it could be shown that the root *be* ever existed with an *s* at the end, it would no longer be thought a violent step to suppose a connection between *bes* and *wes*, more especially when we find the *b* already half way towards a *w* in *fui.* Now, a strong presumption that the root *be* had a sibilant, arises from the old German form *bir-umes, we are*, compared with *war-umes, we were*, in the same language (see Grimm's 'Deutsche Grammatik'). In these words the suffix, which denotes the plural pronoun, cannot claim more than four letters *umes*, thus agreeing very precisely with the Doric Greek suffix *omes*, the Latin *umus*, and the Lithuanian *ame* of the same power. The radical parts then are *bir* and *war;* and as we know the latter to be connected with the form *was*, there is no slight suspicion that *bir* implies an early form, *bis.* If the Greeks lost the *s* in many of their forms derived from the short root *es*, as they did, and if we ourselves have dropped it from *am*, we can scarcely be surprised at its disappearance from the longer form *bes* or *bis.* The notion that the roots *bes* and *wes* are connected, is confirmed again by the other forms in these languages, which represent the idea of eating. In Greek, we find *bo-sco, bo-tos, bo-ra*, in Latin *pasco, pascor*, as well as *vescor.*

The use of this auxiliary in the passive, both in ancient and modern languages, is familiar to all; but it has been less carefully observed, that it is likewise employed in the perfect tenses of the active voice, at least in the Latin language. *Amav-eram, amav-ero, amav-issem, amav-isse*, evidently contain the forms *eram, ero, essem, esse;* and in the perfect subjunctive, an older form, *amaresim*, may be inferred from the three existing forms *amassim, amaverim, amarim;* and in *amavesim* we see the full form *esim* which preceded *sim*. We have left out *amavi* from the series, solely because it would require some space to demonstrate what is yet undoubted, that here too the verb *es*, be, entered. Indeed, in the form *amavistis* we have all we need desire. Probably we ought to have divided the Latin forms just quoted so as to give the *v* to the suffix, *ama-veram*, in which case the Latin perhaps exhibits what is virtually the *w* of *wesen* and *was*.

After the verb *to be*, the next in importance among the auxiliaries is the verb *habe-re*, Latin, *to have;* in German, *hab-en*. Like the preceding verb, this also has undergone great corruptions. In the English *hast, has, had*, the main consonant has already disappeared. While in the Italian *ho*, from the Latin *habeo*, we find nothing of the root but the aspirate, and even that is often omitted, so that we should doubt the connection between the words, but for the first and second persons plural. But as we shall have further occasion for the forms of this verb in the Roman languages of Europe, we will place here the present tenses :—

Latin,	habeo,	habes,	habet;	habemus,	habetis,	habent.
Italian,	ho,	hai,	ha;	abbiamo,	avete,	hanno.
Spanish,	he,	has,	ha;	habémos or hémos,	habéis,	han.
French,	ai,	as,	a;	avons,	avez,	ont.

The use of the verb *to have* in the formation of the perfects, so universal in the modern languages derived from Latin, may be occasionally seen in the parent language also, where such phrases as *furem constrictum habeo, fures constrictos habeo*, differ but slightly in meaning from *furem constrinxi*, &c.; and there was the greater necessity for adopting a new formation, as the Latin perfect unites two tenses in itself, namely, the aorist and the present-perfect. It will be seen too from the examples which we have given, why, in the derived tongues, the participle in some cases agrees with the accusative; as *je les ai tués*. But the use of *habeo* as an auxiliary is not confined to the perfect tenses. In connection with the infinitive it forms a convenient periphrasis for a future. From the Italian infinitive *sentir*, we have a future *sentir-o, -ai, -a, -emo, -ete, -anno*, the first and second persons plural, now they are used as suffixes, being reduced as completely as the rest. In the Spanish verb *hablár* the future is *hablar-é, -as, -á, -émos, -éis, -án;* and in the French from *sentir* there is formed *sentir-ai, -as, -a, -ons, -ez, -ont*. In the tense called generally the conditional, the infinitive is again employed. The Italians unite with it their perfect tense of *to have*, derived from *habui*, namely, *ebbi, avesti, ebbe, avemmo, aveste, ebbero;* and their conditional is *sentir-ei, -esti, -ebbe, -emmo, -este, -ebbero*. On the other hand, the French employ *avois*, which may be proved to have been derived from the Latin imperfect *habebam;* but as *avons, avez*, of the present dropped their radical letters *av*, when attached as suffixes to the future, so also *avois*, &c., throughout lose the same letters in forming the conditional, thus, *sentir-ois, -ois, -oit, -ions, -iez, -oient*. The Spanish language, in like manner, employs the imperfect *había, habías, había, habíamos, habíais, habían*, derived also from *habebam*, &c.; and thus, with the same suppression of the first two letters, the conditional of *hablar* is *hablar-ía, -ías, -ía, -íamos, -íais, -ían*. This view of the formation of the futures is of service in explaining the apparent irregularities so often found in those tenses, which moreover generally extend to the infinitive. This explanation of the futures and conditionals in these three languages we take from the writings of the French philologist Raynouard.

Many other verbs of the Latin language have become auxiliaries in the derived languages: 1. *Vado*, Lat. *I go*, is employed thus by the Italians, as *io vo faciendo, I am doing;* and in French for a future, *je vais parler, I am going to speak*. 2. *Venio*, Lat. *I come*, in Italian as an equivalent for the verb *to be, egli vien riputato, he is considered;* in French to denote an action just passed, *il vient de trouver, he has just found*. 3. *Ambula-re*, Lat. *to walk* (corrupted into the Italian *andare* and the French *aller*), is used in the former language thus, *andra rovinato, he will be ruined;* and in the French, *il alloit dîner, he was going to dine*. 4. *Sta-re*, Lat. *to stand*, in Italian *sono stato, I have been, sta scrivendo, he is writing;* and the French *étois* or *étais* (formerly *estois*) is a corruption from *stabam*, precisely as *aimois* from *amabam*. The Spaniards, besides several of the auxiliaries here mentioned, use *tener*, derived from the Latin *tene-re, to hold*, but not exactly as an auxiliary verb: and besides *ser, to be*, they have *estár, to be*, from the Latin *stare*. In the Teutonic languages the auxiliary verbs are very numerous, and our own language contains nearly the whole of them: 1. *may, might*, are the present and perfect of the same defective verb. In the German we find an infinitive of this verb *mög-en*, as well as the forms *mag*, and *mochte;* 2. *can* and *could* correspond to the German *kann* and *konnte* from the infinitive *könn-en;* 3. *will* and *would* to the German *will* and *wollte* from *woll-en;* 4. *shall* and *should* to *soll* and *sollte* from *sollen*, originally meaning to owe.

But though the German auxiliaries correspond with the English as to their having a common origin, they have a use which is not quite the same. "In general, *possibility* is expressed by *können, dürfen* (the English *dare, durst*), *mögen*, and *necessity* by *müssen* (the English *must*), *sollen, wollen; lassen* (the English *let*) implies necessity as well as possibility." (Becker's 'German Grammar,' p. 65.) The German word *haben*, like the corresponding English *have*, and the German *werden*, when used alone, are notional verbs, or verbs expressing a distinct notion and not a mere relation: thus we can say, *er wird reich, he becomes rich;* but in the expressions *ich werde kommen, I will come, die frage wird von ihm beantwortet, the question is answered by him*, the verb *werden* is used as an auxiliary for the future tense and the passive voice respectively.

AVALANCHES are the most dangerous and terrible phenomena to which the valleys embosomed between high, snow-topped mountain ranges are exposed. They are especially frequent in the Alps, owing to the steepness of their declivities, but they are also known in other mountain regions, as in the Pyrenees, in Norway, and in the Himalaya. They originate in the higher region of the mountains, when the accumulation of snow becomes so great that the inclined plane on which the mass rests cannot any longer support it. It is then pushed down the declivity by its own weight, and precipitated into the subjacent valley, where it often destroys forests and villages, buries men and cattle, and sometimes fills up the rivers and stops their course. Besides these destructive effects, it has been stated that persons are often killed and houses overthrown by the sudden compression of the air, caused by the incredible velocity with which these enormous masses finally descend. But this subject does not appear to have been philosophically examined; the statement must be regarded as doubtful.

Four different kinds of avalanches may be distinguished: drift avalanches, rolling avalanches, sliding avalanches, and glacier or ice avalanches, of which the first commonly take place in the early part of winter, the second and third at the end of winter and in spring, and the last only in summer.

The drift or loose snow avalanches (called, in Switzerland, staublauinen) take place when heavy snow has fallen in the upper region of the mountains during a still calm, and this accumulated mass, before it acquires consistency, is put in motion by a strong wind. The snow is driven from one acclivity to another, and so enormously increased in its progress, that it brings down an incredible volume of loose snow, which often covers great part of a valley. The damage caused by these avalanches, is, however, generally not very great, because most of the objects covered by them may be freed from the snow without having sustained great damage; but they are said often to produce such a compression of the air that houses are overturned, and men and cattle suffocated. This latter effect, if rightly attributable to such a cause, has not yet been explained.

The rolling avalanches are much more dangerous and destructive. These take place when, after a thaw, the snow becomes clammy, and the single grains or flocks stick to one another, so as to unite—by the process of regelation, first recognized by Faraday and since investigated by Tyndall [ICE,]—into large hard pieces which commonly take the form of balls. Such a ball, moved by its own weight, begins to descend the inclined plane, and all the snow it meets in its course downwards sticks firmly to it. This snow-mass, increasing rapidly in its progress, and descending with great velocity, covers, destroys, or carries away everything that opposes its course—trees, forests, houses, and rocks. This is the most destructive of avalanches, and causes great loss of life and property. In the year 1749, the whole village of Rueras, in the valley of Tawich, in the canton of the Grisons, was covered, and at the same time removed from its site, by an avalanche of this description; but this change, which happened in the night time, was effected without the least noise, so that the inhabitants were not aware of it, and on awaking in the morning could not conceive why it did not grow day. A hundred persons were dug out of the snow, sixty of whom were still alive, the interstices between the snow containing sufficient air to support life. In the spring of 1755, after a very low barometer, and enormous falls of rain in the plains and snow in the mountains of Piedmont, many destructive avalanches took place, by which two hundred persons were killed. One of them, on the 19th of March, overwhelmed the village of Bergemoletto, in a manner fatal to many of the inhabitants; but two women and a girl, who had taken shelter from the rigour of the weather in a stable, after remaining under the mass of snow for thirty-seven days, were dug out alive, and eventually recovered from the effects of their confinement and privations. The avalanches of the Savoy Alps, and the circumstances of this event, are described in a somewhat celebrated Italian work by Ignazio Somis, Professor of Medicine in the University of Turin, and physician to Charles Emanuel III. king of Sardinia, published at Turin in 1758, and of which an English translation appeared in 1765. He enters into a physiological and experimental investigation of the case, and of the condition of the sufferers, both during and after their misfortune, ascribing their preservation to the continual disengagement of fresh air from the melting snow; and as it has been proved that the air in melted snow and in rain water contains much more oxygen than that of the atmosphere, it is probable that this assisted to counteract the effects of want of ventilation, and that therefore Somis was right in his conclusion, though the state of pneumatic chemistry at the time precluded his knowing all the facts of the case. In 1806, an avalanche descended into Val Calanca, likewise in the canton of the Grisons, transplanted a forest from one side of the valley to the other, and placed a fir tree on the roof of a parsonage-house. In 1820, sixty-four persons were killed in Fettan, in the high valley of Engadin, in the country of the Grisons; and, in the same year, eighty-four persons and four hundred head of cattle, in Obergestelen, and twenty-three persons at Brieg, both situated in the canton of Valais. In the same country, the village of Briel was almost entirely covered by an avalanche in 1827.

Many thousands of strong trees are destroyed by these avalanches, either by being broken off near the ground, or by being rooted up, shivered to pieces, and thus precipitated into the valley. Where the avalanches are of common occurrence, the inhabitants of the valleys know the places where they come down, and by observing the changes of the weather, they are able to foretell the time of their descent. They also endeavour to protect themselves by preserving the forests in the paths of the avalanches, and by erecting massive edifices of a particular construction, placed against projecting rocks.

The sliding avalanches (rutsch lauinen, also called suoggi (pron. suggy) lauinen in Switzerland) originate on the lower and less steep declivities, when, after a long thaw in spring, those layers of the snowy covering which are nearest the ground are dissolved into water, and thus the bond is loosened which unites the mass to its base. The whole snowy covering of a declivity then begins to move slowly down the slippery slope, and to carry before it everything which is too weak to withstand its pressure. When an object does not directly give way to the mass, it is either borne down by the snow accumulating behind it, or the whole mass divides, and proceeds in its course on each side of it.

The ice or glacier avalanches are nothing but pieces of ice which formerly constituted a part of a glacier, but, loosened by the summer heat, are detached from the principal mass, and precipitated down with a noise like thunder. They are commonly broken into small pieces by the rocks which they meet in their progress. When seen from a distance, they resemble the cataracts of a powerful stream. In the valley of Grindelwald, in the canton of Berne, they may be often seen; and at the base of the Jungfrau, the noise which accompanies their fall is almost continually heard. They are less destructive than the other avalanches, because they descend only upon places which are not inhabited.

Occasionally the avalanches change their character in their progress. When the declivity is not too great, and the ground under it not too slippery, the mass of snow begins to slide; but arriving at a precipitous descent, its velocity and its mass are greatly increased, and it begins to roll. If, at this stage of its course, it meets a strong, craggy rock, the mass is instantly divided into innumerable small pieces, and thus it appears at the end of its progress like a drift avalanche.

In the spring season, travellers in the Alps take every precaution to avoid being overwhelmed by these falls of masses of snow. The guides urge them to refrain from causing noise, lest the agitation of the air should occasion an avalanche. In Switzerland, for the same reason, the mule-bells are made silent, and in dangerous localities, before descending into the valleys, it is usual, by the discharge of fire-arms, to determine the fall of the snow which a concussion of the atmosphere may bring down.

Avalanches is the common French expression for these natural phenomena; but in those districts of France which are situated between the ranges of the Alps, they have other names: as avalanges, lavanches, lavanges, lavanzes, lids, lits, lydts. The drift avalanches are also termed lauvines venteuses, and the rolling, lauvines joncières. In Italian they are called lavina, lavine, labine, and valanca; and in the Rhetic dialect of the Grisons, lavina and lavigna. Among the German inhabitants of Switzerland, they are named lauinen, lauwinen, lauwen, leuen, lowen, and lahnen. In the Pyrenees they are sometimes called congeres; and in Norway, snee-shred, and snee-fond. (Kasthofer's 'Observations on a Journey through the Alps,' &c.)

The avalanches or snow-slips of northern India have been noticed by Dr. Thomas Thomson, F.R.S., in his 'Western Himalaya and Thibet.' In Rondu, on the Indus, in February 1848, the progress of the thaw, he states, occasioned constant avalanches, the snow slipping from the steep sides of the ravines, and when once in motion, advancing with constantly increasing momentum, till it reached the lowest level. "All day long," he relates, "the mountains echoed with the sound of falling snow; the avalanches were not often visible, as they took place in the ravines, but now and then (where the ravines terminated in precipices) they were seen pouring in cataracts of snow over the face of the cliffs. In each large ravine which joined the Indus I found one of these gigantic avalanches, and was enabled to see that they were composed of a congeries of balls of snow, varying in diameter from one to six feet, and often containing fragments of rock in their centre. Many of these snow-streams were not less than forty or fifty feet thick. At the level of the Indus they were now very soft, and evidently thawing rapidly."

At Kharbu, in the Dras valley, early in April, the fallen avalanches, universal in the ravines, were cut off abruptly by the river (a tributary of the Indus), forming cliffs of snow fifteen or twenty feet high, in which the structure and development of the mass by successive slips, alternating with falls of snow, could be distinctly made out. One or two of them still crossed the river, which flowed below the bridge of ice thus formed. In the northernmost valley of Cashmere, that of the river Sind, another affluent of the Indus, in one of the ravines which furrow the mountain slopes, Dr. Thomson witnessed the descent of one of these avalanches, having been warned by the sound that it was approaching, and had time to attain a place of safety before it came near. When it came into sight, the ravine, which was narrow and deep, was completely filled by balls of snow of various dimensions, which continued to flow past for several minutes. The snow-slip terminated in the river, which was speedily blocked up for two-thirds of its width with an immense accumulation of snow. The narrow rocky gorge of the river, further to the south, after the 16th of April, was in many places still blocked up with snow, which had descended in avalanches down the ravines, and had accumulated in the bed of the stream; the travellers having three times to cross the river on these snow beds.

In the Himalaya, therefore, as in Europe, the agency of the process of regelation is evident; the partially melted snow, from the time of its beginning to slip, gradually resuming its frozen condition, as it accumulates into balls, and finally into masses.

AVANTURINE GLASS. [GLASS MANUFACTURE.]

AVATA'RA is a Sanskrit word, which properly signifies "a descent, or the act of descending"—for example, from a boat or other vehicle,—but is particularly applied to the incarnations of the Hindoo deities, or their appearance in some manifest shape upon earth. Our information regarding the successive development of religious and mythological ideas among the Hindoos, is not yet perfect. It appears, however, that the doctrine of the Avatâras belongs to a comparatively recent period, and are chronicled with considerable variations in different Puranas. Those portions of the Vedas or sacred writings of the Hindoos to which, from the style and structure of their language, the highest antiquity may with safety be attributed, inculcate the worship of elements and deified natural powers, but do not allude to those apparently more spiritualised deities that require to be invested with a bodily frame to operate in the material world.

The number of the Avatâras mentioned in the Puranas, or legendary poems of the Hindoos, is very great. Those of Vishnu alone, who is distinguished by the character of 'Preserver' in the Trimûrti, or triad of the principal Hindoo deities, are stated to be endless. They are variously enumerated; but all accounts seem to agree in selecting the following ten as the most conspicuous:—

1. *Matsya*, the Fish, under which form Vishnu preserved Manu, the ancestor of the present human race, during a universal deluge.

2. *Kûrma*, the Tortoise, which incarnation Vishnu underwent in order to support the entire earth, when the celestial gods and their opponents the Asuras, or Daityas, were churning the sea (using Mount Mandara as a churnstaff) for the beverage of immortality (amrita).

3. *Varâha*, the Boar. Vishnu, with the head of a monstrous boar, is represented as slaying Hiranyâksha, the chief of the Asuras, who had taken possession of the celestial regions, and as uplifting the earth, which had been sunk to the bottom of the sea.

4. In his incarnation as *Narasinha*, a being half man and half lion, Vishnu killed Hiranyakasipu, the brother of Hiranyâksha.

5. The form of *Vâmana*, the Dwarf, was assumed by Vishnu to humble the pride of King Bali. He went to a sacrifice which the king was performing, and supplicated for as much ground as he could measure with three steps, which request being granted, the dwarf suddenly grew to an immense size, and with his steps comprised earth, mid-air, and heaven.

6. Vishnu appeared in a human form, as *Parasurâma*, the son of Jamadagni and Rênukâ, in order to preserve mankind, and especially the Brahmans, from the tyranny of the military tribe of the Kshatriyas.

7. Vishnu was born as the four sons of King Dasaratha, and, under the names of *Râma*, *Lakshmana*, *Bharata*, and *Satrughna*, in order to destroy Râvana, the Daitya sovereign of Ceylon, and other demons who were then infesting the earth. The actions of Râma, who was the chief hero, form the subject of a celebrated epic poem in Sanskrit, called the Râmâyana, and attributed to the ancient sage Vâlmiki. One of the most remarkable of his exploits is, that he is said to have "humbled the pride of Parasurâma," who, as just mentioned, was an incarnation of Vishnu also; and the cause of the humbling is stated to have been the slaughter of the Kshatriyas.

8. The most celebrated of the Avatâras of Vishnu is his appearance in the human form of *Krishna*, in which he is supposed to have been wholly and completely incarnate, whereas the other Avatâras are only considered as emanations from his being. Krishna assisted the family of the Pândavas in their war with the Kurus, and through them relieved the earth from the Daityas and the wicked men who oppressed it. The history of this conflict is told at length in the Mahâbhârata, another great epic poem in Sanskrit. He also slew Kansa, the king of Mathura, after a number of adventures.

9. *Buddha* is, by the followers of the Brahmanical religion, considered as a delusive incarnation of Vishnu, assumed by him in order to induce the Asuras to abandon the sacred ordinances of the Vedas, by which they lost their strength and supremacy.

10. *Kalki* is the name of an Avatâra in which Vishnu will appear at the end of the Kaliyuga, or present age of the world, to destroy all vice and wickedness, and to restore the world to virtue and purity.

We cannot enumerate the Avatâras of the inferior deities, in which the mythology of the Hindoos abounds. There is no mention of any Avatâr of Brahmâ and of Siva, the two supreme deities who, with Vishnu, constitute the Trimûrti; they are only repeated births, always in the form of a youth, but of various colours. In the seventh volume of the 'Asiatic Researches' (Calcutta, 1801) may be seen an account given by Captain Edward Moor of an incarnation of Ganesa, or Ganapati, which had, since the year 1640, become hereditary in the family of Mooraba Gosain, a Brahman, at Punah. Mrs. Graham, who in 1809 visited this living Avatâra, which was then a child, has given an interesting notice of it in her journal.

(See the articles MANU, RAMA, KRISHNA, and BUDDHA; Bohlen, *Das alte Indien*; Vans Kennedy, *Researches into the Nature and Affinity of Ancient and Hindu Mythology*, 4to, London, 1831; H. H. Wilson, *The Vishnu Purana; a system of Hindoo Theology and Tradition*, 4to, 1840.)

A'VE MARI'A, the two first words of a short Latin prayer or invocation to the Virgin Mary, said by Roman Catholics in their orisons. As a prayer it only became established in the 13th century when it was enlarged, and in 1508 it was completed and finally sanctioned by Pope Pius V. The first part of the prayer is merely a repetition of the salutation of the angel to Mary on her conception. (St. Luke, i. 28.) The second part is an entreaty to the Virgin "to pray for the salvation of sinners now and at the time of their death." The recital of the Ave Maria generally follows that of the Pater Noster, or Lord's Prayer.

Ave Maria is also in Italy the name of a particular time of the day, about half an hour after sunset, when the church bells ring, and pious persons leave off for a moment their occupations or pastimes and ejaculate the Ave Maria. It is also called the Angelus in other catholic countries. To this custom Byron alludes in these fine lines,—

> Ave Maria! blessed be the hour!
> The time, the clime, the spot where I so oft
> Have felt that moment in its fullest power
> Sink o'er the earth so beautiful and soft,
> While swung the deep bell in the distant tower,
> Or the faint dying day hymn stole aloft,
> And not a breath crept through the rosy air,
> And yet the forest leaves seem'd stirr'd with prayer.
>
> *Don Juan*, Canto III.

In many churches, and especially convents, the bells are also rung at the first dawn of day, and this is called in Italy the morning Ave Maria, *l'Ave Maria del giorno.*

AVERAGE is a quantity intermediate to a number of other quantities, so that the sum total of its excesses above those which are less, is equal to the sum total of its defects from those which are greater. Or, the average is the quantity which will remain in each of a number of lots, if we take from one and add to another till all have the same; it being supposed that there is no fund to increase any one lot, except what comes from the reduction of others. Thus, 7 is the average of 2, 3, 4, 6, 13, and 14; for the sum of the excesses of 7 above 2, 3, 4, and 6—that is, the sum of 5, 4, 3, and 1—is 13; and the sum of the defects of 7 from 13 and 14—that is, the sum of 6 and 7—is also 13. Similarly, the average of 6 and 7 is $6\frac{1}{2}$. To find the average of any number of quantities, *add them all together, and divide by the number of quantities.* Thus, in the preceding question, add together 2, 3, 4, 6, 13, and 14, which gives 42; divide by the number of them, or 6, which gives 7, the average.

It must be remembered that the average of a set of averages is not the average of the whole, unless there are equal numbers of quantities in each set averaged. This will be seen by taking the average of the whole, without having recourse to the partial averages. For instance, if 10 men have on the average 100*l.*, and 50 other men have on the average 300*l.*, the average sum possessed by each individual is not the average of 100*l.* and 300*l.*; for the 10 men have among them 1000*l.*, and the 50 men have among them 15,000*l.*, being 16,000*l.* in all. This, divided into 60 parts, gives 266*l.* 13*s.* 4*d.* to each. A neglect of this remark might lead to erroneous estimates; as, for instance, if a harvest were called good because an average bushel of its corn was better than that of another, without taking into account the number of bushels of the two.

The average quantity is a valuable common sense test of the goodness or badness of any particular lot, but only when there is a perfect similarity of circumstances in the things compared. For instance, no one would think of calling a tree well grown because it gave more timber than the average of all trees; but if any particular tree, say an oak, yielded more timber than the average of all oaks of the same age, it would be called good, because if every oak gave the same, the quantity of oak timber would be greater than it is. It must also be remembered that the value of the average, in the information which it gives, diminishes as the quantities averaged vary more from each other; but this and other points connected with averages will be mentioned more fully in the article MEAN, this being the mathematical word which is used in the same sense as average in common life.

AVERAGE. In Marine Insurance this term is applied to the mode and ratio of compensation for losses, not being total losses of both ship and cargo. Average is of two kinds, 'General' and 'Particular.'

General Average is a term used indiscriminately, sometimes to denote the *kind of loss which gives a claim to general average contribution*, and sometimes to denote *such contribution itself.* To avoid confusion it is better to use the term *general average loss* when speaking of the *former*, and *general average contribution* when speaking of the *latter.* All losses which give a claim to general average contribution may be divided into great classes:—1. Those which arise from extraordinary *sacrifices* of part of the ship or part of the cargo, purposely and reasonably made in order to save the whole adventure from perishing. 2. Those which arise out of extraordinary *expenses* incurred for the joint benefit of both ship and cargo. Losses of the first class, and those limited to jetsam of cargo, are alone mentioned in the text of that Rhodian law which is generally regarded as the foundation of the whole doctrine of general average; *jactus factus levandæ vadis patiâ.* A general average loss may be defined to be, "a loss arising out of extraordinary sacrifices made, or extraordinary expenses incurred, for the joint benefit of ship and cargo." A general average contribution may be defined to be "a contribution by all parties in a sea adventure, to make good the loss which has been sustained by one or more of their co-adventurers, from sacrifices made or expenses incurred for the general benefit." This contribution is assessed upon each adventurer in proportion to the value of his *whole* property actually at risk as, or as though, finally saved by the *sacrifice*, or at the time it was benefited by the *expenditure.* This contribution is ordinarily insured against; and when ascertained by *adjustment of general average*, is settled by the underwriters.

Particular Average loss differs from general average loss, both as to its cause and the mode of its compensation. It is a partial loss arising from damage accidentally and proximately caused by the perils insured against, or from extraordinary expenditure necessarily incurred for the sole benefit of some particular interest, as of the ship alone, or the cargo alone. This damage or expenditure, instead of being contributed for by the general body of adventurers, falls entirely upon the *particular* owner of the property deteriorated by the damage, or benefited by the expenditure; and such owner, if insured, has a claim against his underwriter in proportion:—1st., to the degree by which the damage sustained, or the expenditure to be refunded, may have diminished the value to him of the property as insured; and 2nd, to the sum insured.

It may further be observed, that certain charges called *Petty Averages*, being the ordinary charges at the places of loading and unloading, and during the voyage, and formerly borne *one-third* by the ship, and *two-thirds* by the cargo, are now usually compounded for in bills of lading by provision for the payment of 5 per cent. calculated on freight, and 5 per cent. more for primage charged on the captain—'primage and average accustomed.' A good deal of difficulty and complication often arises upon the adjustment of averages, and 'Averages Staters' now carry on a distinct business in commercial countries. (Arnould on 'Marine Insurance and Average,' 2nd edit., p. 894, et seq.)

AVOCA'T, a French word, derived from the Latin *advocatus*, and corresponding to the English counsellor at law. [ADVOCATE.] In French law language the avocats are distinguished into avocats plaidans, who answer to our barristers, and avocats consultans, called also jurisconsultes, a kind of chamber counsel, who do not plead in court, but give their opinion on intricate points of law. Under the old monarchy the avocats were classed, with regard to professional rank, into various categories, such as avocats au conseil, who conducted and pleaded causes brought before the king's council; they were seventy in number, and were appointed by the chancellor; they were considered as attached to the king's court: and avocats généraux, who pleaded before the parliaments and other superior courts, in all causes in which the king, the church, communities, and minors were interested. At first the avocats généraux were styled avocats du roi, and the other barristers who pleaded in private causes were called avocats généraux, but towards the end of the 17th, or the beginning of the 18th century, these appellations were changed, the avocats du roi were styled avocats généraux, and three of them were appointed to each superior court, while the counsel who filled the same office before the inferior courts assumed the name of avocats du roi. ('Répertoire Universel de Jurisprudence,' and 'Dictionnaire de l'Académie.') Avocat fiscal was a law-officer in a ducal or other seignorial court of justice, answering to the avocat du roi in a royal court.

At present there are in France avocats au conseil d'état; avocats généraux, of whom there are five at the Court of Cassation or Supreme Court, four at the Cour Impériale of Paris, besides substitutes, and two or three at each Cour Impériale in the departments. The practising barristers are classed into avocats à la Cour de Cassation, who are fifty in number, and who conduct exclusively all causes before that court; and avocats à la Cour Impériale, who plead before the various imperial courts. All avocats must be licentiates in Law, take the oath before a court of appeal (Cour Impériale), and show that they have a domicile in Paris. There is a roll of the advocates practising in each court. Candidates are admitted by the Council of Discipline after a probationary term. The members of the council are elected by ballot, by the advocates inscribed on the roll, and their functions last for the judicial year. The avoués (attorneys), are public ministerial officers, whose business it is to represent the parties before the court and before the tribunals, although their duty, strictly speaking, is to place the judges in a position to come to a decision (postuler), and to present to them in the form of abridged propositions the claims of the parties (conclure) yet they may in some cases undertake the defence orally, as, for example, when the number of advocates is not sufficient for the despatch of business (R. Jones's 'History of the French Bar'). The word avoué, in canon law, meant the protector or guardian of some church, abbey, or monastery, or other ecclesiastical community and jurisdiction, and by their authority all contracts relating to these corporations were made; in some ancient charters we find proofs that in gifts to the church or monastery, the conveyance was made personally to the avoué. In the middle ages he was generally some feudal lord who took care of the temporal interests of the community, and defended them either in court or field. Thus Charlemagne accepted the title of avoué of St. Peter; Hugh, that of St. Riquier; and mention is made by Bolland, of letters of Pope Nicholas, constituting St. Edward, king of England, and his successors, avoués of the monastery of Westminster and of all churches in England. The avoué dispensed justice in the name of the ecclesiastical superiors in all places under their jurisdiction, and commanded the forces assembled in their defence. In German he was called "kastvogt;" the name occurs often in the history of the middle ages.

AVOIDANCE OF A BENEFICE. [BENEFICE; CESSION.]

AVOIRDUPOIS, or AVERDUPOIS, the name given to the common system of weights in England, now applied to all goods except the precious metals and medicines. Thus, a pound of tea is a pound *averdupois*, and contains 7000 grains; a pound of gold is a pound *troy*, and contains 5760 grains. The word has been supposed to be derived from the French *avoir du poids*, to have weight; but considering that *averdupois* is the more ancient mode of spelling the word, and that the obsolete French verb *averer*, and the middle Latin word *averare*, signify to *verify* (see Ducange, at the word *Averare*), it is more likely that we are to look here for the true etymology. It has also been supposed that the word is derived from *averia ponderis*, *averia*, and *avera*, being (on the same authority) words used for goods in general.

The ounce averdupois is generally considered as the Roman *uncia*. It contains $437\frac{1}{2}$ grains (N.B. there is but one grain in use amongst us), while the Roman *uncia*, according to Arbuthnot, contains $437\frac{1}{2}$ grains; according to Christiani ('Delle Misure,' &c., Venice, 1760, cited by Dr. Young), it is $415\frac{1}{10}$ grains; and according to Paucton (cited by Dr. Kelly), it is $431\frac{1}{2}$ grains. Whether the preceding be correct or not, we cannot suppose that in any case the supposition could be nearly verified, as our ancestors do not appear to have been very attentive to small weights: for instance, in the list of church gold and silver plate delivered to Henry VIII. (preserved in the Bodleian library), nothing less than an ounce is mentioned, except only once, in which a quarter of an ounce is given.

The ancient pound (now used in Scotland) was heavier than the averdupois, and weighed 7600 grains: the earliest regulations on the subject fix the *troy* weight; the averdupois is mentioned in some orders of Henry VIII., in 1532, and a pound of this sort was placed in the Exchequer as a standard by Elizabeth in 1588. The committee of 1758 found this pound to be $1\frac{1}{2}$ grain less than it should be as deduced from the standard troy pound kept at the Mint, which they attributed to frequent use; but considering the averdupois weight altogether as "of doubtful authority," and troy weight as the one "best known to our law," they recommended the adoption of the latter as a standard, which it has accordingly been ever since, though goods in general are weighed by averdupois weight.

The committee of 1816 made no alteration in the weights, but ascertained the value of the grain, as afterwards described in the Act of Parliament 5 Geo. IV. c. 74: "A cubic inch of distilled water, weighed in air by brass weights, at the temperature of sixty-two degrees of Fahrenheit's thermometer, the barometer being at thirty inches, is equal to two hundred and fifty-two grains, and four hundred and fifty-eight thousandth parts of a grain." The pound averdupois contains 7000 such grains. From this it may be deduced that a cubic foot of water, under the above conditions, weighs 997·14 ounces, which, being very nearly 1000 ounces, gives an expeditious rule for roughly deducing the real weight of a cubic foot of any substance from its specific gravity. For example, if the specific gravity of gold be 19·36, the weight of a cubic foot of gold is 19,360 ounces averdupois. If more accuracy be required, subtract three for every thousand from the result.

The averdupois pound is divided as follows:—

Grains.	Dram.		
$27\frac{11}{32}$	1	Ounce.	
$437\frac{1}{2}$	16	1	Pound.
7000	256	16	1

28 pounds make one quarter.
112 pounds, or 4 quarters, one hundred weight.
20 hundred weight, one ton.

The ounce is more commonly divided into quarters than into drams
The usual contractions are as follows:—

grain	gr.	pound	lb.
dram	dr.	quarter	qr.
ounce	oz.	hundred weight	cwt.

To reduce a large number of pounds to hundred weights roughly, *from all but two figures take all but three.* Thus 17,684 pounds contain 159 hundred weight, done as follows:—

	176
Subtract	17
	159

The pound averdupois is ·45354 of the French kilogramme, and ·9071 of the common French pound. That is, 904 pounds are 410 kilogrammes, and 452 pounds averdupois are 410 French pounds [WEIGHTS and MEASURES].

If decimals be employed: from one *hundredth* of the pounds subtract one *thousandth*, and from the result subtract its *hundredth* part. The result is about one five-hundredth part too small. We give the preceding example, and another which is an obvious verification:—

17,684 llb.	112 llb.
176·84	1·12
17·68	·112
159·16	1·008
1·59	·010
157·57	·998

AVOWRY. [REPLEVIN.]

AVOYER is a term derived from the Latin *advocatus*. *Avoué* or *Avoyer* was no doubt a French form or corruption of *advocatus*, and was applied in general to the lay champion or guardian of the church. In South Germany and Switzerland, however, a country so anciently and universally of ecclesiastical organisation, the officers who ruled as deputies of the emperor were induced to designate their authority by the title which was most general in the country, viz., the title implying ecclesiastical authority. Thus we find in the beginning of the 13th century, Berthold, Duke of Zähringen, styled the emperor's *advocatus* in these regions, and Rodolph afterwards was advocatus of Suevia. This term, half Germanised, half Gallicised (for the Burgundians then governed the plains of Western Switzerland), became in common parlance *Avoyer*, and was assumed by the magistrates of such towns as had attained the rank of *Imperial*. This meant that they belonged nominally to the emperor, which privilege rendered them independent of, and on a level with, the feudal aristocracy. The magistrates of Swiss cities assumed the title of *Avoyer*, to which the German term Schultheissen is equivalent, but the title sunk everywhere into disuse, except at Berne, in which town it lasted till the revolution of 1794.

In an amusing account of Switzerland (published in 1704), by Temple Stanyan, Esq., the reader will find a full description of the dignity and duties of these officers, who were two in number and were at the head of the government of the Canton, retaining their employments for life, but exercising them annually by turns.

AWARD. [ARBITRATION.]

AXIOM, a word derived from the Greek ἀξίωμα, which is formed from the Greek verb ἀξιόω, *to think worthy of*; and thence to *desire* or *demand*. It was not used in the time of Euclid, by whom the principles which we call axioms are termed *κοιναὶ ἔννοιαι*, or *common notions*. The word was not in universal use as late as the year 1600, at which date we find "*communis sententia*" preferred to "*axioma*." (See Chambers' edition of 'Barlaam,' Paris, 1599.)

The term axiom was originally peculiar to geometry, in which science it came to mean a proposition which it is necessary to take for granted. It is usual to define an axiom as a *self-evident proposition*; but this, though a true description of all the axioms which are found necessary, is not a good definition. In the first place, it is well known that the geometer must deduce the properties of space in the best way he can, from the smallest possible number of the most evident principles; and it must be his study so to choose them, that his own mind, or that of his pupil or opponent, shall be at the least possible expense of concession. But he cannot say beforehand that his science *shall* be deduced from self-evident principles. Imagine a person of cultivated reasoning powers first approaching geometry, and capable of being made to take a view of the general objects of the science. It would not appear to him certain that he should be able to deduce all the properties of figure from those which are self-evident; on the contrary, he might suspect that he would be obliged to have recourse to actual measurement, in order to verify some essential preliminaries. At least no answer could be given to him, if he did express such a suspicion, except a reference to the science itself; and this clogs an axiom, defined as a self-evident proposition, with a condition which can only be verified by subsequent study.

In the second place, a self-evident proposition, as such, ought not to be called an axiom, because it is not admitted as such in geometry, however evident it may be, provided it can be proved from those propositions which *are* called axioms. That two sides of a triangle are greater than the third, has a greater degree of evidence than some of the admitted axioms; yet it is not taken for granted, because it can be deduced from these.

The Epicureans are said to have laughed at geometry, because, among other things, it proves the proposition that two sides of a triangle are greater than the third; which, said they, is evident even to a jackass, who always makes practical use of it in going from one place to another. This evidently arises from the mistake that a geometrical axiom is self-evident, and that all self-evident propositions ought to be axioms. And the oldest remaining opponent of geometry, Sextus Empiricus, has a chapter upon the subject ('Pyrrhoniarum Hypotyposeon,' lib. ii. cap. 11); on which, as on most other things of the same sort, it may be safely averred that the axioms of geometry themselves are much clearer than the axioms of psychology on which the opposition to them is grounded. For it is not to be supposed that the opponents of axioms take first principles which are more evident than that "the whole is greater than its part," or that "two straight lines cannot inclose a space."

The necessity that there should be some axioms is evident from the process of reasoning. The deduction of propositions from the comparison of other propositions must have a beginning somewhere, so that there must be at least two propositions to begin with, the evidence of which is derived from other sources than reasoning. Every attempt which has been made to dispense with axioms altogether, has, as might be expected, proved unsuccessful; somewhere or other in the process assumed theorems have been found.

The more modern discussions which have arisen about axioms appear to us to proceed from some fallacy of this sort, that the idea conveyed by the whole of a sentence must be more complicated than that conveyed by any one of its parts; or at least, that it must always be necessary to enter separately upon the consideration of the auxiliary forms of speech in which a simple idea is conveyed, before that idea can be said to be explained. As an instance, in that most simple of all propositions, "two and two are the same as four," which by itself is comprehended as soon as spoken, we have the (by itself) difficult phrase "are the same," implying identity, and leading, if pursued far enough, to many very abstruse metaphysical considerations. These, in their proper science, and considered with reference to other objects, are not misplaced; but, as applied to geometry, are not only unnecessary, but subversive of the natural order of reasoning; for however much may be said upon maxims, axioms, first principles, or by whatever name they may be called, there remains the simple proposition, "two and two are the same as four," clearer, as a whole, than any one of the explanations, illustrations, or comments, which have been brought to its aid. There is however this to be said for many writers who have endeavoured to make such points better known than they are already; namely, that the older writers, in their love of what is called the *à priori* method, had filled their books with notions against which it was necessary to contend; whence sprung a confirmed habit of reasoning upon the nature of self-evident propositions. Locke (book iv. chap. 7), 'On Maxims,' can hardly be intelligible to a reader who has not some knowledge of what the school writers have said upon our simplest perceptions, which rendered it necessary to contend both against words without meaning, as when they said some such thing as that "knowledge is the likeness of the thing known, formed in the knowing faculty;" and also against assumptions of a very dubious character, such as "general propositions are known, at least sometimes, before particular ones."

All the oldest manuscripts of Euclid, the summary of Boethius, the commentary of Proclus, the Arabic translations, and the earlier European editions, agree in what is no doubt Euclid's plan, of distinguishing assumptions distinctly relating to space, under the name of *postulates* (αἰτήματα), from assumptions which equally relate to other kinds of magnitude, under the name of *common notions* (κοιναὶ ἔννοιαι). We cannot find out who first made the alteration which Robert Simson has adopted: it appears in Gregory's Greek text. This modern alteration converts the postulate into an assumed *problem*, and the axiom into an assumed *theorem*; but the distinction of propositions into problems and theorems does not exist in Euclid's work; it is an addition of editors. The more recent Greek texts have returned to Euclid's distinction, and we hope translations will in time follow them. We give Euclid's collection of postulates and common notions at length.

Postulates.—1. Let it be granted, from any point to any point, to draw a straight line. 2. Also, to lengthen a finished straight line, and continue it straight. 3. Also, with any centre and radius (διάστημα, meaning *interval measured from that centre*) to describe a circle. 4. Also, all right angles are equal to one another. 5. Also, if a straight line, falling upon two straight lines, make the angles which are within and upon the same side less than two right angles, the two straight lines, being lengthened without end, shall meet one another upon that side on which the angles are less than two right angles. 6. Also, two straight lines cannot inclose a space.

Common Notions.—1. Things equal to the same are equal to one another. 2. Also, if equals be added to equals, the wholes are equals. 3. Also, if from equals equals be taken, the remainders are equals. 4. Also, if to unequals equals be added, the wholes are unequals. 5. Also, if from unequals equals be taken, the remainders are unequals. 6. Also, things which are double of the same are equal to one another. 7. Also, things which are halves of the same are equal to one another. 8. Also, things which fit one another (have the same boundary) are equals. Also, the whole is greater than the part.

Euclid has not stated *all* the properties of space which he takes for granted. It is our belief that his work was not written for elementary students, but was a controversial treatise on the question, Can geometry be formed into a demonstrated system, resting upon definite postulates? We imagine that when he collected his postulates, six in number, and put them forward at the head of the first book, he did not thereby intend to collect everything which he assumed, but only his own selection from the theorems the postulation of which had been matter of discussion. The theorems which all parties had admitted without question among postulates, we suspect him to have left unnoticed. In the following list will be found Euclid's postulates, with the substitutions we have recommended above, and all the postulates which are tacitly assumed; giving, we believe, a full account of all the theorems relating to space and figure only, which the student of the first six books will be required to assume:—

1. Any two points may be joined by a straight line. 2. Any terminated straight line may be indefinitely lengthened. 3. A circle may be drawn with any centre, and any distance terminated at that centre as a radius. 4. Any point is within or without a circle, according as its distance from the centre is less or greater than the radius. 5. A line drawn from a point within a figure to a point without, cuts the boundary of the figure. 6. A straight line which passes through a point within a figure, will, if sufficiently produced, cut the boundary of the figure in two points, one on each side of the point. 7. A figure may be removed without any alteration of figure from one part of the plane to another, and may be turned round before removal. 8. If two straight lines coincide in two points, they coincide altogether, both between the points and beyond them. 9. A straight line being indefinitely produced both ways, any line drawn from a point on one side of it to a point on the other, must cut the straight line. 10. Two lines which cut one another cannot both be parallel to any third line. 11. If a smaller area be cut out from a larger, the area left is the same from whatever part of the larger the smaller may be taken.

It would hardly be possible to make a list of *all* the "common notions" which Euclid employs. The postulates, or notions concerning space and figure, are the things on which it is most important to dwell with precision.

What is required to be conceded in the first three postulates, is not that a straight line or circle can be imagined to be drawn, in the sense usually attached to these words, but that the *geometrical* line can be drawn, which is *length without breadth.* This is impossible, mechanically speaking, the line being a conception of the mind which cannot be executed. [LINE.]

The last of the "postulates" is a self-evident property of the straight line, a term incapable of other definition than that which is contained in its properties; that is, we can make no use of the obvious notion conveyed in the words "straight line," unless we admit some one or other of its distinguishing characteristics, which is more definite than saying that it lies evenly between its extreme points. We might appear to avoid an axiom by saying, let the name "straight" line be given to that species, no two of which can, under any circumstances, inclose a space; but in that case we should need another axiom—namely, we should require it to be granted that there is such a thing as the straight line so defined, and that we have not assumed any contradiction in supposing the above species of lines to exist. It must be remembered, that though the definitions are placed at the beginning in Euclid, it is not thereby implied that the terms defined are really possible. "Let lines which, being in the same plane, do not meet, though ever so far produced, be called parallels," does not mean us to assume that such lines do exist, but only, that when they shall have been proved to exist, the name by which it is agreed to call them has been given. But some of the definitions, which ought therefore to be distinguished from the rest, are tacitly accompanied by the assumption of existence of the things defined.

The 4th postulate is a theorem of more difficulty than the subject requires; since, with one additional assumption respecting the straight line, it admits of proof. The assumption previously discussed, namely, that two straight lines cannot enclose a space, amounts to assuming that if two straight lines coincide in two points, or if two different points of the one can be made to lie upon two different points of the other, the portions of the straight lines *lying between these points* will also coincide entirely. Let it be granted, in addition, that the parts which are *not* between these points will coincide (an equally evident proposition), and the 4th postulate of Euclid admits of proof. Euclid's editors, in taking this postulate for granted, make use of it to prove our additional assumption, which, as they phrase it, is "no two lines can have a common segment;" that is, two lines cannot coincide between two points and not coincide elsewhere. But, of two propositions, one of which it is found necessary to assume, that one should be the more simple of the two.

The 5th postulate, which is a theorem of some difficulty, neither self-evident, nor even easily made evident, is not at all required in the form given, even in Euclid. For he proves, without its assistance, that if the two lines there mentioned meet, it must be on the side on which the angles are less than two right angles. But it may be reduced to a very evident form as follows: If a straight line be taken, and a point exterior to it, of all the straight lines which can be drawn through the point, one *only* will be parallel to the first-mentioned straight line. The whole assumption lies in the word *only;* for Euclid shows, without the help of this axiom, that a parallel can be drawn, and how to draw it.

This axiom is the cause of the celebrated discussion on the theory of PARALLELS, under which head it will be more fully treated.

AXIS, AXE. This word is used in so many different senses, that it may be defined as follows: Any line whatsoever which it is convenient to distinguish by a specific term with respect to any motion or other phenomenon, is called the axis. Thus we have axes of co-ordinates, of oscillation, of inertia, of rotation, of polarisation, &c., under which heads definitions will be given.

The word, when used by itself, generally means either axis of *Rotation*, or axis of *Symmetry*. An axis of rotation, or revolution, is the line about which a body turns; an axis of symmetry is a line on both sides of which the parts of the body are disposed in the same manner, so that to whatever distance it extends in one direction from the axis, it extends as far in the direction exactly opposite. Or if perpendiculars to the axis be drawn from all points and in all directions through the body, the whole of each perpendicular which is within the limits of the body will be bisected by the axis. Such is the middle line of a cone, any diameter of a sphere, the line drawn through the middle of the opposite faces of a cube, &c.

AXLE. Since the extensive use of locomotives, the theory of the action of axles, and the causes of their fracture, have been subjects of elaborate inquiry among engineers. Whether solid or hollow axles, with a given weight of metal, are the stronger, is one among these inquiries. Mr. Yorke, in a paper read before the Institute of Civil Engineers in 1843, contends for the superior strength of hollow axles; but this conclusion is disputed by others. The theory of axles may, indeed, be considered at present in a tentative state; meanwhile, patents are frequently obtained for improvements in form and in mechanical action. Hardy's patent axles have shown the possession of such a remarkable degree of toughness, that the Privy Council in 1849 granted a continuation of the patent; and remarks were made in the House of Lords relating to the lessening of railway accidents by their use. Since that period the patent has been sold for a considerable sum to a company at Birmingham, established for the manufacture of these axles on a large scale.

Rowan's patent axles are intended to lessen the amount of friction usually produced by the action of a wheel on its axle. For the axle in common use is substituted a small centre revolving arm, along which are fitted five or six rollers, closed at each end; the sheath over the rollers revolves with very little friction, as it touches upon a small portion only of each of the rollers. The arm is turned truly parallel, with a bevelled shoulder to fit a corresponding bevel on the rollers; and a screw-nut is fitted in the extremity of the arm, having also a bevelled shoulder. The rollers are fitted into and carried by two rings in such a manner that they are perfectly free to move on their centres; and, when placed on the arm, are free also to move round it without lateral motion, being confined by the bevels. By this contrivance the bearing is transferred to the surfaces of the rollers, and does not affect their centres.

Mr. Bessemer, in a 'Treatise on Railway Axles,' considers the probable causes why the axles of railway carriages break more frequently than those of a road vehicle, in spite of the fact that the one go upon smooth rails, while the other pass over roughly paved surfaces. He attributes it to the oscillation of a railway carriage. The flanges of the two wheels are alternately driven up close against the rails by this oscillation, and whenever this occurs, there is a momentary tendency in one wheel to revolve a little faster than the other; and thus a strain or twist is given to the axle, first in one direction and then in the other. This straining may take place five thousand times in an hour in a railway carriage in rapid motion; and Mr. Bessemer conjectures, that the iron of the axle may in this way be thrown into a molecular state liable to fracture. To obviate this source of mischief, he proposes the use of a compound axle, formed of two pieces so united endwise that, while the ordinary action of an axle is maintained, the two halves may yield a little during oscillation, instead of being subjected to a twist in the fibre of the metal.

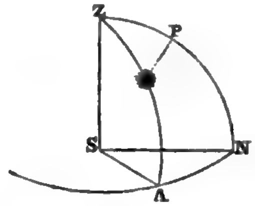
AYEEN AKBERY, properly *Ayîn-i-Akbari*, is the title of a geographical and statistical account of the Mogul empire in India during the reign of the emperor Jelâleddin-Mohammed-Akbar, written by his vizir Abu'l Fazl. [ABUL FAZL and AKBAR, in BIOG. DIV.] It constitutes the third or concluding part of the 'Akbarnameh' of the same author. The first volume consists of a summary account of Akbar's ancestors, and the second volume comprises the occurrences of his reign, from his accession to the throne down to the 47th year. A free and often abridged translation of this work into English was undertaken by Mr. Francis Gladwin, and a portion was issued in Calcutta as early as 1783. It has more than once been reprinted in England. As an original and we may say an official account of the internal organisation of the Mogul empire at the time of its greatest prosperity, the 'Ayîn-i-Akbari' is highly interesting. It is divided into four parts: the first three are chiefly political and legislative; the fourth part is chiefly statistical and geographical, giving a description of the several provinces at that time comprehended under the Mogul government, and a detailed account of the ancient institutions, religion, and literature of the Hindoos, which is very comprehensive, and in many parts surprisingly accurate.

AYUNTAMIENTO, JUSTICIA, CONCEJO, CABILDO, REGIMIENTO, are the names given in Spain to the councils of the towns and villages. These councils are in general composed of the corregidor, alcalde, regidores, jurados, and personeros, or hombres-buenos. All these officers, with the exception of the corregidor, who was always appointed by the government, were originally elected every year by the inhabitants of the concejo or commune. To be the head of a family, a native of Spain, and settled in the commune, were the only qualifications required either from an elector or a candidate. The origin of this institution may be traced to the remotest period of Spanish history. (Masdeu's 'Historia Critica,' vols. iv. to ix., more particularly vol. viii. book 3.) It has been ever the most cherished and the most carefully preserved of all their privileges by the Spanish people. It was chiefly by the ayuntamientos that the resistance to the French under Buonaparte was rendered so persevering and so obstinate; and it was the law against them in 1840, which created so much dissatisfaction in the country as enabled Espartero to succeed in exiling the regent-queen Christina. (For a full account of them, see Mariana, 'Examen de la Antigua Legislacion de España;' 'Recopilacion de las Leyes de estos Reinos,' book vii.; Mariana, 'Historia de España,' book xx. chap. 13.)

AZADIRINE. An alkaloid of uncertain composition, found in the *Melia Azadirachta*.

A'ZIMUTH, a corrupted Arabic word, which when properly written is *as-samt*, the *as* being the article *al*, assimilated to the initial letter of the word to which it is prefixed; *samt* means 'a way, a road, a path;' also 'a part, tract, country, or quarter.'

Azimuth denotes the angular distance of the horizontal point which is directly under a star from the north point of the horizon. Thus if



S be the spectator, Z his zenith, Z N his meridian, N A the horizon, and Z A the vertical circle passing through a star *, then the angle A S N is the star's azimuth, or it is the angle made by the vertical circle Z A and the meridian Z N.

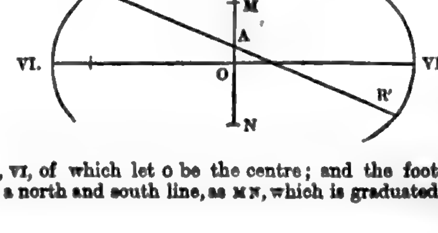
The only instruments in use by which the azimuth could be immediately observed are the theodolite and the altitude and azimuth circle. [THEODOLITE; CIRCLE.] It is not one of those elements which are usually measured in astronomy. When the star is known (that is, when its declination is known), the azimuth can be found by observing the altitude A * and solving a spherical triangle; for in the triangle whose sides are the complements of the star's altitude, the star's declination, and the latitude of the place, the azimuth is the angle opposite to the complement of the declination, as may be seen in the triangle Z P *, where P is the pole. Similarly the latitude of the place may be found when the altitude and azimuth of a known star are observed at the same moment. For in the triangle just mentioned, Z * and * P are given, and the angle * Z P; whence Z P may be calculated. When the azimuth of a star is found by means of an instrument adjusted by the magnetic needle, then the azimuth obtained (which needs a correction on account of the deviation of the needle) is termed the *magnetic azimuth*. In this way the deviation of the needle may be found at any known place by observing the magnetic azimuth and calculating the true azimuth by observing the altitude of a star in the manner before described.

An instrument is said to be moved in *azimuth* when it is turned on a vertical axis, so that any line in it drawn through the axis points to the same altitude in the heavens, but not to the same azimuth. Similarly an instrument is moved in *altitude* when it is turned on a horizontal axis. An altitude and azimuth instrument is one which admits of both motions.

It is hardly necessary to observe that when the star is in the horizon, and when the azimuth is less than 90°, (90°—azimuth) is the amplitude (which see); and that when the azimuth is greater than 90°, (azimuth —90°) is the amplitude.

An *azimuth circle* is a circle all the points of which have the same azimuth, that is, a vertical circle. For azimuth Compass, see COMPASS.

AZIMUTH or ANALEMMATIC DIAL is one whose plane is parallel to the horizon, and whose gnomon, or stile, is moveable in a vertical position. The hour-points are in the periphery of an ellipse,



as VI, XII, VI, of which let O be the centre; and the foot of the stile moves in a north and south line, as M N, which is graduated from O to M and from O to N in tangents of the sun's declination, from zero to $23\frac{1}{2}$ degrees, the radius of the circle being equal to the eccentricity of the ellipse. To these graduations are annexed as many corresponding days of the month as can be introduced.

In order to investigate the place of any hour-point, as R, let A be the foot of the stile for any given day. Then AR will be the direction of the shadow for the given hour; and there must be found the azimuthal angle MAR, or its supplement MAR′. Now the sun being in the plane of the hour-circle which cuts the horizon in RAR′, and it being understood that, in the celestial sphere, there may exist a spherical triangle formed by arcs joining P the pole of the equator, S the place of the sun, and Z the zenith of the place, or the point vertically above O [see *fig.* to AZIMUTH, and imagine S to be put in place of ∗], we shall have PZ the co-latitude of the place, PS the sun's north-polar distance, and the given hour-angle at P; to find the angle at Z (= MAR′ or MAR).

In that triangle we obtain [SPHERICAL TRIGONOMETRY, formula 6],

$$\text{cotan } Z = \frac{\cos ZP \cos P - \text{cotan } PS \sin ZP}{\sin P}$$

But RB (*fig.* above) being let fall perpendicularly on OM produced if necessary, let $OB = x$, $BR = y$, $OA = x'$; then

$$\text{cotan } MAR \; (= \text{cotan } Z) = \frac{AB}{BR} = \frac{x - x'}{y}.$$

Equating these values of cotan Z, there is obtained $x' =$

$$\frac{x \sin P - y \cos ZP \cos P + y \sin ZP \text{ cotan } PS}{\sin P}$$

This equation containing three unknown quantities, the problem is indeterminate; but, since the following conditions must be satisfied, the values of x and y may be found: First, the position of R, the hour-point, must be independent of the sun's polar distance; therefore x and y must be independent of PS, which gives

$$x \sin P - y \cos ZP \cos P = 0;$$

also x' must be independent of the given hour; whence $\frac{y \sin ZP}{\sin P}$ must be considered as constant; let the constant be represented by m; then

$$y = \frac{m \sin P}{\sin ZP} \text{ and } x' = m \text{ cotan } PS.$$

From the equation for 0 we have

$$x = y \cos ZP \text{ cotan } P,$$

and substituting the value of y,

$$x = m \text{ cotan } ZP \cos P.$$

Squaring the values of x and y, and adding the results together, there is obtained, after reduction,

$$\frac{x^2}{m^2 \text{ cotan}^2 ZP} + \frac{y^2}{m^2 \text{ cosec}^2 ZP} = 1,$$

which is the equation to an ellipse, having for its semi-tranverse axis m cosec ZP, and for its semi-conjugate axis m cotan ZP.

The constant m may be taken of any magnitude at pleasure according to the intended scale of the dial; thus the ellipse may be traced. The hour-points may be found by giving to the angle P successive values, as 15°, 30°, &c., and corresponding values for the half-hours, quarter-hours, &c. in the above values of x and y.

AZOBENZIDE ($C_{24}H_{10}N_2$). A reddish-yellow crystalline body, obtained along with aniline, by the dry distillation of azoxibenzide. It is lightly soluble in water, and easily soluble in alcohol, fuses at 149° Fahrenheit, and distils without alteration at 379°.

AZOBENZOYL ($C_{42}H_{15}N_2$). An unimportant neutral solid, obtained amongst other compounds by the action of ammonia on oil of bitter almonds.

AZOERYTHRIN. [LICHENS, COLOURING MATTERS OF.]

AZOLEIC ACID. One of the acids formed by the action of nitric acid on oleic acid.

AZOLITMIN. [LICHENS, COLOURING MATTERS OF.]

AZOMARIC ACID ($C_{40}H_{22}(NO_4)_2O_8$)? A yellow, amorphous acid, obtained by acting upon resin with a large quantity of nitric acid.

AZONAPHTYLAMINE. [NAPHTHALIN.]

AZOTANE. [NITROGEN, CHLORIDE OF.]

AZOTE. [NITROGEN.]

AZOTIC ACID. [NITRIC ACID.]

AZOXIBENZIDE ($C_{24}H_{10}N_2O_2$). A yellow, crystalline, inodorous, and tasteless substance, obtained by the action of caustic potash upon an alcoholic solution of nitrobenzol.

AZULMIC ACID. This name has been applied to the brown flocculent matter which is deposited when an aqueous solution of cyanogen is exposed to light.

B

B, which occupies the second place in the Hebrew alphabet, and those derived from it, is the medial letter of the order of labials. It readily interchanges with the letters of the same organ. 1. With *v*, as *habere* Latin, *avere* Italian, to have; *habebam* Latin, *aveva* Italian, I had. In Spain, and the parts of France bordering upon Spain, the letter *b* will often be found in words which in the kindred languages prefer the *v*. This peculiarity has been marked in the following epigram by Scaliger:—

Haud temere antiquas mutat Vasconia voces
Cui nihil est aliud vivere quam bibere.

The modern Greeks pronounce the *b*, or second letter of their alphabet, like a *v*: thus βασιλεὺς, *basileus*, is pronounced by them *vasilefs*. When they write foreign words, or words of foreign origin, it is not unusual for them to express our sound of *b* by μπ (*mp*). It appears probable that the ancient Greeks pronounced the *b* more like the Spaniards and modern Greeks than we do; for they wrote the Roman names *Varro*, *Virgilius*, thus Βάῤῥων (Barron), Βιργίλιος (Birgilius). The Macedonian Greeks wrote Φίλιππος thus—Βίλιππος (Bilippus).

2. The interchange of *m* and *b* takes place very frequently, especially when they are followed by the liquids *l* or *r*. Thus *malakos* and *blaks* are two Greek nominatives, signifying soft. *Melit*, in the same language, means honey, and *blitto* signifies "I remove the honey from the comb." So *bro-tos*, the Greek for mortal, and *mor-i*, the Latin for to die, contain a common root. An interchange of a similar nature marks the difference between the Greek *molubos* or *molubdos*, lead, and the Latin *plumbum*. If an *m* in the middle of a word be followed by either of these liquids, the *m* is retained, but is strengthened by the addition of a *b*, just as a *d* inserts itself between *n* and *r*. Instances are to be found in nearly all languages: *mes-emer-ia*, mid-day, was reduced by the Greek ear to *mesembria*; the Latin *cumulare*, to heap, has been changed to the French *combler*; the Latin *numerus*, number, to the French *nombre*, &c. The Spanish language affords examples of a still greater change. Thus, if a Latin word contain the letters *min* after an accented syllable, we find in the corresponding Spanish term the syllable *bre* or *bra*: *homine* Latin, *hombre* Spanish, man; *femina* Latin, *hembra* Spanish, female; *famina* (middle-age Latin), *hambre* Spanish, hunger. This corruption arises from a previous interchange of the *n* into an *r*, as in *diaconos* Greek, deacon, *diacre* in French. The Spaniards have carried this corruption even further, by changing the Latin suffix *tudine* (*tudo* nom.) into *tumbre* or *dumbre*; *consuetudine* Latin, *costumbre* Spanish, *coutume* French, custom; *multitudine* Latin, *muchedumbre* Spanish, multitude. 3. *B* interchanges with *p*. Of this the pronunciation of the English language by the Welsh and Germans presents sufficient examples. 4. With *f*. Thus the term *life*-guards appears to have meant originally *leib*-guards, *body*-guards, from the German *leib*, body. The word was probably introduced by the Hanoverian dynasty. 5. *Du* before a vowel in the old Latin language became a *b* in the more common forms of that language. Thus, in the old writings of Rome, we find *duonus* good, *duellus* fair, *duellum* war, &c., in place of *bonus*, *bellus*, *bellum*. The Roman admiral Duilius is sometimes called Bilius; and in the same way we must explain the forms *bis* (*duis*) twice, and *viginti* (*dui-ginti*) twenty (*twain-ty* compared with thir-ty, &c.) 6. *Bi* before a vowel has taken the form of a soft *g* or *j* in several French words derived from the Latin: *cambiare* (a genuine Latin word), *changer* French; *rabies*, *rage*, French; *Dibion*, *Dijon*; so *rouge* has for its parent some derivative of *rubeo*, and *cage* is from *cavea*. 7. In some dialects of the Greek language a *b* exists (apparently as a kind of aspirate) before the initial *r*, where the other dialects omit it: as *brodon*, a rose, &c. Again *bl* and *gl* are interchanged in dialects of the same language. Thus *balanos* Greek, and *glans* Latin, are no doubt related words; as well as *blandus* Latin, signifying 'soft, mild, calm,' and *galenos* Greek, which has the same signification. For the forms of the letter B, see ALPHABET.

In the Sanskrit alphabet the letter *b* is classed in that division of the consonants called mutes, and in that subdivision of the mutes called labials. The subdivision of labials contains four letters—*p*, *ph*; *b*, *bh*; and *m*. The *p* and *ph* are called hard (*surd*) consonants; the *b* and *bh* are called soft (*sonant*); *bh* is the aspirated sonant corresponding to *ph* the aspirated surd. ('Journal of Education,' No. xvi. p. 341, &c.)

BAAL (from the root בָּעַל, *he governed* or *possessed*) means literally *lord*, *owner*; hence also *husband*. Baal, with the definite article, הַבַּעַל, *the Baal*, means the deity of the Phœnicians and Carthaginians, whose complete title seems to occur in a Maltese inscription, as מַלְקֶרֶת בַּעַל צוּר, *Malkereth Baal Tsor*, that is, *King of the City*, *Lord of Tyre*. (See 'Philosoph. Transact.' T. 54 pl. lin. 1.) The name Malkereth is a contraction of מֶלֶךְ קֶרֶת, king of the city. Hence it appears likely that Baal and Moloch are names of the same idol. Baal was the god of the Sun, as Astarte was of the Moon. The crue worship of Baal, together with that of Astarte, was practised by the Egyptians and Assyrians, and was frequently introduced among the Israelites, especially at Samaria. As the Greeks, Germans, and other nations frequently form the names of men by compounding them with the names of God (for example, *Gottlieb*, *Gotthold*, *Fürchtegott*, Θεόφιλος, Θεόδωρος, Τιμόθεος, &c.), so the Phœnicians and Carthaginians frequently formed names by composition with *Baal*, as Ethbaal (אֶתְבַּעַל), *with Baal*, the name of a king of the Sidonians (1 Kings xvi. 31), whom Josephus calls Ἰθόβαλος and Εἰθώβαλος, from אִתּוֹ בַּעַל, that is, *with him* Baal; *Jerubaal*, יְרֻבַּעַל, that is, *Baal will behold it*. Hannibal is written in Punic inscriptions חַנִּבַּעַל, that is *grace of Baal*; Hasdrubal עֲזְרֻבַּעַל, that is, *help of Baal*.

In Hebrew also many names of cities occur, compounded with Baal, from the idol so called; as Baal-Gad, Baal-Hammon, Baal-Thamar, &c. Balbec in like manner signifies the city of Baal.

The statues erected to Baal were called Baalim, or rather B'alim, בְּעָלִים. The temples and altars of Baal were chiefly built on the tops of hills under trees and also on the roofs of houses. In the sculptures discovered by Layard at Nimroud, representations of the symbolic tree of Baal—corresponding to the grove of the Scriptures—are very numerous. So also are representations of Baal himself, who, in a bas-relief from the south-west ruins of Nimroud, is figured in a walking attitude, raising an axe in one hand, and grasping an object resembling the thunderbolt placed by Greek sculptors in the hand of Zeus in the other; he is also represented in front of a circle, the radiating lines of which seem to typify the sun's rays; but very frequently only the symbol of the deity (the circle and radiating lines) occurs above the head of the Assyrian king. Very similar symbols are frequently met with over the doorways of Egyptian temples. Pliny says that obelisks were regarded as typical of the solar rays, and dedicated to Baal or the Sun: and it has been suggested that the image of gold set up by Nebuchadnezzar (Dan. iii. 1), was really such an obelisk. The proportions of the image, threescore cubits high and six wide, are evidently unsuitable for an image of a man; while, as Mr. Bonomi ('Nineveh,' p. 450) has pointed out, they "agree perfectly with those of an obelisk, most of the Egyptian obelisks being about ten times the width of the base in height."—Indeed, there is still standing among the ruins of Karnak, in Egypt, an obelisk of a single block of granite 90 feet high by 9 feet wide—the dimensions of the image of Nebuchadnezzar, "and we have only to fancy that monument to be covered with plates of gold, to have present to the imagination the image of the plain of Dura."

The worship of Baal gave employment to a numerous priesthood, who burned incense, sacrificed children, danced round the altar, and if their prayers were not speedily heard, cut themselves with knives and lancets till the blood gushed out upon them. By this self-chastisement, the priests expected to excite the compassion of Baal, and thus to obtain the object of their prayers.

The general character of Asiatic idolatry renders it likely that Baal meant originally the true Lord of the universe, and that his worship degenerated into the worship of a powerful body in the material world. Sanchoniathon states that the Phœnicians worshipped the sun as μόνον οὐρανοῦ κύριον, "the only Lord of heaven," called Βεελσάμην *Beelsamen* (that is, בַּעַל שְׁמַיִן, Lord of heaven); and that this Beelsamen was the Greek Ζεὺς, *Zeus*. In the Septuagint, Baal is called Ἡρακλῆς, Hercules, called in the Phœnician language אוֹר־כֹּל, *Or-cul*, that is, light of all. Some mythologists have asserted that Baal was Saturn (compare Servius 'ad Æn.' i. 729); others have considered Baal to be the planet Jupiter. A supreme idol might easily be compared with those of other nations; hence arose this variety of opinions.

The statement of Herodian (v. 5; and Capitol. 'vit. Macrini,' 9) that the Phœnicians and Syrians worshipped the sun, is confirmed by the occurrence of the name of Baal together with that of the sun on Carthaginian coins and Palmyrene inscriptions, as בַּעַל שֶׁמֶשׁ, בַּעַל שָׁמַיִם, בַּעַל חַמָּן.

The name of Baal occurs frequently with epithets, as Baal-B'rith, (בַּעַל בְּרִית) that is, lord of confederacy, or God of treaties, like the Greek Ζεὺς ὅρκιος, and Latin, Deus Fidius, Judges viii. 33; ix. 4.

Beelzebub, (בַּעַל זְבוּב, that is, *lord of flies*,) corresponds to the Greek Ζεὺς ἀπόμυιος, μυίαγρος, Zeus the fly-chaser (Pausan. v. 14): compare Hercules μυίαγρος. He had a temple at Ekron, 2 Kings i. 2.

Baal Peor (בַּעַל פְּעוֹר), Numbers xxv. 1—9, is the Priapus worshipped by the Moabites on Mount Peor, from פָּעַר, *distendit.*

To worship Baal signifies frequently, in the phraseology of the Jewish writers of the middle ages, to practise the rites of the Christian religion. Rabbi Joseph Ben Josua Ben Meir tells us, in his 'Chronicles,' that Clovis forsook his God and worshipped Baal, and that a high place was built at Paris for Baal Dionysius, that is, the Cathedral of St. Denis. Rabbi Joseph informs us also that the Friar Vincent, of the sect of *Baal* Dominic, that is, the Dominican Friar, was a Satan unto the Jews in Spain about A.D. 1430.

(For further information on Baal we refer to the commentators on Judges, Kings, Chronicles, Isaiah, Jeremiah, Hosea; J. E. Elsner, *De Ritu Baalem exorandi*, Ling. 1723; Fromman, *De Cultu Deorum ex Onomothesia illustri*, Altorf, 4to et seq. 1745; Müntur, *Religion der Carthager*, Kopenhagen, 8vo, 1821; Serv. ad Æn. i. 729; Lingua Punica Deus Bal dicitur, Isidor. *Origin.* viii. 11; Creutzer's *Symbolik*, ii. 266, &c.; Eusebii *Præparatio evangelica*, i. 10; *Fragmenta* Sanchoniathon, ed. Orelli, p. 14; Gesenius in his dictionaries, and in the *Hallische Encyclopädie;* Winer's *Biblisches Réal Wörterbuch; Classical Journal*, vii. p. 293; Jahn's *Jewish Antiquities;* Layard, Botta, &c.)

BA'BYLON, HISTORY. The Babylonians belonged to the Semitic race of nations; their language was an Aramaic dialect, and differed little from the common Syriac. The existence of their city and empire can be traced back to an epoch of the remotest antiquity. In the tenth chapter of Genesis, Babel is mentioned as having formed part of the dominions of Nimrod, and Josephus ('Ant. Jud.' i. 6) calls him the founder of the town of Babylon. The building of the city and tower of Babel, and the subsequent confusion of tongues (Genes. xi. 1—9) are among the earliest facts in the history of mankind which we find recorded in the Hebrew scriptures. We learn from Josephus, Eusebius, and the Armenian chronicle of Moses of Chorene, that the Chaldæans had a similar tradition to account for the origin of the different languages now spoken by men; but it is difficult to determine whether this tradition was independent of, or whether it was derived from, that recorded in the book of Genesis. Diodorus (ii. c. 7), on the authority of Ctesias, attributes the foundation of the city of Babylon to the celebrated queen Semiramis, and when we read of immense numbers of workmen (two hundred myriads) from all parts of her empire, whom she employed in the execution of her design, we are almost involuntarily reminded of that part of the Hebrew narrative, which describes "the children of men" building the tower, until "the Lord scattered them abroad from thence upon the face of all the earth, and they left off to build the city." ('Genes.' xi. 8.) The epoch at which the city and the tower were founded cannot be determined with precision; according to the calculation usually adopted, it happened about two hundred years after the deluge.

Herodotus (i. c. 184) says that the building of Babylon was the work of several successive sovereigns; but among them he distinguishes the two queens, Semiramis and Nitocris, to whom the city was indebted for extensive embankments along the Euphrates, and for many other improvements. According to Diodorus (ii. 1, &c.), the Assyrian king Ninus, assisted by an Arabian chief, Ariæus, conquered and killed the then reigning king of Babylon, and made himself master of his dominions; the town of Babylon did not then exist, but there were other flourishing towns in the country. His wife Semiramis, who succeeded him, founded Babylon, and made it her residence, until which time Nineveh had been the capital of the empire. [NINEVEH, in GEOG. DIV.] She enclosed it with brick walls of great height and thickness, joined the two banks of the river by a bridge (besides a subterraneous passage or tunnel), built a royal palace on each side, and erected in the middle of the town a high temple in honour of the god Belus. This is usually supposed to have happened about the year 2000 before our era.

Respecting the history of Babylon under the successors of Semiramis we are left in almost entire ignorance. From one of the inscriptions found at Nineveh (many of which are now in the British Museum), Sir W. Rawlinson has deciphered much of the history of Sardanapalus (which he writes As-sar-adun-pul); but it only contains an account of his military expeditions up to the thirty-first year of his reign, against peoples and countries many of which it is not easy to identify. After the overthrow of the Assyrian monarchy and the death of Sardanapalus (888 B.C.), Belysis, a skilful priest and astrologer, assumed the government of the Babylonian state. (Diodor. ii. c. 24, &c.) He was succeeded on the throne by his son Nabonassar, and the regal dignity became hereditary in his family. The era of Nabonassar, beginning the 26th of February, 747 B.C., is supposed to have been so called, because the Chaldæans, during the reign of this king, might have begun to avail themselves in their astronomical observations of a moveable solar year, which they might either have invented themselves, or received from the Ægyptians. This era was, however, never used in common life, and for all ordinary practical purposes the Chaldæans counted by lunar years. (See Ideler, 'Lehrbuch der Chronologie,' p. 89.)

We know very little of the immediate successors of Nabonassar. Sharpe and Oppert give lists of kings to the taking of Babylon, but the lists do not agree either in the number or the names. Merodach-Baladan, or Berodach-Baladan, the son of Baladan, is mentioned in the Old Testament (2 Kings, xx. 12, 13; Isaiah, xxxix. 1) as being on friendly terms with Hezekiah, the king of Judah, at a time when both dreaded the ascendancy of Sennacherib, the king of Assyria. Soon afterwards the Assyrian monarch, Esarhaddon, incorporated Babylon into his empire. But towards the latter part of the 7th century before our æra, we again find Babylon under Nabopolassar, the Ahasuerus of Tobit (627—604 B.C.), an independent and powerful state, and as such it continued till the period of its destruction by Cyrus. In the battle of Circesium (604) the independence of the Babylonian state was vindicated against the ambitious designs of Nekos, king of Egypt, who had sent an army to conquer it. Babylon had its bright epoch in the reign of Nebuchadnezzar, or Nabuchodonosor (604—561 B.C.), who increased his dominions by the conquest of Palestine, Tyrus, and Jerusalem (2 Kings xxv. 1; 2 Chron. xxxvi. 17), and added to the fortifications as well as to the ornaments of the city of Babylon. He subdued the Idumæans (the Edomites) and the Ammonites, and his empire extended from the Caucasian mountains to the African desert. It is surprising that the name of Nebuchadnezzar is apparently unknown to Herodotus, especially as we are told by Josephus, that it was familiar to Megasthenes and other Greek historians. The queen Nitocris, mentioned by Herodotus (i. 183), who contributed much to the improvement of the town of Babylon, is supposed to have been the wife of Nebuchadnezzar. After the death of Nebuchadnezzar, the empire began rapidly to fall into decay. His son Evilmerodach (561—559) permitted king Joacim, of Juda, to return home out of his captivity at Babylon, whither Nebuchadnezzar had brought him. Evilmerodach was killed in the second year of his reign by his brother-in-law Neriglissar, who occupied the throne during the four succeeding years (559—555). He was followed by his youthful son Laborosoarchod, or Labassoarascus, who had been only nine months on the throne when a conspiracy broke out in which he was dethroned and killed. Nabonnedus (the Labynetus of Herodotus, i. 74—77, and the Belshazzar, or Balthasar, of the Old Testament) followed him, and reigned seventeen years (555—538 B.C.), at the end of which he was attacked and defeated by Cyrus ('Dan.' v. 30, 31), and Babylon became subject to the Persian empire.

Cyrus did no injury to the town of Babylon: on the contrary, he made it his winter-residence, and the third capital town of his kingdom, after Susa and Ecbatana. But in consequence of a revolt under Darius I., the walls and gateways of the town were broken down, and the population soon decreased in such a degree that a supply of women from the surrounding country became requisite. (Herod. iii. 159.) Xerxes carried away the golden statue of Belus (Zeus, Herod. i. 183), and Alexander the Great found the temple of that deity in ruins. (Arrian. 'Exp. Alex.' vii. 17.) Soon afterwards Seleucus founded the town of Seleucia in the neighbourhood of Babylon, which further contributed to the decrease of the latter. At the time of Diodorus and Strabo, the greater part of Babylon lay in ruins, and there were cornfields within its ancient precincts. Curtius says, that at his time only one-fourth of the town was inhabited: Philo and Josephus observe, that a considerable proportion of the inhabitants were Jews. [NINEVEH, in GEOG. DIV.]

(Rich, *Babylon and Persepolis;* Rawlinson, *Journal of Asiatic Soc.;* Layard.)

BABYLONIAN ARCHITECTURE. [NINEVEH, ARCHITECTURE OF.]

BACCHANALIA. [DIONYSIA.]

BACHELOR, an unmarried man; a word, as Johnson says with truth, of uncertain etymology, for which many fanciful and absurd derivations have been given, the most absurd being those from βάκηλος foolish; *bacillus*, a little stick; and *bacca lauri*, the berry of the laurel. Ducange has collected various meanings of the word, of which the following deserve mention :—

1st. The term baccalarii was applied to those who held, possessed, and cultivated certain lands called baccalaria (which Ducange supposes to be a corruption of vasseleria, the fee belonging to an inferior vassallus); frequent mention of these tenants and their lands is made in old charters.

2nd. By the expression baccalarii are described ecclesiastics of a lower dignity and grade than the other members of a monastery; the term frequently occurs in this sense in monastic writings and records; thus, for example, in one old abbatial history we read, "Finita Missa, in exitu ecclesiæ incipitur Antiphona O Martini; sequitur Litania et debet dici a duobus baccalariis;" and in an old charter of amortization, in 1408, occurs the following: "Les chappelains et les bacheliers de l'église collégial de Nostre Dame de Mirebeau."

3rd. The word was used by later writers to distinguish those who, being members of the military order, were inferior to bannerets, not having as yet, levé bannière, either from want of age or from poverty. The word in this sense is often referred to in the poems of the Troubadours.

4th. Any young unmarried person, whether male or female, was called bachelier and bachelette. From ancient documents cited by Ducange, it would appear that it was not unusual to impose a tax upon unmarried men. One in 1223 runs "Homo qui est bachalarius, quamdiu in illo statu erit et hospitium tenebit, reddit annuatim quinque solidos de censa."

5th. The term was, in analogy to the above, appropriated by learned bodies, such as universities and academies, to designate those who, like the military baccalarii, were aiming at the higher grades of their profession, "ad doctoratum aspirantes;" see Ducange *sub verbo* baccalarii; and for more information on the etymology of the word the reader is referred to Ménage's 'Etymological Dictionary of the French Language,' and to Selden's Treatise—'History of Titles,' 2nd part, c. 3, s. 24.

The legislation of the Romans placed unmarried persons (cælibes) under certain disabilities, the chief of which were contained in the Lex Julia et Papia Poppæa. But even before that time, according to Livy (lxv. 15), they had been placed in an inferior position to the married citizens, and separated into four urban tribes, an inferiority Cicero (3 De Legibus, 3, 7) alludes to in the words "Censores prolem describunto, cælibes esse prohibento." The original Lex was simply called Julia, and was passed 18 B.C. (Dion Cassius, liv. 16.) The Lex Papia et Poppæa, which was intended as an amendment and supplement to the Lex Julia, was passed A.D. 9; and both these leges seem to have been considered as one, being often referred to under the title of the Lex Julia et Papia Poppæa. One object of the Lex was to encourage marriage. An unmarried person (cælebs), who was in other respects qualified to take a legacy, was incapacitated by this Lex, unless he or she married within one hundred days. (Ulpian, 'Frag.' xvii. 1.) The law was the same if the whole property (hereditas) was left to a cælebs. (Gaius, ii. 111, 144, 286.) It was the opinion of the lawyers, that though a cælebs could not take directly under a testament, a cælebs could take by way of fidei commissum, or trust; but the Senatûs-consultum Pegasianum, which was passed in the time of Vespasian, rendered a cælebs equally incapable of taking anything by way of fidei commissum. (Gaius, ii. 286.) A testamentary gift, which failed to take effect because the heres or legatee was a cælebs, was called Caducum (and the word was applied to other cases also), "something which failed or dropped." In the first instance, such a gift came to those among the heredes who had children; and if the heredes had no children, it came to those of the legatees who had children. If there were no such claimants, the Caducum came to the public treasury (ærarium). But by a constitution of the emperor Antoninus Caracalla, the Caducum came to the Fiscus, or Imperial treasury, instead of the public treasury; the rights of children and parents, however, were reserved. (Ulpian, 'Frag.,' xvii.) An unmarried man who had attained the age of sixty, and an unmarried woman who had attained the age of fifty, were not subjected to the penalties of the Lex Julia et Papia Poppæa as to celibacy, but a Senatûs-consultum Pernicianum (Persicianum), passed in the time of Tiberius, extended the penalties to unmarried persons of both sexes who were above sixty and fifty years old respectively, and it made them for ever subject to the incapacities. However, a Senatûs-consultum Claudianum, passed in the time of Claudius, mitigated the severity of the Pernicianum by substituting a new clause in the place of the old one, enacting that there should be no penalties imposed on men who, being above the age of sixty, married wives under fifty years, for from those unions there was a fair prospect of issue. (Ulpian, 'Frag.' xvi.; Suetonius, 'Claudius,' c. 23.)

The Lex Julia et Papia Poppæa also imposed incapacities on *orbi*, that is, married persons who had no children from the age of twenty-five to sixty for a man, and twenty to fifty for a woman. Childless persons who came within the terms of the Lex lost one-half of any hereditas or legacy; and what they could not take became Caducum. The Lex also gave direct advantages to persons who had children. The original object of this Roman law was perhaps only to encourage marriage, but it was afterwards used as a means of raising revenue.

In the preceding exposition of the Lex Julia et Papia Poppæa, it has been assumed that the provisions above enumerated applied both to males and females. The word *cælebs*, indeed, which may be explained as one "qui est sine conjugio sive aliquando sive nunquam matrimonium inserit," seems to be applied only to males, and the Latin term for an unmarried woman is *vidua*, which means any woman who has not a husband. But the expression of Ulpian ('Frag.' xvi. 3), "Qui intra sexagesimum vel quæ intra quinquagesimum annum neutri legi (the Julia or Papia Poppæa) paruerit," &c., shows that the provisions applied both to males and females. The word cælebs would not be used in the enactments of the Lex, but the phrase would be 'Qui Quæve,' &c. That the Lex applied to women also, appears from other evidence. ('Cod.' viii. tit. 57.) Under the republic there were also penalties on celibacy, and legal inducements to marriage, which are mentioned in the speech which Dion Cassius (lvi. 2—9) puts into the mouth of Augustus. Julius Cæsar, in the division of the Campanian lands, gave allotments only to those who had three children or more. (Dion Cass. xxxviii. 7; Appian, 'Bell. Civil.' ii. 10.) Hence in later times we find the celebrated Jus trium, quatuor et quinque liberorum, which was a consequence of the enactments above referred to, whose importance is abundantly testified in the old inscriptions which have survived to our day. For a lengthened commentary on this law, see the work of M. Vertranius Maurus, in Otto's 'Thesaurus Juris Romani,' iii. p. 967. The censors also are said to have had the power of imposing a penalty called Æs Uxorium, "wife-money," on men who were unmarried. (Festus, *voce* 'Uxorium.') From the earliest times it had always been a part of the Roman policy to encourage the procreation of children; the object of the English law imposing extraordinary payments on bachelors, and relieving to a certain extent married persons with children, was apparently to raise money, though a certain vague notion that marriage should be encouraged seems also to have occurred to the law-maker. A constitution of Constantine ('Cod.' viii. tit. 58) relieved both unmarried men and women from the penalties imposed on cælibes and orbi, and placed them on the same footing as married persons. This change was made to favour the Christians, many of whom abstained from marriage from religious motives.

Not only bachelors, but widowers have been unequally taxed in this country, and there is more than one instance, within the last sixty years, in which persons have been favoured by special exemptions, or have been charged less on account of the number of their children. In 1695 an Act was passed (6 & 7 Will. III. c. 6) entituled "An Act for granting to his Majesty certain rates and duties upon marriages, births, and burials, and upon bachelors and widowers, for the term of five years, for carrying on the war against France with vigour."

Bachelors above the age of twenty-five, and widowers without children, paid 1*s.* yearly, and further according to their rank. Thus, for a bachelor duke the tax was 12*l.*, and other ranks in proportion. An esquire was charged 35*s.* a year, and a person of the rank of gentleman 5*s.* Persons possessed of real estate of 50*l.* a year, or personal property of 500*l.* value paid 5*s.* A supplementary Act was passed two or three years afterwards (9 Will. III. c. 32), to prevent frauds in the collection of the taxes imposed by the former Act, but the tax was allowed to expire in 1706. In 1785, when Mr. Pitt proposed a tax on female servants, he exempted persons who kept only one servant, and who had two or more lawful children or grandchildren under the age of 14 living in the house with them. But to make up for the deficiency, he proposed that the tax on servants should be higher for bachelors than for others; and he stated that the idea of this tax was borrowed from Mr. Fox. This differential rate, though reduced in amount by 4 Geo. IV. c. 11, has been continued to the present time, and the number of servants charged at the higher rate in 1842 was 11,831, or rather more than one-tenth of the whole number charged. In 1853, the number charged amounted only to 11,417, the relative proportions being about the same. Roman Catholic clergymen are exempt from additional duty, 4 & 5 Will. IV., c. 73, s. 4; and by Schedule I of 48 Geo. III., c. 55, incorporated into 52 Geo. III. c. 93, the unmarried daughters of any person are exempted from the tax upon hair-powder. When the income-tax was imposed by Mr. Pitt in 1798, deductions were allowed on account of children, and an abatement was made of 5 per cent. to a person with children, when the income was above 60*l.* and under 400*l.*; and other rates of abatement were allowed according to the amount of income and the number of children: this indulgence extended to incomes of 5000*l.* a year and upwards, but these deductions have not been continued by recent legislation.

There does not appear to be a tax on bachelors in any country in Europe. In the city of Frankfort an income-tax is paid by journeymen who work in the city, "if they are foreigners, and not married."

BACHELOR OF ARTS. [ARTS, DEGREES IN.]

BACKGAMMON, a game played by two persons with dice, upon a table divided into two parts, upon which there are twelve points of one colour and twelve of another. Dr. Henry ('Hist. of Eng.' 4to, 1774, vol. ii. p. 601), speaking of the end of the Anglo-Saxon time, says, "The game of backgammon, it is pretended, was invented in Wales in this period, and derives its name from the two Welsh words *bach*, little, and *cammon*, battle." He refers for this information to the glossary at the end of Wotton's 'Leges Wallicæ,' p. 583. Bishop Kennett, however, among his manuscript collections, gives us a more probable etymology of backgammon from bæc, back or backward, and the Anglo-Saxon ʒamen, a game, sport, or play. Strutt, in his 'Sports and Pastimes,' adopts this derivation, and gives a representation of the game in the 13th century, from Harl. MSS. No. 152. The name however was changed by the Normans for that of *Tables*, derived immediately from the French, under which it is mentioned by Shakspere ('Love's Labour's Lost,' Act. v. sc. 2), Burton ('Anatomy of Melancholy,' part ii. § 2, No. 4), and others. Somewhat later, it acquired also the name of *tric-trac*, or *tick-tack*, a term also used by Shakspere in 'Measure for Measure.' After centuries of disuse, the original Saxon name re-appeared, and for a long time the game has been only known as backgammon.

Hoyle, in a short 'Treatise on Backgammon,' has treated amply of its practice, and given full directions how to play the different chances, with observations, hints, and cautions to be attended to. The table is divided into twenty-four points of alternate colours, and the game is played with fifteen men of different colours, and a pair of dice for each player. The men are disposed in a settled order on the board, and the game consists in bringing the men home,—that is, into the division of six nearest the player's left hand, the moves being made according to the numbers thrown by each player with the dice, the throws being taken alternately. Where a single man is left on a point, it may be lifted by the adversary if the throw enables him to hit it. When all the men are home, they are taken off according to the throw of the dice, and the party first clearing off all his men is the winner. If this is done before the adversary has all his men home, it is a gammon, which counts double; if while he has one man or more in his antagonist's home, it is a back-gammon, which counts as three. Hoyle gives the following as the laws of backgammon: 1. If you take a man from any point, that man must be played; the same must be done if two men are taken from it. 2. You are not understood to have played any man till you have placed him upon a point and quitted him. 3. If you play with fourteen men only, there is no penalty attending it, because by playing with a less number than you are entitled to you play to a disadvantage, by not having the additional man to make up your tables. 4. If you bear any number of men, before you entered a man taken up, and which consequently you were obliged to enter, such men, so borne, must be entered again in your adversary's tables, as well as the man taken up. 5. If you have mistaken your throw and played it, and if your adversary has thrown, it is not in your or his choice to alter it, unless both parties agree to it.

Strutt also says, "At the commencement of the last century backgammon was a very favourite amusement, and pursued at leisure hours by most persons of opulence, and especially by the clergy, which occasioned Dean Swift, when writing to a friend of his in the country, sarcastically to ask the following question: 'In what esteem are you with the vicar of the parish; can you play with him at backgammon?'"

BACON. Considered as an article of food, bacon gives rise to a considerable commerce. Whether of superior or inferior quality, it is prepared from pork by a process in which salt, heat, and smoke are employed. Good bacon has a thin rind; the fat has a firm consistency and a reddish tinge; and the lean adheres strongly to the bone. There is no other country in Europe in which the working-classes are so particular in the quality of the bacon eaten by them, and pay for it at so high a price, as in England.

There are no means of ascertaining the quantity of bacon made and sold in the country. That which we import is mixed up in the Board of Trade returns with hams. In the three years ending with 1858, the average quantity of bacon and hams imported was 312,000 cwts. annually.

BACTRIAN COINS. A sketch of the history of Bactria, or Bactriana (now Bokhara), is given under AFGHANISTAN, in the GEOGRAPHICAL DIVISION of the ENGLISH CYCLOPÆDIA. The Persian province of Aria was bounded partly on the north and to a greater extent on the east, by Bactria. The river Oxus was the boundary between Bactria and Sogdiana, which lay to the east of Bactria, and was possessed by the Greek kings of this province. (Strabo, p. 517.) The northern boundary of Bactria was naturally indefinite, and the western was Margiana. These limits, which mark the extent of Bactria as a province or satrapy, do not of course correspond with the more extended limits of the Greek Bactrian kingdom. The province of Bactria was a territory of great extent, partly barren and waste, but in many parts of great fertility, watered by the Oxus and its tributary streams, and peopled by a brave and hardy race, who were reckoned amongst the best soldiers in the service of Persia after Bactria became a Persian province. The chief city was Bactra, called also Zariaspa, situated on the Bactros, one of the tributary rivers of the Oxus. Of Bactra little is known prior to its subjugation by the Macedonians under Alexander the Great. The account of an expedition against it by Osymandyas the Egyptian, merits no confidence; and those of Ninus and Semiramis perhaps not much more. According to Herodotus, Cyrus, having defeated Crœsus, intended to invade Bactria; and (according to Ctesias) after a drawn battle, the Bactrians voluntarily surrendered themselves to him. In the reign of Darius I. the Bactrians paid a tribute to that monarch of 360 talents. In the time of Xerxes there were Bactrians in the army which he led against Greece, who were under the command of Hystaspes, a son of Darius by Atossa, a daughter of Cyrus. The province continued to be governed by the satraps of Persia down to the time of Darius Codomannus. In the final overthrow of that king by Alexander the Great, at the battle of Arbela or Gaugamela, there was a body of Bactrians in his service who were under the command of Bessus, the satrap of Bactria; they were stationed in the left wing, and behaved with great bravery. After the conquest of Bactria by Alexander he appointed Artabazus, a Persian, as governor, with Macedonian garrisons in the towns. Shortly afterwards they were attacked by the Scythians, joined by the people of Sogdiana and some Bactrians, the whole under the command of Spitamenes, who slew the garrisons and fortified themselves. They were attacked in their turn by Alexander, who stormed seven of their cities, and among them Cyropolis, the strongest of the whole. His next step was to build a city, which he walled in twenty days, and gave to his Greek mercenaries and to such of the Macedonians as were unfit from age or wounds for longer service. Such was the foundation of the Greek colony of Bactria, to which volunteers from the neighbouring countries were admitted. This, however, was not the earliest settlement of Greeks in Bactria; for the first Darius transplanted there a number of Greeks from Barce, in Africa (Herod. iv. 204); and the Branchidæ also, from Ionia, were planted here by Xerxes I. (Strabo, p. 517.)

After the death of Alexander, Bactria remained for fifty years a province of Persia, with which it was united by Seleucus Nicator, between B.C. 312 and 301. When Seleucus became king of Syria, Bactria became a dependency of the great Syrian empire of the Seleucidae. During the reign of Antiochus Theus (B.C. 262-247) Bactria was constituted an independent kingdom by the governor Theodotus or Diodotus, who was a Greek by birth, and it continued so under his successors for several centuries. The history of the Bactrian kings of Greek descent is not given by any of the extant Greek or Roman historians. It may have been noticed in Arrian's lost history of the successors of Alexander. A few names mentioned by the ancient historians, or discovered on some rare coins, and the fact related by the Chinese annalists that this Greek kingdom was overthrown by the Scythians, was all we knew of it. In spite of the barrenness of materials, the learned Bayer undertook to write his 'Historia Regni Graecorum Bactriana,' Petersburgh, 1738, a book more valuable for what the author says on things connected with Bactria, than for information on Bactria itself. Bactrian coins were then so rare, that the discovery of two gold coins towards the end of the past century created a great sensation in Europe, and the acquisition of the names of two kings was considered a valuable addition to our knowledge of Bactrian history. Nobody expected that Bactrian coins would be found in such quantities as to be sold by the measure and for little more than their intrinsic value. This was actually the case not many years back in some places in India and Afghanistan, though only with the copper coins. In the beginning of this century the late Colonel Tod made a collection of coins during his long residence in India, of which several are of high interest for the history of Bactria. A description of them was given with engravings in the first volume of the Transactions of the Royal Asiatic Society, 1824. Two of these coins bore the names of Apollodotus and of Menander, both Bactrian kings. Their historical value, says Wilson, is undiminished, but nothing is calculated to exhibit the rapid progress of numismatic discovery in respect to Bactrian coins more strikingly than the diminution of their value as objects of rarity within the last twelve years. Instead of only two medals, the cabinets of Paris and London now possess two thousand of the coins of Menander and Apollodotus, of silver and copper, of a great variety of types, and mostly in excellent preservation. The country on both sides of the Indus and north of the Hindu Koosh having been explored with a view of searching for coins, great discoveries were made. Generals Ventura, Alard, and Court, Dr. Swiney, James Prinsep, Sir Alexander Burnes, Masson, and many others, mostly British residents in India, have made collections of Bactrian coins, which enabled us to make out a complete series of Bactrian kings, of Greek and barbaric descent.

The following lists of the Greek kings of Bactria have been drawn up by Professor Wilson and by Mr. H. T. Prinsep, the brother of the late Mr. James Prinsep.

B.C.	WILSON.	B.C.	PRINSEP.
256.	Theodotus I.	256.	Theodotus I.
240.	Theodotus II.	240.	Theodotus II.
220.	Euthydemus.	220.	Euthydemus.
190.	Demetrius.	190.	Demetrius.
181.	Eukratides.	178.	Eukratides.
147.	Heliokles.	155.	Heliocles.
147.	Lysias.	150.	Antimachus.
135.	Amyntas.	190.	Agathocles.
	Agathoclea.	195.	Pantaleon.
140.	Antimachus.	155.	Menander.
130.	Philoxenus.	135.	Apollodotus.
135.	Antialkides.		Diomedes.
125.	Archebius.		Zoilus.
126.	Menander.		Hippostratus.
110.	Apollodotus.		Straton.
100.	Diomedes.		Dionysius.
98.	Hermaeus.		Nicias.
135.	Agathocles.	120.	Hermaeus.
120.	Pantaleon.		

According to these lists, several kings reigned at the same time, or at least several persons acted as independent sovereigns and coined money.

Besides the kings placed in Mr. Prinsep's list there is still a small number of others, namely, Antimachus, Archebius, Antialkides, Lysias, Philoxenus, and Amyntas, who appear to have been governors in Herat and Southern Bactria, and to have occasionally assumed the titles and prerogatives of kings. Only two Bactrian gold coins of the Greek kings are known, one of Diodotus and one of Euthydemus; all the others we know of are of silver, of billon, or of copper.

Hermaeus, the last king of the series, is supposed to have been overpowered by Azes, a Scythian, who, as it appears, conquered these countries in company with Maues. Coins of these princes, and of their successor Azilides, are frequent. They have the Greek and Arianian inscriptions. It appears that these Scythians remained in possession of the country about thirty years, from 90 to 60 B.C.

Under the term Bactrian coins are understood in this article only such medals as were struck by kings of either Greek or barbaric descent who ruled over the ancient kingdom of Bactria or parts of it; but not coins of Hindu, Afghan, or foreign Mohammedan princes who reigned at Kabool and other places in Afghanistan. The Greek coins may be divided, with respect to their inscriptions, into pure Greek and bilingual coins. The first class comprehends the names of five kings, Theodotus I., Theodotus II., Euthydemus, Demetrius, and Eucratides, who ascended the throne in B.C. 181, and perhaps reigned as long as B.C. 155. Of Theodotus I. two coins are known. One, a gold medal, was bought at the fair of Nishni-Novgorod in Russia, and is now in the Imperial Cabinet of Paris. It corresponds in weight and style with the gold coins of Antiochus II., and the portrait bears so close a resemblance to that of Antiochus, that it is supposed the artist copied

Euthydémus. (Weight 187 grains.)

Héliocles Dikáios. (Weight 251 grains.)

Demétrius.

Eucrátides I.* (Weight 257 grains.)

BACTRIAN COINS OF THE GREEK KINGS.

the head of that prince. The obverse has the head of Theodotus. The reverse has a naked figure of Jupiter erect, with his back to the spectator, and turned to the left; he is in the act of hurling his thunderbolt from his right arm raised, whilst his left arm extended bears the ægis: on one side, in the field of the coin, is a crown, and at the foot of the figure an eagle. The legend on each margin of the reverse is ΒΑΣΙΛΕΩΣ ΔΙΓΔ°Τ°Υ, perfectly distinct. The second coin is a silver tetradrachm, presented by Sir Alexander Burnes to the British Museum, where there are also many coins belonging to the other Greek kings of Bactria.

The bilingual class of Bactrian coins begins with Heliocles, who reigned about B.C. 147, but bilingual inscriptions are also found on the square copper coins of his predecessor Eucratides. The two languages are Greek and Prakrit, a Hindu dialect written with particular characters forming the Arian or Arianian alphabet. The oldest bilingual coins are all square, the barbaric inscriptions having been adopted together with the barbaric shape, but the later coins are both square and round. Fourteen kings with Greek names are ascribed to this class, the last of whom is Pantaleon, who reigned about B.C. 120. The Greek letters on these coins are nail-headed; the design is generally good, on some very fine, and probably done by Greek artists; but there are also many of apparently barbaric execution, and in the whole the appearance of Eastern emblems of royalty, and different Indian animals and other figures, betrays the decline of Greek civilisation; and, in addition, the title Basileus is translated by Maharajasa. Among the animals, the elephant and elephant's head, which we find on the coins of Demetrius, Menander, Apollodotus, Lycias, and Heliocles, and the humped bull on the coins of Philoxenus, Diomedes and several other kings, are supposed to indicate dominion in India. The wild horse, however, and the double-humped camel are believed to have exclusive reference to Bactria. Barbaric dynasties reigned over Bactria from the end of the second century before Christ.

The coins of the Scythic princes are exclusively of gold and silver, and bilingual—a proof that Greek civilisation, although on its decline, had still some influence upon the people, as was the case in Parthia under the Arsacidae. There are also many Sassanian coins found in Afghanistan; a fact by no means extraordinary, as the power of the Sassanians in Persia extended occasionally as far as the Indus, so that those Scythian kings were not always independent, but paid tribute to the Persians. The prince of Iskardo, in the upper valley of the Indus, pretends to be descended from Alexander. As the Greek power in Bactria was maintained in some parts of the Hindu Koosh after the Scythian conquest, the principality of Iskardo may be a remnant of the Bactro-Greek empire, and a closer investigation into the history of Iskardo and the whole upper valley of the Indus would perhaps lead to interesting results.

The obscurity prevailing in the history and chronology of Bactria has of course an influence upon Bactrian numismatics, and one cannot be surprised at seeing the principal writers on these subjects at variance on essential points.

(Wilson, *Ariana Antiqua;* Lassen, *Zur Geschichte der Griechischen und Indo-Skythischen Könige in Bactrien, &c.;* Grotefend, *Die Münzen der Griechischen, Parthischen, und Indo-Skythischen Könige von Bactrien, &c.;* H. T. Prinsep, *Note on the Historical Results deducible from recent Discoveries in Afghanistan;* James Prinsep, *Essays on Indian Antiquities, Historic, Numismatic, and Palæographic,* edited, with addit., notes, &c., by Edw. Thomas, 1858.)

BA'GNIO, a word derived from the Italian *bagno,* which means a bath, and also a bathing-house. It has been applied, by the Europeans trading with the Levant, to the prisons in which the slaves or convicts who are made to work in the docks and at other public works in Constantinople, Tunis, and other cities of Turkey or Barbary, are shut up for the night. The French likewise call *bagne* the house of detention, where they keep their galley-slaves, at Toulon and Brest. Bagnio, in English, has been used as synonymous with brothel.

BAGPIPE, a musical instrument of the pneumatic kind, still well known in Scotch regiments. It is described by Grassineau as consisting of a leathern bag, inflated by a port-vent fixed in it, which has a valve; and of three pipes, the first and the second called the *great* and the *little drone,* each giving but one note, the third, a kind of oboe, having eight ventages or holes, on which the tune is played by the fingers. The wind is communicated to the pipes by compressing the bag under the arm, the mouth piece of each pipe being fixed in the bag. The compass of this instrument is three octaves.

The *bagpipe,* or something nearly similar to it, was in use among the ancients. Blanchinus gives a figure of it under the name of *tibia utricularis,* though this is not precisely the same as the modern instrument. Luscinius, in his 'Musurgia' (1536), has a woodcut of it, whence it appears that the bagpipe in his time was in all respects the same as in ours. Indeed, it is mentioned, though not described, by Chaucer, who says of his miller—

"A baggepipe wel coude he blowe and soune;

and this, we are told in the same prologue, was the music to which the Canterbury pilgrims performed their journey.

Bagpipe seems to be a translation of the German *Sackpfeife.* By the Italians it is called *Cornamusa;* by the French, *Musette,* not *Chalumeau,* as Dr. Burney states; the latter signifying a single pipe of the simplest kind.

BAHR, the Arabic word for the sea, a lake, or a large river, appears as a component part of many proper names in eastern geography: *Bahr-al-Kolzum,* 'the Sea of Kolzum,' that is, the Arabian Gulf, or Red Sea, especially its north-western extremity (the Sinus Heroopolites); *Bahr Lût,* 'the Lake of Lot,' that is, the Lacus Asphaltites, or Dead Sea, in Syria; *Bahr-al-Abiad,* 'the White River,' and *Bahr-al-Azrak,* 'the Blue River,' that is, the two principal southern branches of the Nile. It has passed into the Portuguese language under the form *Albufeira,* 'a reservoir, a tank, a lagune;' and into Spanish under the two forms of *Albufera* and *Albuhera,* in the same sense. The prefixed *al* in these words is the Arabic definite article; and it is a general remark that the letter *h* of many Arabic words that have been received into the Spanish and Portuguese languages, has been changed into *f.*

BAIL, in civil causes, ordinarily signifies the sureties who become responsible for a defendant arrested by legal process while the cause is yet pending—*mesne* process;—and they are so called, because anciently the defendant was *baillé,* delivered or committed to the custody of his bail, who were bound to produce him at the time appointed for his appearance. By the statute of 23 Hen. VI. c. 9, the sheriff was compelled to admit to bail all persons arrested by him in any personal action, or because of any indictment of trespass, on reasonable sureties being offered for their appearance; and if he refused to take sufficient bail when offered, he was liable to an action by the party arrested. Bail were formerly either *common bail* or *special bail,* a distinction which arose thus: until the commencement of the last century, the defendant was in *all* cases of process against his

* The fourth letter of the name of Eucratides, which on the original coin is an I, was evidently intended for a P, and has probably been damaged a little; compare the P on the coin of Demetrius.

person actually arrested; and it was then discretionary in the court either to discharge him on *common bail* (that is, fictitious sureties, John Doe and Richard Doe) being entered for his appearance, or to detain him till he found real sureties or *special bail*. But this discretion in the court was abolished by the 12 Geo. I. c. 29, which provided that no person should be held to special bail unless the demand amounted to 10*l*., over and above costs, which sum was increased, by the 7 & 8 Geo. IV. c. 71, to 20*l*.; and for less than that sum no debtor could thereafter be arrested and required to give special bail. In all cases where the defendant was not actually arrested, the ancient fiction, stating that he was delivered to bail to John Doe and Richard Doe, continued in the Court of King's Bench to be the only mode of his effectually entering an appearance to the suit till the Act for Uniformity of Process, 2 Will. IV. c. 39, s. 2, which provided, with an exception removed by the Common Law Procedure Act, 1852, sec. 24, that, for the future, the appearance of the defendant should be by entering a memorandum that he either appears in person or by some attorney to the suit instituted by the plaintiff, so that common bail as a step in the cause was thenceforth entirely abolished.

Special Bail.—In considering the subject of special bail, we shall explain: 1, in what cases and in what manner special bail are rendered necessary; 2, who may become special bail; 3, the mode of putting in bail and their justification; 4, the nature and extent of their liability; 5, the mode in which they may be discharged; 6, proceedings on the bail bond and against the sheriff; 7, paying money into court in lieu of special bail; 8, proceedings under the Absconding Debtors Arrest Act, 1851.

1. *In what cases special bail is necessary.*—We have seen that, by the 7 & 8 Geo. IV. c. 71, a defendant could only be arrested and held to special bail (which are convertible terms) where the plaintiff's demand amounted to 20*l*., over and above costs. By a subsequent statute (1 & 2 Vict. c. 110, s. 3) the cases in which a defendant may be held to bail in civil causes are confined to those therein provided. It enacts, that if a plaintiff in any action in any of the superior courts of law at Westminster, in which the defendant is now liable to arrest, shall show by affidavit to the satisfaction of a judge of one of the said courts that such plaintiff has a cause of action against such defendant or defendants to the amount of 20*l*. or upwards, or has sustained damage to that amount, and that there is probable cause for believing that the defendant or any one or more of the defendants is or are about to quit England, unless he or they be forthwith apprehended, such judge may order the defendant or defendants to be held to bail in any sum he may think fit, not exceeding the amount of the debt or damages. The plaintiff may thereupon sue out a writ of capias, and arrest the defendant, who, when so arrested, is to remain in custody till he shall have given a bail bond to the sheriff, or shall have made deposit of the sum endorsed on such writ of capias, together with 10*l*. for the costs. The application for this order is to be made to a judge at chambers, and is, of course, made *ex parte*. It should not be made until after the issue (not service) of the writ of summons, although the affidavit in support of it may be made before. This affidavit must clearly disclose the grounds of the defendant's liability, and show a complete and subsisting cause of action. The amount of the claim should upon no account be overstated. The facts which evidence the intention of the defendant to leave the country must be stated in the affidavit, and it is not sufficient that the deponent merely states his own belief in the existence of such intention. A short and merely temporary absence in the ordinary course of business, as in the case of the captain of a steamer plying between an English and a Continental port, is not a "quitting England" within the meaning of this statute.

A copy of the writ of capias must be delivered by the sheriff to the defendant upon his arrest. Instead of giving bail, he may, under the 43 Geo. III. c. 46, s. 2, recognised by the above enactment, deposit with the sheriff the amount endorsed, with 10*l*. for costs, on receiving which deposit the sheriff is bound to discharge him. If he does not make this deposit under the Statute, he either remains in the sheriff's custody, or is discharged on entering into a bail-bond to the sheriff, with two or more sufficient sureties, the condition of which is, that the defendant shall duly put in special bail to the action within eight days from the execution of the writ: the condition of the bond thus given can only be satisfied by *special bail* being duly put in and perfected, unless money be paid into court under the 7 & 8 Geo. IV. c. 76, s. 2, as will be afterwards explained.

2. *Who may become special bail.*—The general qualification of special bail is that they should be householders or freeholders. A peer of the realm, a member of the House of Commons, a servant in the king's household liable to be called on to attend the king, cannot become bail, all such persons being exempted from the ordinary process of the courts. It is a rule of the courts that no attorney shall become bail, which rule has been extended to their clerks, and was intended to protect attorneys from the importunities of those who employ them; and no person can be bail who is indemnified for his liability by the defendant's attorney. In order to prevent extortion, no sheriff's officer, bailiff, or person concerned in the execution of process can become bail, which rule has been extended to keepers of prisons and turnkeys. Uncertificated bankrupts, and insolvent debtors who have not paid 20*s*. in the pound upon their scheduled debts, are disqualified from becoming bail by their want of sufficient property. For the same reason, persons who have suffered their parents or near relations to receive parochial relief have been rejected. Foreigners cannot become bail merely in respect of property abroad which is beyond the court's jurisdiction; but it seems that British subjects may become bail in respect of property abroad belonging to such British subjects. The special bail, in order to justify, must be worth double the sum indorsed on the writ of *capias*, or if that exceed 1000*l*., then 1000*l*. in addition to it, over and above their just debts.

3. *Of the mode of putting in or recording bail and their justification.*—Special bail may be put in by the defendant himself or his attorney, or by the sheriff or his bail in order to their own indemnity; and they may be put in either before a judge in London or (in vacation) before a commissioner under 1 & 2 Vict. c. 45, s. 4, before a judge of assize in his circuit, or a commissioner in the country. When bail are put in, they are required to make a formal acknowledgment, called a *recognizance of bail*, that they owe to the plaintiff the sum sworn to, and that they undertake to pay the same and all costs, to be levied upon their property, unless the defendant, if defeated in the action, pays the debt or damages, and costs, or renders himself to prison; or, in case he fails to do either, unless they, the bail, pay the costs and money recovered, for him, or surrender him to custody.

Bail is thus put in either absolutely, with the consent of the plaintiff's attorney, which is very unusual in practice, or *de bene esse*, to be perfected, subject to the plaintiff's approval or exception. When put in *de bene esse*, a formal notice in writing of their being put in should be forthwith given to the plaintiff's attorney, accompanied by an affidavit of justification of each of the bail, to the effect that they are freeholders or householders, and are worth the amount necessary for justification, as above explained. Four days' notice of intention simultaneously to put in and justify special bail may also be given where that course is preferred. If notice of justifying the bail was duly given, and accompanied by the affidavits of sufficiency above mentioned, the bail will be considered as justified, unless the plaintiff have given notice of and entered his exception to them at least *one* day before that appointed for their justification. But if the bail were not put in in due time, they must justify whether excepted to or not. If unopposed, the justification is allowed as of course.

The bail may be opposed on their justification by personal examination as to their sufficiency, or by affidavits disclosing such facts as show some irregularity in the proceedings, or that the bail are really incapable of fulfilling their engagement. The corrupt practice of men hiring themselves out as bail is as old as the time of Charles II., when Butler alludes to it, and it continued to a considerable extent until the amendment of the law relating to arrest on *mesne process*. Personating another person, so as to render him liable as bail, was made a capital felony by the statutes 21 Jac. I. c. 26, and 4 & 5 Will. and Mary, c. 4; but by the 11 Geo. IV., and 1 Will. IV. c. 66, s. 11, it was reduced to a felony, punishable with transportation or imprisonment.

4. *Of the extent of the liability of bail.*—We have seen that the bail enter into a recognizance, that if the defendant is convicted, he shall pay the debt or damages, and costs recovered, or render his body to the prison of the court; and therefore if the plaintiff proceed in his action in due time, for the cause of action expressed in the process, and regularly recover judgment, the bail are in general liable to pay the money which he recovers, or to render the defendant to prison. Anciently an absurd practice prevailed, that if a man became bail for another, in however small a sum, he was bail for him in all actions brought by the same plaintiff against the same defendant during the same term, were the sums ever so great: while, on the other hand, if the plaintiff declared in his action against the defendant for a greater sum than was expressed in the process, the bail were wholly discharged. It is now however settled (see Rules of Hilary Term, 1853, r. 109), that whatever sum may be declared for or recovered by the plaintiff in the particular action, the bail remain liable; but they are only together liable to the extent of the sum sworn to by the plaintiff, and the costs of suit, not exceeding in the whole the amount of their recognizance. They are of course further liable to the costs of any proceedings that it may become necessary to take against them to enforce their liability. They are not liable to the costs of proceedings in error against their principal. The liability of the bail on the recognizance attaches, according to its terms, on conviction of the defendant, that is, on final judgment being entered against him; but as the recognizance is in the alternative, they are not immediately fixed with the debt, &c., but have a certain time allowed by the practice of the courts, within which, even after judgment, they may discharge themselves by rendering the defendant's person; the length of which interval is determined by the mode of proceeding by which the plaintiff proceeds against the bail on their recognizance. A writ of *ca. sa.* must have been issued against the defendant, and have been returned before any proceedings can be had against the bail. [Capias.]

5. *The modes in which the bail are discharged.*—The bail are discharged either by performing the recognizance, or by some matters which operate to excuse them from such performance. As to the special circumstances which operate to relieve the bail from their obligation, the general rule is, that wherever by the act of God or by the act of the law, a total impossibility or temporary impracticability to render the defendant has been occasioned, the courts will relieve the bail from the unforeseen consequences of having become bound

for a party whose condition is so changed as to put it out of their power to peform the alternative of their obligation without any default of their own. Thus, if the principal die before the return of the writ of execution (the *capias ad satisfaciendum*) against him, or if before that time he is made a peer of the realm, or become a member of the House of Commons; or if he become bankrupt and obtain his certificate, or be discharged under the Insolvent Act; or if he be sentenced to transportation, and actually on board a convict-ship under such sentence, or be impressed into the Queen's service, or be sent out of the kingdom under an alien act; or if the plaintiff is guilty of some default, as if he do not proceed in due time or in proper manner against the defendant; or if he take a security from the defendant, and thereby give him time without consent of the bail,—in these cases the bail are excused from performance of their obligation, and will be relieved by the courts. In cases where there is not a total impossibility of rendering the bail, but only a temporary impracticability, the courts will not absolutely discharge the bail, but will assist them in other modes; as by issuing a *habeas corpus*, in order to bring up the defendant to be rendered in cases where he is in legal custody for crime, or by enlarging the time for making the render.

6. *Of proceedings on the bail-bond and against the sheriff.*—We have seen, that when the defendant is discharged from arrest, he in most cases enters into a bail-bond with sureties to the sheriff, the condition of which bond is that the defendant do cause special bail to be put in for him to the action within eight days after execution of the *capias*. If special bail are not put in and justified in proper time, according to the rules of practice of the court, this bond becomes forfeited, and the plaintiff then may either proceed against the sheriff by calling upon him to bring in the defendant's body according to the command of the writ; or, if he is satisfied with the bail to the sheriff, he may cause the sheriff to assign over to him the bail-bond, under the statute 4 & 5 Anne, c. 16, s. 20, and may in his own name sue the defendant and his bail on the bond. The plaintiff, by adopting this last course, in general discharges the sheriff from his liability; and therefore it is only resorted to when the sheriff's bail are of undoubted sufficiency. If the plaintiff's proceedings on the bail-bond are *irregular*, they will (like other proceedings) be set aside with costs. But the courts will also stay such proceedings in many cases, even when they are *regular;* the action on the bail-bond being in fact only a subsidiary proceeding for enforcing the general object of bail. In cases where there is really any defence to the original action—any fair question to try—it is obvious that this can only be properly and satisfactorily tried in that action, and not in the collateral action on the bail-bond. Therefore, if the defendant makes application to the court with a proper affidavit of *merits* (that is, a good and lawful defence,) in the original action, the courts will in general stay proceedings on the bail-bond upon terms, so as to give an opportunity for a trial in the original action.

If there is no bail-bond, or if the plaintiff is dissatisfied with the sheriff's bail, he may take proceedings against the sheriff, who is responsible for the due execution of the writ. The plaintiff therefore obtains a rule or order of the court, calling upon him to make a return to the writ (see r. 132, H. T. 1853), which must, by the 20 Geo. II. c. 37, s. 2, be done before six months after the expiration of his office; and the rule must be served on the sheriff or his under-sheriff. This is usually effected by leaving a copy (showing the original) at the office of the sheriff's deputy in London. If there is no return, it is a contempt of court, and an attachment against the sheriff will be granted. To the rule to return the writ the sheriff may make such return as is consistent with the fact, either that the defendant is not found in his bailiwick, or that he has taken him (*cepi corpus*) and has him ready; or that he is sick, or that he has escaped, or has been rescued; or that he has been discharged on making a deposit with the sheriff, under the 43 Geo. III. c. 46, s. 2, &c. &c. If the return is false, the sheriff is liable to an action. If he return *cepi corpus et paratum habeo*, and if special bail are not put in and perfected in due time, the plaintiff may either take an assignment of the bail-bond, if any given, and proceed thereon against the bail, or he may obtain an order of the court requiring the sheriff to bring in the body or person of the defendant. If the plaintiff adopt the latter course, the sheriff must either bring the defendant (*constructively*, by showing him to be in his safe custody,) into court, or he must put in and perfect bail within the time allowed by the rule. If he fail in this it is a contempt of court, for which an attachment will issue on an affidavit that the rule has been duly served, and that no bail is put in. As these proceedings against the sheriff are (like the proceedings on the bail-bond) regarded by the courts as only intended to enforce the attainment of sufficient bail, the courts will also in this case extend their indulgence to the sheriff, and stay the proceedings against him, and let in a trial on the merits for the benefit of the sheriff, or the bail, or the defendant, on good bail being put in and perfected.

The rules on the subject of bail, which were formerly very complicated, and different in each separate court, have been of late much simplified by rules of court, and by the statute above cited, for uniformity of process, which was introduced by the late Lord Tenterden.

7. *Paying money into court in lieu of special bail.*—In cases where the defendant has, in pursuance of the 43 Geo. III. c. 46, s. 2, in lieu of bail to the sheriff, deposited in his hands the sum indorsed on the writ, and 10*l*. for costs, to answer the costs up to the eighth day inclusive after the arrest, and the sheriff has paid these into court, as he is bound to do, the defendant, instead of putting in and perfecting special bail, may, by virtue of the 7 & 8 Geo. IV. c. 71, s. 2, allow such sums, together with the additional sum of 10*l*. to be by him paid into court as a further security for costs, to remain in court to abide the event of the suit. In other cases, where the defendant has not made such deposit with the sheriff, the defendant, instead of putting in and perfecting special bail, may deposit and pay into court the sum indorsed on the writ, and 20*l*. as a security for the costs of the action, there to remain to abide the event of the suit. In either case, defendant should enter an appearance to the writ of summons; and if judgment be given for the plaintiff, he will be entitled, by order of the court upon motion, to receive the money so remaining in, or so deposited or paid into court, or so much thereof as will be sufficient to satisfy the sum recovered by the judgment and the costs of the application. And if judgment be given for the defendant, or the plaintiff discontinue or be otherwise barred, or if the sum deposited and paid into court be more than sufficient to satisfy the plaintiff, the money so deposited or paid into court, or so much thereof as shall remain, will, by order of the court upon motion, be repaid to the defendant.

8. *Proceedings under the Absconding Debtors' Arrest Act*, 1851.—Further legislative provision has been made by 'The Absconding Debtors' Arrest Act, 1851,' which empowers country commissioners of bankruptcy, and judges of county courts beyond the metropolitan district, to issue, upon similar application and similar affidavit to those above considered, a warrant for the absconding debtor's arrest, to the messenger of the commissioners of bankruptcy, or to the high bailiff of the county court, indorsed in the same manner as a writ of *capias*. This warrant may be executed at any time within seven days from its date inclusive; the officer executing it must detain the debtor until he has paid the debt and costs indorsed on the warrant, or given bail according to the practice of the superior courts, or is otherwise lawfully discharged. A copy of the warrant must be served upon the debtor when arrested. The warrant may be executed in any part of England, and is to be transmitted, if necessary, from the bailiff of the county court whence issued to the bailiff of any other county court within the district of which the debtor is supposed to be, and such latter bailiff may lawfully execute it, as though it had been directed to him by the judge of the county court out of which it issued. But as this warrant is only auxiliary to the process under the 1 & 2 Vict. c. 110, s. 3, it becomes void and of no effect as a protection to the creditor, unless a *capias*, and, in cases where no action was pending in the superior courts, a writ of summons therein, be forthwith issued and served within seven days from the day of the date of the warrant inclusive. Upon such service of the *capias*, the debtor is deemed to have been arrested by virtue of the *capias*, and all proceedings must be had upon it as if it had been issued prior to the issuing of that warrant, and according to the ordinary practice. If the debtor, upon his arrest under the warrant, pays the debt and costs, and is accordingly released from custody, the *capias* must be issued, but need not, of course, be served. The debtor, when arrested, may at once pay the debt and costs indorsed on the warrant to the officer duly arresting him, or enter into a bail-bond to him with two sufficient sureties for the amount indorsed, conditioned to put in special bail as required by the warrant, or to make deposit of the sum so indorsed, together with 10*l*. for costs, and thereupon he is entitled to be discharged from custody. Any person for whose arrest a warrant has been granted may, either before or after arrest, and before the writ of *capias* has been issued, apply to any commissioner of bankruptcy or county court judge, or to any judge of the superior courts, or to the court mentioned in the affidavit of debt or warrant for the arrest, for a summons or rule calling upon the creditor who has the warrant to show cause why it should not be set aside (if the application is made before arrest), or why the debtor should not be discharged out of custody (if the application is made after arrest); and the commissioner or judge may make absolute or discharge the summons or rule, and direct the costs of the application to be paid by either party, or make such other order therein as he thinks fit; but such order may be discharged or varied by the court, on application made by either party dissatisfied with it. (See Archbold's 'Practice,' 10th edit., by Prentice, vol. i. pt. 2; and Pollock's 'County Court Practice,' 3rd edit. pt. 1, cap. 26.)

Bail in error.—These are sureties required to be given by a defendant at law, who sues out a writ of error to reverse a judgment which has passed against him, and who desires to stay execution in the meantime. The condition of the recognizance into which they enter is, that the party suing out the writ of error shall prosecute it with effect, and if the judgment be affirmed, shall satisfy the debt and costs recovered, together with all such costs and damages as are awarded by reason of the delay of execution occasioned by the writ of error, or else that the bail shall do it for him. By the common law, no bail in error was required, and a defendant might therefore delay a plaintiff of his execution without giving any security to prosecute his writ of error, or to pay the debt and costs if the writ failed. This inconvenience was only partially remedied by the statute 3 Jac. I. c. 8, which required bail in error only in certain particular actions, and by the 13 Car. II. stat. ii, c. 2, and the 16 & 17 Car. II. c. 8, which rendered it necessary only where the judgment was after verdict, and not in cases where the defendant suffered judgment by default. And accordingly it became the common practice of defendants sued upon bills of exchange and other simple contracts, and having no real defence, to delay the plaintiff by suffering judgment by default, and then by bringing a writ of error, in which case they were under no obligation to find bail. These delays were suppressed by an Act, 6 Geo. IV. c. 96, s. 1, introduced by the late Sir Robert Peel, which required bail on every writ of error after judgment for the plaintiff, whether by default or after verdict, unless otherwise ordered by the court or one of its judges. The practice is now regulated by the 'Common Law Procedure Act, 1852,' the provisions of which consolidate the previous law, and extend to cases of error *in fact*, to which the above cited statute of Geo. IV. did not apply. The bail must be put in within four days after lodging the memorandum alleging error, or after the signing final judgment, otherwise the plaintiff in the original action may proceed to take out execution. The recognizance is taken in double the sum recovered by the judgment, except in the case of a penalty, where it is limited to double the sum really due and double the costs. The bail must justify, if required, and may be opposed by the plaintiff; but as the engagement is not alternative, like that of the bail in the original action, but absolute to pay the sum recovered and costs, bail in error cannot discharge themselves by surrendering their principal; nor are they entitled to relief if their principal becomes bankrupt. By the 'Common Law Procedure Act, 1854,' an appeal somewhat in the nature of a writ of error is given in certain cases, upon the refusal, or making absolute, or discharging, rules for new trials, or for nonsuit, or to enter verdicts; and upon such appeals it is provided, sec. 38, that notice of appeal shall be a stay of execution, provided bail to pay the sum recovered and costs, *or to pay costs where the appellant was plaintiff below*, be given in like manner and to the same amount as bail in error, within eight days after the decision complained of, or before execution delivered to the sheriff. (See Archbold's 'Practice,' 10th edit., by Prentice; vol. i. pt. 1. cap. 26, and vol. ii. pt. 5, cap. 28.)

Bail in Criminal Cases.—These are the sureties given to the crown by a party accused of a crime, who is allowed by a court or magistrate to be at liberty till trial, on giving security for his due appearance. By the common law, all accused persons, even though charged with heinous felonies, were allowed the privilege of bail, till the crime of murder, and afterwards treason, and other felonies, were excepted by statute. Further regulations were introduced on the subject by statutes of Henry VI., and of Philip and Mary, which contained many nice distinctions as to the offences which were bailable, and those which were not so. The provisions of these statutes respecting bail, were extended by the 7th of Geo. IV., c. 64, s. 1, introduced by the late Sir Robert Peel. A subsequent statute, 11 & 12 Vict. c. 42, s. 23, now regulates the law of bail in all cases of felonies, and also of those misdemeanors which are by statute excepted from the common law right of bail. This common law right of bail in all other misdemeanors is recognized and enforced by the same enactment. It enacts that any person charged before a justice with any felony (not being treason), or with any assault with intent to commit felony, obtaining or attempting to obtain property by false pretences, receiving property stolen or obtained by false pretences, perjury or subornation of perjury, concealing the birth of a child by secret burying or otherwise, wilful and indecent exposure of the person, riot, assault in pursuance of a conspiracy to raise wages, assault upon a police officer in the execution of his duty, or upon any person acting in his aid, neglect or breach of duty as a peace officer, or any misdemeanor for prosecution of which the costs may be allowed, may be bailed *at the discretion* of the justice or justices. By section 21, provision is made for bailing persons remanded for further examination; and see hereon in cases of summary jurisdiction the 18 & 19 Vict. c. 126, ss. 5 & 6; and the 20 & 21 Vict. c. 43, s. 3. In cases of treason, the justices have, as above stated, no power of taking bail, but such power is reserved to a Secretary of State, to the court of Queen's Bench, or in vacation to a judge thereof.

The recognizance of bail is conditioned for appearance and surrender of the person charged, at the time and place of trial, and for his then and there pleading and taking his trial, and not departing without leave. This recognizance may in certain cases be removed to the Central Criminal Court, under the 19 & 20 Vict. c. 16, s. 10, and the person charged may, after appearance at such court, be again bailed or committed to Newgate, s. 22. Bail may at any time seize and surrender their principal, and thus discharge themselves.

The above-mentioned Acts apply only to the taking of bail by justices of the peace, and do not in any way affect the authority of the superior courts of law to admit prisoners to bail. The courts of Common Pleas and Exchequer, and the Court of Chancery, may, by the common law, award a *habeas corpus* to bring up any person committed for a crime under the degree of felony or treason, and may discharge him, if it appear that the commitment was illegal, or bail him if it appear doubtful. The authority of the chancery is said, indeed, to extend to cases of felony; that of the other two courts is confined to misdemeanors. The Court of Queen's Bench has a more extensive authority; that court, or any one of its judges in time of vacation, may bail a party committed for any crime whatever, even for treason or murder; and they will in general exercise this authority in cases not capital, and also in capital cases, where the circumstances raise a presumption of the party's innocence. But neither the Court of Queen's Bench nor any other court can bail prisoners in execution, or suffering imprisonment under the sentence of a competent court for crime, or for a contempt of its authority, unless indeed it is plainly made to appear to that court that they are not guilty of the offence, or unless a prisoner is in danger of losing his life from the effects of continued confinement. And it seems now to be considered as settled that the Court of Queen's Bench has no authority to admit to bail a person committed by either House of Parliament so long as the Parliament is sitting; though, when the session is at an end, it seems admitted that it possesses such power. Metropolitan police magistrates have under the 2 & 3 Vict. c. 71, s. 36, special powers of bailing persons charged before them, even upon their sole recognizance, without surety. Justices of the peace have also special powers under the Juvenile Offenders Act, 10 & 11 Vict. c. 82, s. 15, of bailing either upon remand or commitment for trial, or upon suffering to go at large. Under the 11 & 12 Vict. c. 78, s. 1, the Act establishing the court for the consideration of Crown cases reserved, convicted prisoners upon whom judgment has been postponed, or the execution respited, may be admitted to bail by the court before which they were tried, and this power would seem to extend even to cases of treason. Persons convicted of misdemeanor, and having obtained a writ of error to reverse the judgment, may obtain an interim stay of execution and discharge from custody, provided they enter into a recognizance with two sufficient sureties to prosecute the writ with effect, to appear in court to receive judgment, and to surrender if the judgment be affirmed. See 8 & 9 Vict. c. 68, ss. 1, 2; 9 & 10 Vict. c. 24, s. 4., and 16 & 17 Vict. c. 32, ss. 1, 2. The bail taken, should be such as in the opinion of the justice admitting to bail, will be sufficient to secure the appearance and surrender of the person accused at the time and place of trial. Care must however be taken, at least in all cases bailable as of right, not to require such excessive bail as in effect to amount to a denial of bail, which is one of the grievances complained of by the Bill of Rights (1 Will. & Mary, st. II., c. 2), and prohibited by that Act.

By the 10th Geo. IV. c. 44, s. 9 (the Metropolis Police Act), it is lawful for any constable in London attending at any watchhouse in the night time, to take bail from persons charged with petty misdemeanors, without warrant of a justice, and such recognisances shall be of equal obligation as if taken by a justice of the peace.

(See Blackstone's *Comm.*, by Dr. Kerr, vol. iv. p. 349, et seq.; Bacon's *Abridgment*, tit. 'Bail in Criminal Cases,' 7th edit.; and Archbold's 'Criminal Practice,' 14th ed., by Welsby.)

BAIL. In Scotland, this term properly is confined to criminal law. In the civil courts the proper term is *caution.* Anciently, pledges of prosecution and appearance were demanded from litigants no less universally than in England; the judicial writs in both countries being then essentially the same. The writs which originate proceedings in the Court of Session however do not now make mention of pledges; and, accordingly, bail is now known in the Scottish civil courts only in exceptional cases. Two kinds were formerly in use,—caution *judicio sisti*, and caution *judicatum solvi*; phrases derived from the civil law through the medium of the old French courts, and answering to the forthcoming borgh, and the surety as law will, of the ancient common law of Scotland. Both kinds long continued in use in maritime causes, but by 13 & 14 Vict. c. 36, s. 24, they are abolished in such causes in the Court of Session; and by 1 & 2 Vict. c. 86, s. 22, caution *judicatum solvi* cannot be demanded in such causes in the Sheriff Courts, unless by leave of the judge on cause shown.

The cases in which bail may still be received in civil actions in Scotland are those in which the debtor may be arrested on *foreign* warrant or *flight* warrant. Foreign warrants are of two kinds, usually called *burgh* warrants and *border* warrants. Of all these, the burgh warrant appears the most ancient, and from it the others are perhaps derived. It seems also to have a common origin with the *foreign attachment* of London, Bristol, and other towns of England.

The *burgh warrant* is a burghal or civic proceeding directed against non-resident debtors. It appears as early as the reign of King David II., by cap. 36 of whose laws it was enacted, that if any stranger take up goods or necessaries within burgh, and offer to go away leaving the same unpaid, he shall be attached and detained by public warrant. At length, after various determinations of the courts on the subject, which it is not necessary here to detail, the Act 1672, c. 8, was passed, by which the custom is now regulated. The following particulars may thence be gathered:—The privilege is limited to royal burghs, and to book debts for man's meat, horse meat, and other merchandise due by a stranger to an inhabitant burgess, the plaintiff being the merchant, innkeeper, or stabler from whom the same was gotten, and to whom it was originally addebted, and having no bond from the stranger nor any other security except his own compt-book; and the remedy is arrest and imprisonment of the stranger, by warrant of the magistrates, till he find caution *judicio sisti* in any process to be brought for payment of the debt within six months. *Border warrants* are granted, on application to any judge ordinary, on the borders between England and Scotland, against debtors whose domicile is on the opposite side, for arresting them till they find like caution *judicio sisti.* To obtain a *flight* warrant, *fugæ* warrant, or warrant against a debtor as *in meditatione fugæ*, a petition is presented to any judge ordinary by the creditor, stating his debt, and his information and belief that the debtor is about to flee the kingdom without paying the same, and praying warrant to bring him before the court for examination. With this petition the creditor produces his vouchers of debt. He must also make an affidavit of his debt, and of his belief that the debtor means to abscond, and of the facts on which such belief is founded. If the circumstances are sufficient, the magistrate or judge then issues his warrant to bring the debtor before him for examination. If, after due inquiry, it appear that the debtor is about to flee the kingdom to defraud his creditor, warrant is granted in terms of the application, to seize and imprison him till he find caution *judicio sisti*.

The Scotch law of bail in cases of crime is shut up within a narrow compass, it being almost altogether contained in the Acts 1701, c. 6, and 39 Geo. III. c. 49. By the former, all capital crimes are made bailable. It may be remarked, that although capital sentence is not, nor, under the forms of Scottish law as now in practice, can be pronounced by a judge in the case of any crimes except murder and high treason, yet many of the more heinous offences, as robbery, rape, aggravated theft, arson, &c., are still by statute capital, and are consequently not bailable of right. (Parl. Papers, Sess. 1855, No. 419.) But the chief criminal court, or the lord advocate, as public prosecutor, may admit to bail even in capital cases. (Alison's Crim. Prac., 163, 166.)

In all except capital cases the accused is entitled to be admitted to bail on application to the judge committing or other judge having jurisdiction. By 39 Geo. III. c. 49, the bail is not to exceed 1200*l.* for a nobleman, 600*l.* for a landed gentleman, 300*l.* for any other gentleman, burgess, or householder, and 60*l.* for an inferior person.

BAILEY, or BAILLIE. [BALLIUM.]

BAILIFF signifies a keeper or superintendent, and is derived by us from the French word *bailli*, which appears to come from *ballivus*, and that from *bagalus*, the Latin word signifying generally a governor, tutor, or superintendent, and also designating an officer at Constantinople who had the education and care of the Greek emperor's sons. (Du Cange, 'Glossary.') All the various officers who are called by this name, though differing as to the nature of their employments, seem to have some kind of keeping or superintendence intrusted to them by their superior. The sheriff is called the queen's bailiff, and his county is his bailiwick. The keeper of Dover Castle is called the bailiff; and the chief magistrates of many ancient corporations in England have this name. But the chief functionaries to whom the name is applied, are the bailiffs of sheriffs, the bailiffs of liberties or franchises, and the bailiffs of lords of manors.

1. *Bailiffs of sheriffs* were anciently appointed in every hundred, to execute all process directed to the sheriff, to collect the king's fines and fee-farm rents, and to attend the justices of assize and gaol delivery: they are called in the old books *bailiffs errant*. There is now a certain number of bailiffs appointed by the sheriff in his county or bailiwick, who, from their entering into a bond to the sheriff in a considerable penalty for their due and proper execution of all process which the sheriff intrusts them to execute, "are called *bound* bailiffs, which (says Blackstone) the common people have corrupted into a much more homely appellation." These are called *common* bailiffs; but the sheriff may, and often does, at the request of the suitor or otherwise, intrust the execution of process to a person named merely *pro hâc vice*, who is called a *special* bailiff, and for whose acts the sheriff is not liable to the party obtaining him employment. The bailiff derives his authority from a warrant under the hand and seal of the sheriff; and he cannot lawfully arrest a party till he receives such warrant. It is a contempt of the court from which process issues, to hinder the bailiff in executing it; and when a party is taken by the bailiff, the law considers him in the custody of the sheriff. An arrest may be made by the bailiff's follower; but the bailiff must in such case be at hand and acting in the arrest. If a bailiff misdemean himself grossly in the execution of process, as if he use unnecessary violence or force, or extort money from prisoners, or embezzle money levied, he will be punished by attachment from the court from whence the process issues.

2. *The bailiff of a franchise or liberty* is one who has the same authority granted to him by the lord of a liberty as the sheriff's bailiff anciently had by the sheriff. These liberties are exclusive jurisdictions, which still exist in some parts of the kingdom (as the honour of Pontefract in Yorkshire, the liberty of Gower in Gloucestershire, and adjoining counties,) in which the king's writ could not formerly be executed by the sheriff, but only by the lord of the franchise or his bailiff. These districts proving inconvenient, the Statute of Westminster the Second, c. 29. provided, that if the bailiff, when commanded to execute a writ within the franchise, gave no answer, a writ, with a clause of *non omittas*, should issue, authorising and commanding the sheriff to enter the franchise and execute the writ; and it has long been the practice in every case to insert this clause in the writ, in the first instance, which enables the sheriff at once to execute it in the franchise.

3. *Bailiffs of manors* are stewards or agents appointed by the lord (generally by an authority under seal) to superintend the manor; collect fines and quit-rents; inspect the buildings; order repairs; cut down trees; impound cattle trespassing; take an account of wastes, spoils, and misdemeanors in the woods and demesne lands; and do other acts for the lord's interest. Such a bailiff can bind the lord by acts which are for his benefit, but not by such as are to his prejudice, without the lord's special authority.

(Bacon's *Abridgement*, tit. Bailiff.)

BAILIWICK, from the French *bailli*, and the Saxon ƿic (*vicus*), the street, dwelling-place, or district of the bailiff, signifies either a county which is the bailiwick of the sheriff, as bailiff of the king, and within which his jurisdiction and his authority to execute process extend; or it signifies the particular liberty or franchise of some lord who has an exclusive authority within its limits to act as the sheriff does within the county. [BAILIFF; SHERIFF; BAIL.]

BAILLIAGE, a French term equivalent with bailiwick, a district or portion of territory under the jurisdiction of an officer called a bailiff. This term was more especially appropriated to certain sub-governments of Switzerland, which at the time Coxe wrote his travels were of two sorts: the one consisting of certain districts into which all the aristocratical cantons were divided, and over which a particular officer called a bailiff was appointed by the government, to which he was accountable for his administration; the other composed of territories which did not belong to the cantons, but were subject to two or more of them, who by turns appointed a bailiff. The officer of this last sort of bailliage, when not restrained by the peculiar privileges of certain districts, had the care of the police, and under limitation the jurisdiction in civil and criminal causes. He also enjoyed a stated revenue, arising in different places from various duties and taxes. In case of exaction or mal-administration an appeal lay to the cantons to which the particular bailliage belonged. (Coxe's 'Trav. in Switz.,' 4to, Lond., 1774.) The latter bailliages anciently formed part of the Milanese. They have been formed since into the canton of Ticino. [TICINO, in GEOG. DIV.]

BAILMENT, in law, is a term derived from the French word *bailler*, to deliver, and may be defined to be "a delivery of goods for a particular purpose, upon a contract, express or implied, that the purpose shall be carried into effect, and that, when that is done, the goods shall be restored, by the bailee or person to whom they are delivered, to the owner or bailor, or, according to his directions." The degree of responsibility which attaches to a person who receives goods or other property belonging to another, depends entirely upon the circumstances of the delivery; and as those circumstances are infinitely varied, the subject is one of considerable nicety; while its connection with the transactions of commerce and the daily occurrences of life renders it of great practical importance.

The whole English law of bailment rests upon the Roman law, from which it derives not only its doctrines but its technical terms. In this article it will be sufficient to enumerate the general rules which have been established by the law of England respecting bailment; under some one of which the cases which ordinarily occur in practice are in general comprehended. The most convenient and accurate method of classifying the different species of bailments is that suggested by Sir William Jones, in his 'Essay on the Law of Bailments;' we shall follow his arrangement of the subject, using the Latin names which are common to the English and Roman law.

I. *Depŏsitum* is a mere delivery or simple deposit of goods to be kept by the bailee for the bailor without remuneration. In cases of this kind, the main obligation imposed upon the bailee is faithfully to return the goods upon demand; and he is not liable for the loss or injury of the property deposited with him, unless it has been occasioned by wilful abuse, or gross negligence. In the Roman law, gross negligence was denominated *magna*, or *lata culpa*, and was held to be presumptive evidence of fraud, when applied to cases of trust. And the same principle is adopted by Lord Holt in the case of *Coggs* v. *Bernard* (2 Lord Raymond, 913); but, according to the more recent authorities on this subject, gross negligence, although it may be evidence of *mala fides*, is not identical with it. (*Goodman* v. *Harvey*, 4 A. & E. 870, 876.) The measure of diligence required from the bailee in cases of mere deposit, or, as they are sometimes called, general bailments, is that which a prudent man would use in his own affairs. If, for instance, his house is on fire and he saves his own goods, leaving those deposited to be burned, though he had time and power to save both, he will be bound to restore the value to the owner; if, on the other hand, he is only able to save one of them, he is at liberty to prefer his own, unless the deposited property be obviously of much greater value; in which case it is said that the bailee ought to save it, and that he may then claim indemnification from the depositor for his own loss. But there is no rule in our law to the effect, that if a gratuitous bailee keep the goods as he keeps his own, he is not answerable for loss or damage, however careless or negligent he may be. There are, indeed, some expressions in the judgment of Lord Holt, in the case of *Coggs* v. *Bernard*, from which it may be collected that this was his opinion. But the modern cases show that such a bailee may be guilty of gross negligence, although he may have kept the goods entrusted to him with as much care as he kept his own; and that if he be guilty of gross negligence, the negligent keeping of his own goods will be no defence. (*Dooman* v. *Jenkins*, 2 A. & E. 256.)

II. *Mandatum*, or commission, is a delivery of goods for the purpose of having them carried from one place to another, or of having some act performed upon them, for which service the bailee is to receive no reward or payment, and from which the depositor alone is to derive benefit. The distinction between this kind of bailment and a mere deposit, is that the former implies some act to be done by the bailee, whereas the latter simply relates to custody. Hence arises a difference in the nature of the duty imposed, which is not merely to return the property to the owner, but to execute the commission which, by the acceptance of the goods for that purpose, the bailee has engaged to perform. There is, however, no real difference in the two cases as to the degree of liability incurred by the bailee; for his acceptance of the commission implies an undertaking to do as much towards the execution of it, as he would do if he were performing his own work; and accordingly, if he be guilty of gross negligence or breach of faith, he may be charged with any loss occasioned thereby.

III. *Commodatum*, is a loan of goods to be used by the person to whom they are lent or delivered, without pay. In this case, as the bailee alone derives a benefit from the transaction, a proportionate increase of obligation and responsibility is cast upon him. Where a chair, a book, a carriage, or any other article is lent for the accommodation of the borrower, he is bound to re-deliver it specifically in as good condition as it was in when delivered to him, subject only to the deterioration produced by the ordinary and reasonable use of it for the purposes of the loan: and he is also bound to indemnify the lender against any loss or damage which might have been avoided by very great care and vigilance. A borrower, therefore, is answerable not only for slight, but for the slightest neglect; he is to use not merely ordinary, but the greatest possible care; and it is not sufficient to exonerate him from responsibility for the loss or injury of the article borrowed, that he has taken as much care of it as of his own property; it is his duty to apply the utmost care of a careful and vigilant man. Thus, if I place a borrowed horse in a ruinous stable, and a violent tempest blows down the stable and kills the horse, I must bear the loss; because a very careful man would have repaired the stable, or would not have put the horse into it; while, on the other hand, if the stable had been in good repair, and had fallen from the violence of the tempest only, I should not have been liable. Even if the goods be stolen from a borrower, he must indemnify the owner, unless he has observed the greatest care, and used every precaution to prevent the occurrence. Thus, if I lock up a borrowed horse in my stable, and robbers break the door and steal him, I am not chargeable; but if I or my servants neglect to lock the stable-door, and thus give an opportuuity to the robbers, I shall be liable, because my negligence has contributed to the loss. This instance will also serve to illustrate a distinction between a loss by robbery and a loss by theft, which is fully adopted into our law from the Roman law. If I neglect to lock the stable-door, in consequence of which the horse is stolen, this is a case of theft, which would not have happened but for my neglect; whereas if robbers break the door and take the horse, this is a case of robbery or overpowering violence, which no care of mine could prevent. "Adversus *latrones*," says the civil law, "parùm prodest custodia; adversus *furem* potest, si quis advigilet." There may, however, be a case in which a borrower will be liable, though the borrowed article be taken from him by superior force. Thus, if I borrow a horse for a journey, and instead of taking the common road, I ride across a country notoriously infested by robbers, in consequence of which I am assailed and the horse is killed or taken from me: in such a case, I shall be chargeable, because the loss was occasioned by my imprudence in quitting the main road. The borrower of an article is also bound to use it for no longer time and for no other purpose than those for which it was lent. Thus, if I borrow a horse for a week to ride to Bath, and instead of using him for that time and purpose, I ride him to Oxford, and keep him a month, I am liable to indemnify the lender for any accident which may befal the horse in the journey to Oxford, or after the expiration of a week. So also, if I lend a borrowed horse to another person, in consequence of which the horse is injured, I must indemnify the owner.

IV. *Vadium*, is a delivery of goods in pledge or pawn as security for some debt or engagement. In this case a benefit is derived by each party to the transaction: by the pawnee, by his having a profit on the loan and also a security for it; and by the pawnor, by his having the advantage of goods or money on credit. The duty, therefore, of the bailee in this case is to take *ordinary* care of the property while in his custody,—such care, namely, as a careful man bestows upon his own property. He is not bound to use the most exact diligence, as in the case of a borrower for use; but he is responsible for less than gross neglect. As the presumption is, that a bailee does not use ordinary diligence who suffers the goods deposited with him to be taken away by *stealth*, it follows that if they are simply *stolen* from him, he is liable to account for them to the pawnor, unless he can show by the circumstances of the transaction, that he was in no default. But the distinction above mentioned between a theft and a robbery exists in this case also; and, therefore, a pawnee is not liable if he be forcibly robbed without any misconduct or neglect on his part. So in case of his house being accidentally burnt, the pawnee is not liable to restore to the owner the value of goods pawned, if he has used ordinary care to prevent the occurrence of such an accident. The pawnee is not, in general, at liberty to use the thing pawned; although if such use were necessary for its preservation, or otherwise beneficial to it; or if, where the pawn is an animal, it were used as a recompense for the cost of its keep, the law would perhaps imply the consent of the pawnor, to the use of the article pledged. Such use, however, is always at the peril of the pawnee who must indemnify the owner in all cases, even of robbery by violence, if the goods pawned are lost by him while he is wearing or otherwise using them.

V. *Locatum*.—This species of bailment, which is of the most extensive importance in the common affairs of life, is where an article is delivered to the bailee, on the terms that a payment or remuneration shall be made, either by the bailee for the use of it, or by the bailor for work and services to be performed by the bailee upon the article delivered to him. For more clearly understanding the relative rights and duties of the parties to this kind of bailment, it may be conveniently divided into two parts: 1. A bailment of goods to be used by the hirer for a compensation to be paid by him to the owner, which contract is called *locatio rei;* and, 2. A delivery of goods for the purpose of having work done upon them, or of being safely kept for the owner; and in each case for a reward or payment to be given or made to the bailee by the owner. This latter contract is called *locatio operis.*

A third division has been made by some authors, namely, *locatio mercium vehendarum*, where goods are bailed for the purpose of being carried from one place to another, for reward to the carrier. This seems, however, to be merely an instance of the *locatio operis.*

With regard to the first of these divisions, the modern and approved doctrine is, that the hirer of goods for a payment to the owner is bound to keep them with ordinary care, that is, with that degree of care which a careful man uses in keeping his own goods. If, therefore, I hire a horse, I am bound to treat it in all respects with the same care and moderation with which a man of common sense and prudence would treat his own horse; if I place it in a stable and leave the door open, so that it is stolen through my negligence, I must indemnify the owner; but I am not answerable if it be violently taken from me by robbers; unless, by riding at unseasonable hours, or travelling by unusual roads, I have imprudently placed myself in the way of danger. So, also, if I hire a house, lodging, or carriage, I must take the same care of them, and of the conduct of my servants and family respecting them, as a prudent and discreet man would take of his own property.

A bailee of goods for hire, even for a time certain, by *selling* the goods, determines the bailment; and the bailor may sue the purchaser as for a conversion thereof, although the purchase was *bonâ fide.* And so if, during the bailment, the goods are taken in execution for a debt of the bailee, this puts an end to the bailment, and the bailor may sue as for a conversion of the goods.

The second kind of bailment comprised under this general head, namely, *locatio operis*, is of very general occurrence. Not only manufacturers and artizans, who have materials delivered to them to work up, but innkeepers, carriers, factors, wharfingers, and warehousemen fall under this general head. But as innkeepers, factors, and carriers are exposed to a greater degree of responsibility by the law of England than that of mere bailees for hire, by means of acts of parliament and ancient customs, we refer, for the details of their liabilities, to CARRIER, FACTOR, and INN. Generally speaking, all bailees of this description, who in fact let their skill and attention to hire, are bound to take *ordinary* care of the things respectively bailed to them. With respect to manufacturers or artizans, they are not only bound to keep with ordinary care the goods deposited with them to be worked upon, but they must also apply a degree of skill equal to the performance of the particular kind of work committed to them. This obligation is founded upon the presumption, that every man possesses the ordinary skill required for the art or business he professes. The doctrine of the civil law is, that every person professing an art or handicraft *spondet peritiam artis;* and the consequence of this doctrine is that *imperitia culpæ numeratur.* If, therefore, I deliver cloth to a tailor with directions to make it into a coat, and if, for want of having the ordinary skill of his trade, he cuts it so as to spoil the cloth, he must indemnify me for the loss. With respect to agisters of cattle, wharfingers, and warehousmen, it may be stated generally that they are all responsible for want of good faith, and of reasonable and ordinary care and diligence, and not to any greater extent unless under peculiar circumstances.

(Upon the whole of this subject, see Sir William Jones's *Essay on the Law of Bailments;* Bacon's *Abridgment*, title 'Bailment'; Pothier's *Traités des Contracts, &c.;* and Kent's *Commentaries on American Law;* in which latter work the subject of bailment is treated in a most perspicuous manner.)

BAIRAM is the designation of the only two festivals annually celebrated by the Turks and other Mohammedan nations. The word is Turkish, and means a feast day or holiday. The first is also called *Id-al-Fitr*, that is, "the festival of the interruption," alluding to the breaking of the universal fast which is rigorously observed during the month Ramadan or Ramazan. This is, according to Sale, properly the lesser Bairam, but from having been celebrated more generally, and for a longer period than the other, it is now almost universally distinguished as the Grand Bairam. It commences from the moment when the new moon of the month Shawall becomes visible, the appearance of which, as marking the termination of four weeks of abstinence and restraint, is looked for and watched with great eagerness. At Constantinople it is announced by the discharge of guns at the seraglio upon the sea-shore, and by the sounding of drums and trumpets in all public places of the city. This festival ought, properly, to last but one day; but the rejoicings are generally continued for two days more. In other parts of Turkey, and in Persia, it is prolonged by the lower orders at least for five or six days, or even longer. The second festival, denominated *Id-al-Azhá*, or *Kurbán Bairám*, that is, "the festival of the sacrifices," is instituted in commemoration of Abraham offering his son Isaac, and is celebrated seventy days after the former, on the 10th of Dhu'lhajja, the day appointed for slaying the victims by the pilgrims at Mecca. It lasts three days, the first being the most solemn day of the pilgrimage, but as the ceremonies are only imitations of what takes place at Mecca, it is observed with much less strictness, and has, therefore, obtained the name of the Lesser Bairam. At each of these festivals but one *khutba* is read, that is, divine service is only once publicly performed, on the first day, about an hour after sunrise; and in the Turkish empire even this solitary act of public worship is now no longer announced by the muezzins, or public criers, from the tops of the minarets or turrets of the mosques. At Constantinople the two Bairáms are celebrated with much pomp. The sultan on this occasion receives the homage of the different orders of the empire, and proceeds in state, followed by all the higher officers, to the mosque. As the Mohammedans have a lunar year of 354 days, the two festivals run, once every thirty-three years, through all the seasons.

(Sale's *Koran*, Preliminary Discourse, s. vii.)

BAKING. [BREAD; ENAMELLING; GLASS-MANUFACTURE; POTTERY.]

BALANCE, a corruption, probably, of the middle Latin word *Valentia*, used (see Ducange) to denote price or value; whence came *valance*, mentioned by the same author, who considers the word *Balanx*, or *Bilanx*, to be a re-construction from the common idiom. The word *ballancia* is found in the 13th century. From meaning the worth or value, it came to signify any instrument used for ascertaining it, but particularly when weight was the quality referred to. Hence came the general meaning of the term, in which it stands for any state of things under which opposing circumstances just destroy the effects of each other; as when we speak of a balance of power, of good and evil, &c. Hence also the commercial meaning, in which the balance is not the state just mentioned, but the sum of money which must be added to one or the other side of an account, in order that the debts and credits may be *balanced*, or of equal amount. As an instrument of common use, the term *Scales* is more frequently applied. In philosophical apparatus, the word is applied to any machine by which an effect is measured, at the pleasure of the inventor, for there is no other rule. For the hydrostatical balance, see GRAVITY, SPECIFIC; for the torsion balance, see TORSION, &c. [STEEL-YARD, LEVER, COIN WEIGHING-MACHINE, SPRING-BALANCE.]

The instrument most commonly known by the term balance is a superior sort of scales, executed with all the precision necessary for the nicest operations of physics, and particularly of chemistry. We shall therefore confine ourselves to a statement of the circumstances which are necessary to a good performance of the philosophical balance.

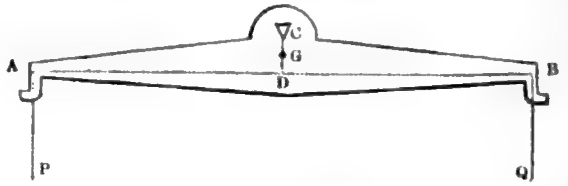
A simple straight lever, balanced by weights resting immediately upon it, so that the centre of gravity fall on the fulcrum, is at rest in every position: for no motion will change the position of the centre of gravity. The same may be said when some of the weights hang by strings; firstly on the mechanical principle that any force may act at any point of its direction, and secondly, by a geometrical theorem, which points out that when weights either hang by strings from different points in a straight line, or when some are on the straight line, and others hanging from it, if the centre of gravity of all the weights be ever in the same vertical with the fulcrum, no motion round the fulcrum can remove it out of that vertical: and all that is necessary to a perfect equilibrium is, that the centre of the weights (that of the machine included) should fall directly under the fulcrum.

The preceding statement rests upon the hypothesis of a system so contrived, that every weight shall hang as it were by a string, and from a straight line, so that all the strings shall approach to, or recede from, the vertical passing through the fulcrum, at the same time and in the same proportion. But if the line from which the weights hang be bent, or if any weight be so attached to the system that it cannot be considered as hanging from a given point, the equilibrium which subsists in one position will not subsist in another. And this, namely, that there should be only one position of equilibrium, is not only required for the use of the instrument, but practically necessary in its construction, as an *indifferent* balance, like that just described, would be difficult of execution.

A balance should be *sensible*, meaning that, when poised, a very small addition of weight to either scale should make it turn—that is, overcome the necessary friction and adhesion of the pivot or knife-edge on which it rests. If there were no friction, the smallest weight would make it turn. The first condition of sensibility, therefore, is the diminution of friction to the utmost possible extent. This is done by making all the parts of a high polish, and by placing the beam upon the support by means of knife-edges attached to its sides. But in order that the knife-edge may not become blunt, the beam is not allowed to rest upon the support except when the instrument is in use; at other times it is raised by two arms which just remove the knife-edge off the support, and these arms can be let down by means of a handle. We shall presently come to the other conditions of sensibility.

A balance should also be *stable*, that is, it should, on being disturbed, immediately return and oscillate about the position of rest. This is done by making the centre of gravity of the whole apparatus fall below the point of support. But as stability is not so difficult to attain as sensibility, the latter must be most attended to. The scales in the shops are sufficiently stable, but few are very sensible.

Neglecting the particular nature of the method of support, and circumstances of mere confirmation, the balance may be represented as follows (see Whewell's 'Elementary Mechanics:')—



C is the point of support, showing a section of one of the knife-edges, which rests upon a smoothly-polished plane; G the centre of gravity of the whole beam, A and B the points of suspension of the scales (which are also usually on knife-edges), D the point of coincidence of AB and CG. The stability of two balances is thus compared. Suppose that the same small disturbance be given to both, say the beam is inclined one degree in both. Then if the force with which the first endeavours to recover its position be double or triple that of the second, the stability of the first is double or triple that of the second. To compare these forces, construct the following formula for both.

To *weight of both scales* $\times$ *CD* add *weight of beam* $\times$ *CG*.

For instance, suppose two balances as follows:—

	First.		Second.
Arm AD	12	.	14 inches.
CD	2	.	3 „
CG	1	.	2 „
Weight of beam	30	.	50 ounces.
Do. both scales	24	.	30 „

Then will the stabilities of the first and second be as $24 \times 2 + 30 \times 1$ to $30 \times 3 + 50 \times 2$, or as 78 to 190.

The sensibility is estimated by comparing the angles through which very small equal weights would incline the balances. If, for example, a grain put into a scale of each inclines the first four degrees, and the second only two degrees, the first is twice as sensible as the second. To compare the sensibilities, multiply the length of the arm of each by the number which represents the stability of the other in the formula just given. Thus the sensibilities of the preceding balances are as 12×190 to 14×78, or as 2280 to 1092.

It would not be worth while to work very accurately by the preceding formula; but the general rules deducible from them are valuable.

1. Other things remaining the same, the longer the arm the greater the sensibility.

2. The arm having a given length, every increase of sensibility is a decrease of stability, and *vice versâ*.

3. Additional weight, either to the scale or beam (the arm remaining the same), is favourable to stability, and unfavourable to sensibility.

4. Whatever does not alter the length of the arm cannot be favourable to both.

In all that precedes, it must be recollected that in the weight of the scales is included whatever may happen to be in them. Consequently every balance has different degrees of sensibility and stability, with the different weights which are employed. But as, generally speaking, the quantities weighed in delicate balances are small, a balance which is highly sensible when no weight is in the scales, will be so for every weight with which it is intended to use it. A balance made by Ramsden for the Royal Society, weighing ten pounds altogether, turned with the ten-millionth of that quantity, or with about the thousandth part of a grain.

A balance should be made as much as possible of brass. Steel and iron are apt to acquire magnetic properties. It should also be inclosed in a glass case, with doors for communication; and, when not in use, a portion of muriate of lime, or any other strong absorbent of moisture, should be placed in the case. A needle is usually attached to the beam, which points either exactly upwards or downwards when the beam is horizontal. A graduated scale of degrees is attached to the frame-work of the instrument, in such manner that the needle may point to zero when it is vertical. The oscillations of the balance, when the centre of gravity is near to that of suspension, will be very slow, and by means of the needle it may be ascertained, before the balance comes to rest, whether horizontal equilibrium has been obtained: for in that case it will describe equal arcs on the graduated scale on each side of the zero point; while if either scale be overloaded, the needle will move through more degrees on the side of that scale than on the other. There are other methods of determining the position of the beams, such as a graduated arc attached to one end of the beam viewed through a compound microscope with a horizontal wire in the focus of the eye-glass, or by a mirror attached to the beam in which the reflected image of a scale is viewed through a telescope.

All that precedes has reference to the theoretical construction of the instrument, and supposes that a perfect balance can be made, so that equal weights shall counterpoise each other. This is certainly impossible in practice, though one balance may be nearer than another. The following simple method, imagined by Borda, overcomes this difficulty, provided only the balance be sensible and very well constructed at the knife-edge. Instead of weighing, say a portion of a salt against brass weights, weigh both the salt and the weights against some third substance, say, for distinction, iron weights, as follows:—call the scales A and B; weigh the salt in A against iron weights in B till there is a counterpoise: then remove the salt and substitute the brass weights in A until there is again a counterpoise. It is now of no consequence whether the weight of iron was equal to that of the salt or not; the weight of the salt and of the brass must be the same, because, under the same circumstances, the two counterpoise the same weight of iron.

Dr. Faraday, in his 'Chemical Manipulation,' sect. ii., gives a number of minute directions on the management of the balance, weighing, &c., to which we refer the student; but we may here select a few details of general interest.

Scientific chemistry may be said to owe its very existence to good balances and accurate weighing. Two or three balances are required in the laboratory; a coarse balance for weighing large quantities, which would injure those intended to show minute differences in small weights, by bending the beam or changing the points of support. This balance should weigh from 1 oz. up to 3 or 4 lbs., or more, and when fully loaded should turn with 2 or 3 grains. A second balance should weigh from $\frac{1}{2}$ a grain to 2 or 3 oz., and turn with about $\frac{1}{2}$ or $\frac{1}{3}$ of a grain when fully loaded; but the best instrument should be capable of weighing from 600 to 1000 grains and downwards, and indicate with distinctness and certainty differences equal to the $\frac{1}{50000}$ or $\frac{1}{60000}$ part of the weight in the scale. The weights required for these balances will vary from 3 lbs. down to the 100th part of a grain, and form at least two sets; the one consisting of averdupois pounds, ounces, drachms, and the other of grains, from 1000 down to the smallest fractions. These weights are usually constructed in sets, containing as few as possible in each; thus, four weights of 1, 2, 3, and 4 grains are sufficient to weigh from 1 to 10 grains; and with similar weights of 10, 20, 30, 40, 100, 200, 300, and 400, as much as 1100 grains can be weighed. A perfect set of weights, from 500 grains down to the hundredths of a grain, should be kept with the best balance. The weights are commonly made of brass, but the smaller ones are of platinum, which is very desirable on account of its unchangeable nature, and the ease with which it may be cleaned without loss, either by wiping, or momentary exposure to the flame of a spirit-lamp.

The vibrations of the balance vary with the load, and as this is increased the slower are the vibrations. To a practised eye, the extent and velocity of vibration indicate nearly the weight required to produce equilibrium. The weight required to produce a certain inclination of the beam, or to turn it, should be known when the balance is slightly as well as heavily loaded. A good balance should turn with the 100th of a grain when 600 grains are in each scale, or with $\frac{1}{60000}$ of the weight to be estimated.

When a balance is overloaded, it is liable to *set;* that is, the side which is lowest becomes permanently depressed. For example, a balance with equal weights in each pan, too heavy for its size, if placed horizontal will remain so; but if one of the pans be a little depressed, it will continue to descend with accelerated force just as if it were the heavier of the two. This effect is more likely to take place in a delicate balance, when overloaded, than in a coarser one. The setting is brought about by the position of the fulcrum below the line which joins the extreme points of suspension of the beam, whereby the centre of gravity of the beam is brought below the fulcrum.

A good method of testing a balance is to remove the pans, and to set the beam vibrating, which it should do in a regular and equable manner, and gradually take up a horizontal position. It should then be reversed on its stand and made to oscillate as before, when, should it again come to rest in a horizontal position, the balance is good; for this test is a severe one, generally disclosing, as it does, some defect in the work of the middle knife-edge, and the planes on which it rests. When the pans are hung upon the beam the balance should still remain horizontal, but the accuracy of the lines of suspension should be tried by changing the pans, then by reversing the beam, and afterwards by changing the pans again. Then put equal weights into the pans, and change them from one pan to another; if the equilibrium be now retained, the lengths of the arms are equal.

The balance was well represented in the Great Exhibition of 1851; so much so as to call for a liberal encomium in the 'Jury Report,' Class X. "When it is considered, in order to have a balance as perfect as possible, how very many circumstances are to be attended to, it must be deemed highly honorable to the exhibitors of good balances to have produced instruments standing the test of the rigorous examination to which they have been subjected."

Among the balances exhibited were some novelties. First, with respect to the modes of suspension. In Mr. Fox's balance, the beam has pivots, the conical ends of which play in hollow agate cones of larger angle.* In the short-armed balance, constructed many years ago by Captain Kater and Mr. Robinson, the then novel feature was the long bearing on which the pans were suspended, instead of the hook and eye arrangement employed on the continent, and in the balances imported into this country. The defects of this arrangement are, that the hook does not always occupy the same position upon the ring with reference to the centre of motion, so that the beam is practically sometimes longer and sometimes shorter, causing differences in the indications of as much as ·01 of a grain. Secondly, the divisions of the scale to which the index of the balance points are numbered 1, 2, 3, &c., to the right and left of zero, to which the index points when the beam is horizontal. It is suggested that the number of the divisions should run the same way, and not begin with zero; it being better to number that division to which the index points when the beam is horizontal, 10, 20, or some multiple of 10, in order to avoid the liability to error consequent upon having positive and negative numbers. Thirdly, in the balances exhibited by Mr. Oertling (a London artist, well known to scientific men for the excellence of his instruments), the beam was in one case coated with platinum, and in another case with palladium: the operation having been performed by Mr. Henry, by some electro-metallurgic process. In Mr. Oertling's large balance, the beam was 3 feet in length, and capable of carrying 56 lbs. in each pan. The beam was a pierced rhomb, constructed so as to give great strength in proportion to its weight, any tendency to lateral yielding being counteracted by edge bars. The three knife edges are long, and the whole length of the middle one rests on a plane surface of steel. Plane surfaces of steel also rest on the extreme knife-edges for suspending the scale-pans. In the second balance, the palladium coated beam is 16 inches long; the three knife-edges, as well as the plane on which the middle one rests, and the planes from which the pans are suspended, are of agate, so that the instrument is not liable to be affected by the acid vapours of the laboratory. In this instrument the beam is graduated, so that small differences of weight can be determined by placing a small platinum wire weight on one of the divisions of the graduated beam. Mr. Marriott exhibited a chemical balance, the beam of which was made of a wide piece of fir-wood, with interstices cut out, so as to leave a strongly-framed net-work; it was said to be sensible to the 100th of a grain. In Mr. Dover's balance, constructed on the plan of Robinson's, the final adjustments in the direction of the length of the beam, and in a direction perpendicular to it, are effected by a cut at each end of the beam, making an angle of about 45° with the axis of the beam, and capable of being widened by means of a screw. In the American balance, capable of carrying 56 lbs. in each pan, the knife-edges are square bars of steel, each fitted into a socket attached to the beam, having a rectangular notch, so that any one of the four edges of the bar may be used as a knife-edge, which would be found useful in case of one of the edges being damaged. The socket in which one of the extreme knife-edges is fixed moves in a slit in the direction of the length of the beam, and is adjusted in that direction by means of two screws. Mr. A. Oertling (Prussia) had a balance in which the knife-edges were let into dove-tail notches in the beam. The adjustment of the distance of the extreme knife-edge from the middle knife-edge was effected by means of a vertical cut in the metal of the beam, capable of being slightly widened or contracted by screws. Fourthly, in some of the French balances the pans were of platinum, suspended by silver wires. Fifthly, there were various contrivances for checking the oscillation of the beam and pans when in action, but none of them were considered by the Jury to be equal to Wollaston's arrangement. In Dolberg's balance (Mecklenburg Schwerin) the oscillation of the pans is checked by hair-brushes which, on turning a handle, ascend, until the ends of the brushes touch the under side of the pan. In Mr. Fox's balance, already mentioned, the attraction of a magnet brings the beam exactly to zero before weighing.

In the measures taken to restore the standards of weight and measure, to replace those which had been destroyed by the burning of the Houses of Parliament, the first step in the process of arriving at the weight of the lost standard was to compare among themselves the different troy pounds with which the lost standard had been compared by Captain Kater and Captain V. Nehus. The balance used for these comparisons was furnished by Mr. Barrow, on Robinson's principle, and is described by Professor W. H. Miller, in his paper in the 'Philosophical Transactions' for 1856, 'On the Construction of the New Imperial Standard Pounds,' &c. "The beam is made sufficiently strong to carry a kilogramme in each pan. The middle knife-edge is about 1·93 inch long, and rests, when the balance is in action, throughout its whole length on a single plane surface of quartz. The surfaces of quartz which rest upon the extreme knife-edges, and from which the pans are

* In the balance constructed under the direction of Gauss and Weber ('Gottengen Transactions'), the beam is suspended by two watch-springs, and each pan by a single watch-spring. In Steinheil's balance the beam and pans are suspended by wires or silk ribbons: or by another method the beam carries two small steel spheres in the middle, resting upon a steel plane, while at each end of the beam is a sphere, upon which rests either the plane or the slightly concave spherical surface of the plate from which the scale-pan is suspended. None of these balances were exhibited.

suspended, are also plane. The distance between the extreme knife-edges is about 15·06 inches, the length of each about 1·05 inch. Instead of having an index pointing downwards, as is usual in balances of this description, the beam has a pointer at each end, and a graduated scale is carried by an arm attached to the pillar of the balance at a little distance behind the left-hand pointer. Affixed to the right-hand end of the beam is a thin slip of ivory, a little more than half-an-inch long, divided into spaces of about 0·01 inch each, or subtending an angle of about 5′ each at the middle knife-edge. This scale is viewed through a compound microscope, having a single horizontal wire in the focus of the eye-piece. The distance between two divisions of the scale, as seen through the microscope, subtends an angle of 37′. This contrivance for determining the position of the beam at the extremity of an oscillation was found so superior to a scale and pointer viewed with the naked eye, that after a trial of a few days, the scale at the left hand was found to be a useless incumbrance, and was accordingly removed. A screen was interposed between the observer and the front of the balance-case, having a small opening opposite to the eye-piece of the microscope, through which the scale could be seen."

BALANCE OF POWER. The notion upon which this phrase is founded appears to be the following. When a number of separate and sovereign states have grown up beside each other, the entire system which they constitute may be conceived to be *in equilibrio*, or evenly balanced, so long as no single one of them is in a condition to interfere with the independence of any of the rest.

But as in such a system of states so connected there are generally a few which may be considered as leading powers, it is by these being being made to counterpoise each other that the balance is principally maintained. It is in this way only that the safety of the smaller states can be secured. Thus, in the ancient world, after the destruction of Carthage, there was no power any where left strong enough to cope with Rome; and the consequence was, that, one after another, the countries that yet remained sovereign powers fell under her dominion, until she became the mistress of the ancient world.

On the contrary, so long as the power of one great state (however far surpassing in extent of territory, or other resources of strength and influence, many of those in its neighbourhood) can be kept in check, or, in other words, balanced by that of another, the independence of the smaller states is secured against both. Neither will be disposed to allow its rival to add to its power by the conquest or absorption of any of these minor and otherwise defenceless members of the system. And in this way it happens that each state, whether great or small, has an interest and a motive to exert itself in the preservation of the balance.

This point of policy is so obvious, that it must have been acted upon in all ages, by every assemblage of states so connected or situated as to influence one another. There may have been less or more of skill or wisdom in the manner of acting upon it, or the attempt to act upon it may have been more or less successful, in different cases; but to suppose that its importance had been overlooked by any states that ever existed in the circumstances described, would be to suppose such states to have been destitute of the instinct of self-preservation.

Hume (see his 'Essays,' part ii. essay 7th) has shown conclusively, in opposition to the opinion sometimes expressed, that ancient politicians were well acquainted with the principle of the balance of power, although, as far as appears, they did not designate it by that name. "In all the politics of Greece," he observes, "the anxiety with regard to the balance of power is apparent, and is expressly pointed out to us even by the ancient historians. Thucydides (lib. i.) represents the league which was formed against Athens, and which produced the Peloponnesian war, as entirely owing to this principle; and after the decline of Athens, when the Thebans and Lacedæmonians disputed for sovereignty, we find that the Athenians (as well as many other republics) always threw themselves into the lighter scale, and endeavoured to preserve the balance. They supported Thebes against Sparta, till the great victory gained by Epaminondas at Leuctra: after which they immediately went over to the conquered—from generosity, as they pretended, but, in reality, from their jealousy of the conquerors." "Whoever," he adds, "will read Demosthenes' oration for the Megalopolitans, may see the utmost refinements on this principle that ever entered into the head of a Venetian or English speculatist." He afterwards quotes a passage from Polybius (lib. i. c. 83), in which that writer states that Hiero, king of Syracuse, though the ally of Rome, yet sent assistance to the Carthaginians, during the war of the auxiliaries, "esteeming it requisite, both in order to retain his dominions in Sicily, and to preserve the Roman friendship, that Carthage should be safe; lest by its fall the remaining power should be able, without contest or opposition, to execute every purpose and undertaking. And here he acted with great wisdom and prudence; for that is never on any account to be overlooked; nor ought such a force ever to be thrown into one hand as to incapacitate the neighbouring states from defending their rights against it." "Here," remarks Hume, "is the aim of modern politics pointed out in express terms."

It must be confessed, however, that the preservation of the balance of power was never so distinctly recognised and adopted as a principle of general policy in ancient as it has been in modern times. The systematic observance of the principle of the balance, subsequently to the subversion of the Roman empire, may be first traced in the conduct of the several Italian republics. It appears clearly to have formed part of what may be called the public law of these rival sovereignties from about the commencement of the 15th century. From the commencement of the next century it became an influencing principle in the general policy of Europe.

The leading rule by which it has ever since then been attempted to maintain the balance in question, may be stated to be the opposing of every new arrangement which threatens either materially to augment the strength of one of the greater powers, or to diminish that of another. Thus, first Austria, and afterwards France, have been the great objects of the jealousy and vigilance of the other states of Europe. While the supremacy of the Empire was united in the person of Charles V. to the monarchy of Spain, that province was naturally regarded as formidable both by France and England. If he could have effected a permanent alliance with either of these powers, or could have even induced one of them to stand aside and acquiesce, there can be little doubt that he would have taken that occasion to attempt to crush the other. The vast possessions of Philip II. appeared to call for the same watchfulness and opposition in regard to his projects, from all other states that valued their independence. In later times, the ambition of Louis XIV. of France, and the scheme concerted under his management to unite in one family the crowns of France and Spain, drew upon him, in like manner, the general hostility of Europe. There can be no manner of doubt, that, if the designs of this sovereign had not been thus resisted, France would have become a century earlier than it did the mistress of the continent, and the independence of all other nations would, for a time at least, have been extinguished. Our own liberties, as founded upon the Revolution of 1688, could, in such circumstances, certainly not have been maintained.

It is nothing to the purpose to argue that the maintenance of the balance of power has often involved the nations of Europe in contests with each other, which, if they had disregarded that principle, would not have taken place, at least, not at the time. It may be better that all nations should be subject to one, than that each should preserve its independence; but that is not the question here: if nations will be sovereign and independent, they must fight for their sovereignty, as men must do for any other possession, when it is attacked.

But some persons appear to think that we in this country have nothing to do with the maintenance of the so-called balance of power in Europe, because we live not on the continent, but in an island by ourselves. If the whole continent were reduced under subjection to a single despot, we certainly should not long remain independent. The protection which we now possess from the sea with which we are surrounded would, in the case supposed, certainly become insufficient. The water alone would not keep off an enemy, if we had not a navy to ride on it; and we could not maintain a great navy without our foreign trade; which, with all the rest of Europe united under one head against us, certainly could not subsist.

The maintenance of the principle of the balance of power, however, although it has no doubt given occasion to some wars, has probably prevented more. Its general recognition has, to a certain extent, united all the states of Europe into one great confederacy, and habituated each of the leading powers to the expectation of a most formidable resistance in case of its making any attempt to encroach upon the rights of its neighbours. It is not sufficient objection to say that such attempts have been actually made. They would have been made much oftener had there been no such general understanding as we have spoken of. It must have operated as a great discouragement and check to the schemes of ambitious potentates, to know that, from the first consolidation of the modern European system down to the partition of Poland in 1772—a period, we may say, of three centuries—not the smallest independent state had suffered extinction, or had been even very seriously curtailed of power or territory, notwithstanding all the wars for the purpose of conquest and aggrandisement that had been waged during that long interval.

BALANCE OF TRADE. In a tract published in 1677, called 'England's Great Happiness,' which is quoted by Mr. M'Culloch in the introductory discourse to his edition of Smith's 'Wealth of Nations,' is the following dialogue between "Complaint" and "Content:"—

"*Complaint.* What think you of the French trade which draws away our money by wholesale? Mr. Fortrey gives an account that they get 1,600,000*l.* a year from us.

"*Content.* 'Tis a great sum; but, perhaps, were it put to a vote in a wise council, whether for that reason the trade should be left off, 'twould go in the negative. I must confess I had rather they'd use our goods than our money; but if not, I would not lose the getting of ten pounds because I can't get an hundred. . . . I'll suppose John-a-Nokes to be a butcher, Dick-a-Styles to be an exchange-man, yourself a lawyer,—will you buy no meat or ribands, or your wife a fine Indian gown or fan, because they will not *truck* with you for indentures which they have need of? I suppose no; but if you get money enough of others, you care not though you give it away in specie for these things. I think 'tis the same case."

The year after this sensible and conclusive passage was written, the French trade was prohibited for three years; and in the reign of

William III. the legislature voted the French trade a nuisance, and made the prohibition perpetual. This was to enforce what was called a favourable balance of trade. The notion, we thus see, was not a vague theory, but a mischievous rule of practice, which even in our own time some people regarded with admiration, and would eagerly have laboured to make it a part of our commercial code. They would have the nation to be the lawyer who wants to *truck* his indentures with the wine-merchant; but because the wine-merchant will not have the indentures, the lawyer ought, according to this, to go without the wine, although he might *sell* the indentures to the exchange-man, who would thus furnish him with the specie for buying the wine.

The balance of trade, as understood by those who adopt the theory, is the difference between the aggregate amount of a nation's exports or imports, or the balance of the particular account of the nation's trade with another nation. If the account shows that the imports (valued in money) exceed the exports (valued also in money), the balance is said to be against the nation; if the exports exceed the imports, the balance is said to be in the nation's favour. This mode of estimating the so-called balance is evidently founded on the assumption that the precious metals constitute the wealth of a country;—when the imports from any country, as valued in money, exceed the exports to the same, also valued in money, the exporting country must part with some of its precious metals in payment; and, according to the doctrine, must so far lose by the trade. The nation had not the means of keeping very clear accounts of these matters, for it had an arbitrary standard of value, called *official*, which had been in use for nearly a century and a half, and which *official value* was an ingenious device for perplexing many otherwise simple questions, and for keeping up many absurd prejudices. Now, taking these official or unreal values in connexion with the device of the balance of trade, we find that during the year 1833 the United Kingdom gained some thirty-four millions sterling by a favourable balance; for its imports, or the goods it received from foreigners, amounted to forty-five millions, whilst its exports, or the goods it sent to foreigners, amounted to seventy-nine millions. In 1832 the same sort of excess amounted to thirty-two millions, and in 1831 to twenty-two millions. If the favourable balance of these three years were anything but a fiction, it is manifest that the nation would, in these three years only, have accumulated specie to the extent of the favourable balance, and this would amount to the sum of eighty-eight millions sterling. But, further, the same favourable balance has been going on for the last half century, or longer; and the result would be, that all the specie in the world would at the present time be locked up in this island, and that the balance of thirty-four millions in 1833 would only be a small addition to the heap. Such a result is impossible, for bullion is as much a commodity for sale as corn, and is consequently as generally exchanged. [BULLION.] But if this result were possible, and a nation resolving to sell only for specie, as the Chinese affected to do with regard to tea, could have the power of selling only for specie, this power of turning all its goods to gold, like the same power bestowed upon the wise king Midas, would confer the privilege of being without food, and clothes, and every worldly comfort upon the unhappy inhabitants of such a nation. The truth is, that no commerce is of any value to a country except as it gives the people of that country the power of consuming foreign productions, which they either cannot produce at all at home, or which are produced cheaper and better abroad. It is the power of *exchanging* the surplus produce of one country for the surplus produce of another country which constitutes the ultimate object of all foreign commerce. The profit of the individual merchant is the moving force which impels the machinery of this commerce, but the end is, that each country may consume what it would otherwise go without. In this point of view, every country is a gainer by its foreign commerce; and if this gain could be estimated by figures, every country which exchanges its products with another country would have a favourable balance of trade: for both individuals and nations exchange that which they do not want for other things that they do want; and when both parties continue to carry on such exchange, it is clear that both are gainers. Which gains most is a question that cannot be settled, and would be of no use if it could be settled.

BA'LCONY is derived from the Italian word *balco*, or *palco*. ('Dizzionario della Crusca.') Balcon is often used by Boccaccio in his 'Novelle,' from which circumstance we may conclude that balconies were common in Italy at that time. Palco signifies, in Italian, the box of a theatre; and in the great theatre at Bologna, built, we believe, by Palladio, each box or balcony has a balustrade. [BALUSTRADE.] The balcony has been much employed in modern edifices. The object of balconies is to give the inhabitants of a house a better view. They are formed nearly on a level with the floors of rooms, and supported on cantilevers or brackets, and sometimes, though more rarely, on columns of wood or stone. The floor of the balcony is laid on the cantilevers, and the sides are inclosed with a rail of iron, or a balustrade of stone. Where balconies are formed, the windows are for the most part made to open down to the ground. In London cast-iron railing, variously designed, is most commonly used. There are, however, balconies with balusters of stone sometimes placed before single windows, or continuous ranges of them. The Goldsmiths' Hall, at the back of the Post-office, is an example of the former; the Crescent at the end of Portland-place, of the latter. Some balconies have a very slight projection, and rest not upon cantilevers, but upon the basement wall, as in the Banqueting-house at Whitehall. In Venice there are very magnificent Gothic balconies remarkable for their richness. It is uncertain when balconies were first introduced into England. Some of the old inns, with the galleries round them, are perhaps the oldest examples existing. Elizabethan architecture shows some very elaborately designed balconies; but perhaps the nearest example to the *palco* of the Italians will be found in some of the colleges of Oxford. Magdalen College contains an example of such a balcony in a pulpit supported on corbels.

BA'LDACHIN (*Baldachino*, Italian), a kind of canopy, either supported on columns, or suspended from, and used to cover an altar in a Roman Catholic church. The word is derived from the Italian *baldachino*, signifying a piece of furniture, which is carried, or which is fixed, over sacred things, or over the seats of princes and persons of great distinction, as a mark of honour. The form, for the most part is square, and the top covered with cloth with a hanging fringe: sometimes the fringe is formed of pieces of cloth cut out after the fashion of a banner. The baldachin has been supposed to have been derived from the ancient *ciborium* (*κιβώριον*, a large cup or vase). An isolated building, placed by the early Christians over tombs and altars, was called a ciborium. The modern baldachin is of the same form as the ciborium erected by Justinian in the church of Santa Sophia at Constantinople, which was made of silver, gold, and precious stones, and supported by four silver-gilt columns. The baldachin is however deprived of the curtains which in the ciborium were intended to inclose whatever was deemed sacred within. ('Encyclopédie Méthodique.') The Mohammedans seem to have copied the ciborium in their tombs. (See the domed tombs at Cairo, in the work of the French Institute on Egypt.) The baldachin carried over the host in Roman Catholic countries is not unfrequently of an umbrella shape; a similar sort of umbrella may be seen on an Etruscan vase. (Millingen 'Vases.')

The baldachin in St. Peter's at Rome, made by Bernini, is the most celebrated, and is the largest known work of the kind in bronze. The dais, or covering, is supported on four large twisted columns of the composite order, placed upon pedestals of black marble, the dies of which are ornamented with bronze escutcheons. The columns are fluted for one-third of their height; the remaining part is ornamented with bays and leaves of laurel, combined something after the manner of the columns of the temple designed by Raffaelle in one of his cartoons. The whole work is beautifully executed and highly-finished. Above the columns are four figures of angels standing upright; at the top of the covering there is a cross, and below the entablature the banner-like cloth fringe of the portable baldachin has been imitated. The plan is square, and the altar stands between the two pedestals of the foremost columns. The height is 126 ft. 3 in. from the floor of the church to the summit of the cross, of which the pedestal is 11 ft. 8 in., the columns 50 ft. 4 in.; the entablature 11 ft. 6 in., the covering 40 ft., and the cross is 12 ft. 9 in. There were 186,392 lbs. of bronze employed on this work; the chasing alone cost more than 100,000 crowns. The Pantheon was despoiled of its fine bronze ornaments to form this baldachin, and there being more ornaments than were necessary, the remainder were afterwards cast into cannon.

The baldachin of Santa Maria Maggiore, the next in importance to that of St. Peter's, is a kind of crown supported by four figures standing on columns of porphyry ornamented with bands of bronze. It was made by the Cavaliere Fuga. It is not improbable that the Gothic canopies [CANOPY] over figures of saints and personages of distinction, were intended for baldachins, as they appear to be used as marks of distinction, and not for a covering only to protect them from the weather, as they are placed horizontally on the tombs of kings and queens, and other personages of high rank. (See the tombs of the kings in Westminster Abbey, and the engravings in Stothard's 'Monumental Remains;' Blore's 'Monumental Remains of Great Britain,' &c.)

BALDRICK, or BAUDRICK (Fr., *baudrier*), the military belt, band, or girdle, much used by warriors in more ancient, as well as in the feudal times; encircling the waist, or pendant from the right shoulder, and usually sustaining a sword: was sometimes called a baldrick, but the baldrick seems to have differed from the military belt by being uniformly worn over the shoulder and across the breast, and from it a sword was not always slung. Menage derives this word, through the medium of the low Latin *baldringus*, from the Latin *balteus*. Ducange derives it through *baldrellus*.

The figure of William de Valence, Earl of Pembroke, in Westminster Abbey, has a belt finely enamelled with his coat of arms. Various arms are also enamelled on the belt of Edmund Crouchback, Earl of Lancaster's figure in the same church. The effigy of Geoffrey de Magnaville, in the Temple Church, has both a belt and a baldrick, while that of William Longespee has a belt only. But Spenser, in his 'Faerie Queene' (book i. canto vii.) makes Una to meet a "goodly knight," and—

> "Athwart his breast a bauldrick brave he ware,"

While—

> "Thereby his mortal blade full comely hong."

Chaucer, on the contrary, says of the yeoman, the squire's attendant, that—

> "An horne he bore, the baudrick was of grene;"

And Drayton, in his 'Polyolbion,' speaking of Robin Hood and his followers, has—

> "Their bauldricks set with studs, athwart their shoulders cast,
> To which, under their arms, their sheafs [quivers] were buckled fast,
> A short sword at their belt."

The 'Lytell Geste of Robyn Hode,' however, makes no mention either of baldricks or belts.

BALDWIN'S PHOSPHORUS. This substance consists of fused nitrate of lime, which, after exposure to the direct solar rays, continues to emit a phosphorescent light for several hours after it has been placed in a darkened room. This apparent absorption and subsequent emission of light is accompanied by no chemical change, and is consequently a purely physical phenomenon.

BALENIC ACID ($C_{38}H_{37}O_3HO$)? A fatty acid said to have been found in whale oil, but its existence is very doubtful.

BALISTÆ. [ARTILLERY.]

BALLAD, in music, a short air, repeated to two or more stanzas, simple in construction, therefore confined in modulation, and having an accompaniment of a strictly subordinate kind. When an air, or its accompaniment, is florid, or modulates into unrelated keys,—when, in short, either assumes a more elaborate form, the composition generally takes the name of *song*, or *canzonet*, even when several stanzas are repeated to the same melody. [SONG; CANZONET.]

BALLAD, in poetry, a popular song or roundelay, generally sung or chanted. Johnson, in his dictionary, defines a ballad as a song; and the words are very often used as synonymous. It is not perhaps very easy to define the ballad as distinguished from the song, because in the course of many centuries it has embraced many species of poetry. As our old ballads were chanted, the name of ballad-singer became in course of time applied to everything sung in the street; but the distinction between a ballad and a song, if any, is that the ballad has more of the epic character, the song more of the lyric. The first must contain a narrative, or at least relate to man and his actions; the second may embody only a sentiment or description. The 'Dictionnaire de l'Académie Française' defines the ballade as a species of ancient French poetry, composed in couplets, and which must contain three couplets and an envoi; and a prior of St. Genevieve at Paris, about the middle or latter half of the 15th century, wrote a system of rules for ballad writing, 'L'Art de Dictier Ballades et Rondelles,' which Warton terms the first Art of Poetry printed in France. Bishop Percy says, the English word ballad is evidently from the French *ballade*, as the latter is from the Italian *ballata*; which the Crusca dictionary defines 'Canzone che si canta ballando,' a song which is sung during a dance. But he adds that the word appears to have had an earlier origin: for in the decline of the Roman empire, these trivial songs were called *ballistea* and *saltationes*. "Ballisteum," Salmasius says, "is properly *ballistium*, Gr. *βαλλιστεῖον, ἀπὸ τοῦ βαλλίζω*. . . . . *βαλλιστία saltatio*. . . . . *Ballistium* igitur est quod vulgo vocamus *ballet*; nam inde deducta vox nostra." (Percy, 'Rel. of Anc. Eng. Poet.' 8vo, 1794, vol. i. p. xcviii; Salmas. 'Not. in Hist. Aug. Script.' vi. p. 439.)

Ballads and rude poetry have been, in all countries, the earliest memorials of public transactions; and in the savage state of each were invariably used to rouse and perpetuate a martial spirit. Tacitus tells us that Arminius, long after his death, was remembered in the rude songs of his country ('Annal.' ii. 88); and the same writer informs us that ballads were the only annals known among the ancient Germans. They have a tradition, he adds, that Hercules visited those parts, and they sing his praises, when rushing to battle, in preference to all other heroes. ('De Morib. Germ.' sect. ii., iii.) Saxo Grammaticus, speaking of the Northern writers of a somewhat later period than this, says they drew the materials of their history from Runic songs. The Scandinavians had their Scalds, whose business it was to compose ballads, in which they also celebrated the warlike achievements of their ancestors. Similar panegyrists of warrior-merit existed in Gaul, Britain, Wales, and Ireland; and it must not be forgotten that when Edward I. formed the plan of reducing Wales to subjection, he thought it necessary to destroy the bards. Their compositions, however, survived; and a writer as late as Queen Elizabeth's time, describing North Wales, says, "Upon the Sundays and holidays the multitude of all sorts of men, women, and children of every parish do use to meet in sundry places, either on some hill or on the side of some mountain, where their harpers and crowthers sing them songs of the doings of their ancestors." (Ellis, 'Orig. Lett. of Eng. Hist.' 2nd ser., vol. iii. p. 49.) Even in the New World, the American savages had their war-songs and rude poetry, in which they sung the praises of those who had fought and died for their country. Garcilasso de la Vega says, that in writing his history of Peru he availed himself of old songs and ballads, which a princess of the race of their Incas taught him to get by heart in his infancy.

In process of time, as manners refined, the ballad in every country by degrees included a wider range of subjects; it was no longer solely employed in rehearsing valorous deeds, but included in its rhymes the marvellous tale or the wild adventure, occasionally also becoming the vehicle of sentiment and passion; and no festivity was esteemed complete among our ancestors in the 11th, 12th, and 13th centuries, which was not set off with the exercise of the minstrel's talents, who usually sang his ballad to his own or some other. harp, and was every where received with respect.

As intellectual cultivation advanced, however, these rude performances gradually lost their attraction with the superior ranks in society; but in the further progress of literary taste, they came to be considered as objects of curiosity, on account of the insight they afforded into the manners and modes of thinking of remote times; while the strokes of nature with which they abounded, and the artless simplicity and strength of their language excited the admiration of liberal critics. When, therefore, they had long ceased to be current in popular song or recitation, they were carefully collected by poetical antiquaries, and elucidated by historical notes; and thus a secondary importance was attached to them scarcely inferior to that which they possessed when chanted to the harp of the minstrel. (See Aikin's 'Essay prefixed to his Vocal Poetry,' 8vo. London, 1810.)

Among numerous other collections of our own national ballads, Percy's 'Reliques;' Evans's 'Old Ballads, Historical and Narrative;' and Ritson's 'Ancient Songs from the time of Henry III.' stand conspicuous. Allan Ramsay, Pinkerton, Jamieson, Finlay, and Aytoun have collected the 'Scottish Ballads;' and Sir Walter Scott the particular 'Minstrelsy of the Scottish Border.' Of those of other countries we cannot omit the Spanish ballads so frequently quoted by Percy from 'Hist. de las Civiles Guerras de Granada,' Madr. 1694; and the 'Coleccion de Poesias Castellanas anteriores al Siglo XV.,' by D. Tomas Antonio Sanchez, 3 vols. 8vo. Madr. 1779; among the Italians the 'Canti Carnascialeschi' of the time of Lorenzo de' Medici, 8vo. 1559; and among the ancient ballads of the North, the 'Altdänische Heldenlieder, Balladen, und Mährchen, übersetzt von Wilhelm Carl Grimm,' 8vo. Heidelb., 1811. More recent are the 'Danske Viser,' of Abrahamson and Rahbek; and the 'Svenska Fornsänger,' of A. I. Arwiddson, in 1842. St. Cæsari and the monks of Hières collected the remains and biographies of the minstrels of Provence; and the canon Manesse those of the Swabian poets.

As Ritson says, there can be no doubt that a considerable number of our own ancient printed songs and ballads must have perished. Few exist of an earlier date than the reign of James, or even of Charles I. Being printed only on single sheets, which would fall chiefly into the hands of the vulgar, who had no better method of preserving their favourite compositions than by pasting them upon the wall, their destruction is easily accounted for. The practice of collecting them into books did not commence till after Queen Elizabeth's time, and is probably owing to Johnson and Delaney (great ballad-mongers), who when they were advanced in years, and incapable, perhaps, of producing anything of merit, seem to have contented themselves with collecting their more juvenile or happier compositions into little penny books, entitled 'Garlands;' of these, being popular, and often reprinted, many are still extant, particularly in the Pepysian library. ('Diss. on Ant. Songs and Music,' p. lxxii.)

The earliest English ballad is that on the defeat of De Montfort in the battle of Evesham, but it is written in Norman French, though thoroughly English in sentiment and feeling. The next earliest ballads are those of the genuine Robin Hood series, particularly the 'Lytell Geste,' a series that may well bear comparison for truth and feeling, with a considerable share of English humour, with those of the Spanish Cid, however different in character. And we believe that England and Scotland are richer than any other nation in Europe, not even excepting Spain, in true original popular ballad poetry, as distinguished from lyrical effusions; a fact probably arising from the free nature of their constitution, which has ever been gradually and surely developing itself from the time of the Norman conquest, and the consequent active exercise of the public mind in the discussion of all passing events. They are, moreover, markedly distinguished from those of Spain by a sense of personal independence, and by a frequent selection of persons of low rank as the heroes of great achievements. The ancient ballads of Germany are also marked by national peculiarities; those composing the Niebelungen Lied having more resemblance to those of the Cid than to the English ballad, in treating of high historical, but half or more than half fabulous, events, rather than of the social manners, habits, and feelings of the populace. Those of Hans Sachs had more of these latter qualities, but they were not of any distinguished literary excellence, and indeed are hardly to be called ballads. In modern ballad-writing Bürger, Schiller, Göthe, and Uhland have given many admirable specimens.

The earliest specimen of Scottish song, after the Scots spoke the English language, is preserved in the 'Rhyming Chronicle' of Andrew Wyntown, prior of Lochleven, written, as is generally supposed, about the year 1420, in which he relates the song which was made on Alexander III. who was killed by a fall from his horse in 1286. Ritson has given it in the 'Hist. Essay' prefixed to his 'Scottish Songs,' vol. i. p. xxiv.

The earliest English ballad, separately printed upon a single sheet, is believed to be one upon the downfall of Thomas Lord Cromwell, in 1540.

The ballad, as distinguished from song, has been successfully cultivated by modern English writers. Wordsworth, Southey, Scott, and still later Mr. Browning, Lord Macaulay in his ballads of Montcontour and Ivry, and his 'Lays of Ancient Rome;' and Mr. Aytoun in his 'Lays of the Scottish Cavaliers,' have shown that the spirit, fidelity, and vigour of the old ballad-writers of Britain have not altogether departed. The ballad has given its name to a peculiar metre, which is that used in the old ballad of Chevy Chase; but that metre has not, by modern authorities, been held as a necessary constituent of a ballad.

BALLAST (Danish, *Baglast;* German, Dutch, and Swedish, *Ballast;* French, *Lest;* Italian, *Savorra;* Spanish, *Lastre;* Portuguese, *Lastro;* Russian, *Balast*), a term used to denote any heavy material placed in a ship's hold with the object of sinking her deeper in the water, and of thereby rendering her capable of carrying sail without danger of being overset. Ships are said to be in ballast when they sail without a cargo, having on board only the stores and other articles requisite for the use of the vessel and crew, as well as of any passengers who may be proceeding with her upon the voyage. In favour of vessels thus circumstanced it is usual to dispense with many formalities at the custom-houses of the ports of departure and entry, and to remit the payment of certain dues and port charges which are levied upon ships having cargoes on board.

A foreign vessel proceeding from a British port may take on board chalk as ballast, and shall not be considered as other than a ship in ballast, in consequence of her having on board a small quantity of goods of British manufacture for the private use of the master and crew, and not by way of merchandise; but such goods must not exceed in value 20*l.* for the master, 10*l.* for the mate, and 5*l.* for each of the crew.

Regulations have at various times been made in different ports and countries, determining the modes in which ships may be supplied with ballast, and in what manner they may discharge the same; such regulations being necessary to prevent injury to harbours. It has likewise been sometimes attempted to convert the supply of materials for ballast into a monopoly. In vol. xx. of Rymer's 'Fœdera,' p. 93, of the year 1636, we find a proclamation by King Charles I., ordering "that none shall buy any ballast out of the river Thames but a person appointed by him for that purpose;" and this appointment was sold for the king's profit. Since that time, the soil of the river Thames, from London Bridge to the sea, has been vested in the corporation of the Trinity House, and a fine of 10*l.* may be recovered from any person for every ton of ballast which he may take out of the river, within those limits, without the authority of that corporation.

The ballast of all ships or vessels coming into the Thames must be unladen into a lighter, and if any ballast be thrown into the river, the master of the vessel whence it is thrown is liable to a fine of 20*l.* Some regulation similar to this is usually enforced in every port.

Some art is required in properly ballasting a ship. The quantity required by different vessels of the same tonnage varies according to their shape or build. If any great quantity of heavy ballast, such as lead or iron, is deposited in the bottom of the hold, the centre of gravity will be placed so low that the vessel will labour and roll violently in the sea, and in bad weather will be in danger of being dismasted: it will besides impair her sailing qualities. A ship thus ballasted is said to be too stiff. On the contrary, when a ship has too little ballast, or this is so disposed as to raise the centre of gravity too high, equal danger will arise: she is then said to be too crank. The art of properly ballasting ships consists in placing the centre of gravity so as to be neither too high nor too low, and as this will in a great measure depend upon the shape of the vessel, it is not possible to give any particular directions concerning it, but the task should be confided to experienced hands.

A ship, being under proper and convenient sail, is said to be in 'sailing trim' when the ballast (or cargo) is so disposed, both before and abaft the ship's centre, as to incline her head to approach more nearly the point from which the wind blows: this is called *luffing up into the wind*, and in such case the ship is said to need or carry a little *weather-helm.* Errors in the mode of ballasting or trimming a ship can generally be remedied by increasing or diminishing the quantity of head or after sail.

Ships that take on board cargoes of light goods require also some portion of ballast in order to lower them sufficiently in the water, and by adjusting the centre of gravity, to enable them to carry with safety the necessary press of sail. [FREIGHT.]

By the Mercantile Marine Act of 1854, ballast rates, together with lighthouse tolls, &c., are to form the 'Mercantile Marine Fund.' [LIGHTHOUSE.]

The most important use of ballast in relation to English shipping is, probably, in the colliery trade; owing to the fact, that the vessels which bring coal to London have very little cargo to take back to the Tyne, Wear, and Tees. There are five systems of collier-ballasting adopted: sand ballast, bag-water ballast, bottom-water ballast, hold-water ballast, and tank-water ballast. The first three are employed in ordinary sailing colliers, the fourth and fifth being more exceptional. *Sand ballast* was the earliest, easiest, and most obvious. *Bag-water ballast* was invented by Dr. White, of Newcastle, and was found to be cheaper in the end than sand. The bags are arranged on the floor of the vessel, and are connected with a canvas hose; this hose, through the intervention of a large stop-cock, communicates with the water outside the vessel; to fill the bags, the cock is simply turned; to empty them, the water is allowed to flow into the hold, whence it is pumped out with the bilge-water. *Bottom-water ballast* consists of water filling the intermediate space between the true bottom and a false bottom of the vessel. *Hold-water ballast* is contained in an iron water-hold placed amidships, and capable of containing 200 tons or more. The hold is so constructed, with a hatchway, &c., as to be available for cargo when not filled with water-ballast. These ballast water-holds were first adopted by Mr. Scott Russell, in two iron screw colliers built by him. *Tank-water ballast* is used in the following way: a series of fore-and-aft tanks are supplied with water from a tank in the fore-peak, and the discharge is effected by pumps worked by a small auxiliary engine. Engineers and persons engaged in the colliery trade are not yet agreed as to the relative merits of these five kinds of ballasting; but there is a general agreement that sand ballast will be, and ought to be, superseded by water.

(Hume's *Laws of the Customs; Report of Committee of House of Lords on Lights and Harbour Dues;* Mortimer's *Dictionary;* M'Culloch's *Dictionary.*)

BALLAST-OFFICE CORPORATION, DUBLIN, or more correctly, the Corporation for Preserving and Improving the Port of Dublin. This Board was created, in 1786, by the Act 26 Geo. III. c. 19 of the Irish parliament, and consists of twenty-three members, namely: "The lord mayor and sheriffs, for the time being, of the city of Dublin, three aldermen, chosen by the Board of Aldermen from their own body, and seventeen members who were appointed, in the first instance, by the Act of Incorporation, and who are, on all future vacancies, empowered to elect new members, but leaving the city members as members of the Board."

This self-elected body is endowed with extensive powers to enable it to carry on the works and to improve the port of Dublin; besides which, it has an exclusive right, similar to that exercised by the Corporation of the Trinity House in London, of supplying with ballast all vessels sailing from the port of Dublin. In 1810 the management of all the light-houses on the coast of Ireland was transferred from the Commissioners of Customs to the Ballast-Office Corporation in Dublin, which, however, exercises this part of its duty subject to the control and direction of the elder brethren of the Trinity House in London.

The Ballast-Board has greatly improved the port of Dublin, by re-building the walls of the river Liffey, and by deepening its channel. In the beginning of 1834 a very extensive work of the latter kind was undertaken, in the execution of which powerful steam machinery has been employed. Since 1820 the Board has expended, for the erection of light-houses and the building of floating-lights, a very large sum, which has been defrayed out of the surplus dues.

BALLET, a theatrical representation, in which a story is told by gesture, accompanied by characteristic or illustrative music, and to which dancing (as mere saltation), scenery, decorations, &c., are the accessories.

We are indebted for the word, and even for its pronunciation, to the French, who had it from the Italian, *ballare,* to dance; the latter having been derived from βαλλίζειν, which has the same meaning.

The French enumerate three kinds of *ballet,* namely, the *ballet d'action,* or *ballet-pantomime;* the *opéra-ballet;* and the *comédie-ballet.* The two last are not now in use: the first is that above described, and the only true ballet; for those which consist of little else than steps, leaps, *pirouettes,* and *entrechats,* are unworthy of the name, and in fact are *divertissemens,* in which, as Rousseau remarks, there is no subject, no connection, and the best performers tell you nothing, but that they dance well.

"A ballet," says M. Noverre, who by Garrick was called 'The Shakspere of Dance,' "perfect in all its parts is a picture, drawn from life, of the manners, dresses, ceremonies, and customs of all nations. It must therefore be a complete pantomime, and through the eyes speak to the very soul of the spectator; and being a regular representation, ought, as far as is possible, to be under the general rules of the drama. If it does not point out with perspicuity, and without the aid of a programme, the passions and incidents it is intended to describe, it is a divertissement, a succession of dances, and nothing better." ('Lettres sur la Danse,' Lyon, 1760.)

Appropriate music is a constituent part of a good ballet; it supplies the language which action alone cannot speak, and is grave or lively, energetic or tender, according to the passion or sentiment meant to be pourtrayed on the stage. By its rhythm it also regulates the motion of the dancer (for all the performers in the ballet are indiscriminately called dancers), whose every action and step ought to be more or less measured. Aristotle, in his 'Poetik' (cap. iii.), goes so far as to say, that there are dancers who by rhythm applied to gesture express manners, passions, and actions. A composer of good ballet-music is carefully attentive to locality and to nationality. Almost every civilised nation has, in addition to a general style of melody, a style peculiarly its own; and by a judicious adoption of this, an incalculable addition is made to the interest and the reality of the scene, through the powerful medium of association. Gluck did not hesitate to introduce, in his 'Iphigenia in Tauris,' the real air of a cannibal nation, to which he made certain barbarians dance. The occasional and cautious use too of melodies which recall to mind any thing, whether in the shape of narrative or sentiment, analogous to what is representing on the stage, is practically found to heighten the effect of the action. But in having recourse to such means great judgment must be shown; for if the composer be not sensible and experienced, he runs considerable danger of exciting ideas very foreign to those which he intended to raise.

To the ancients, what we call the pantomime-ballet was well known. The Rev. Robert Nares, author of 'Remarks on the Ballet of Cupid and Psyche,' says, speaking of what he calls the dance, meaning the mimetic part of it, "Being in its origin used in the service of religion, it thereby acquired a dignity which in modern times it never possessed. The most sacred mysteries of heathenism were thus accompanied. Apollo, in a passage of Pindar, is called the Dancer (ὀρχηστὴς); and there is a Greek line extant which represents Jupiter himself in the very act of dancing. Even at Rome, where the dance was on the whole much less respected, the priests of Mars, to whom the care of the sacred *ancilia* was committed, were, from their customary and solemn dances, denominated *Salii* (from *salio*). Of the imitative dance, both Plato and Xenophon, in the person of their master, Socrates, speak very favourably; and Aristotle ranks it with the art of poetry. Plutarch, in the last book of 'Symposiac Questions,' considered it worthy of distinct discussion. And Lucian, an author certainly not deficient in genius or sagacity, has left an express eulogium, in which he scruples not to prefer the *orchestic* to the speaking dramas. 'The Greeks,' says Athenæus, 'had brought their dance to such perfection, in the art of imitating the passions, that the most eminent sculptors thought their time not ill-employed in studying and designing the attitudes of the public dancers; and to this study (he adds) they owed, undoubtedly, some of the transcendent beauties of their works.'"

The ballet has been essentially a product of the European courts, and a fashionable amusement. In the beginning of the 16th century, Aglio, count of Savoy, himself prepared and acted ballets with the princes and princesses of his court. Baltagerini, the music director of Catherine de' Medici, introduced it into France, where it became so great a favourite that Louis XIII., and even Louis XIV. in his youth, danced in ballets; they were however generally allegorical, and sufficiently tasteless. Quinault first elevated it, and interwove it with some of his operas. In 1697 A. H. de la Motte still further improved it, particularly in its action and dramatic interest. But, appealing almost entirely to the eye, it is continually lowering its character by being forced to adapt itself to the caprices of individual dancers; while for its general effect it depends much on a lavish adornment in scenery, dresses, and decoration. About 1750, however, M. Noverre operated a great change in the ballet, and restored it to nearly the dignity, considered as a public amusement, which it supported among the ancients. We have already quoted his opinions on the ballet, and he very successfully applied them in his productions. His 'Médée,' his 'Déserteur,' and his 'Psyché,' still preserve a high reputation. The influence of these works lasted many years; but at length fashion, almost always opposed to good sense and good taste, would view with favouring eyes nothing but that which passes under the name of dancing; and what ought to be the ballet, is too frequently reduced to a divertissement in which even good grouping is generally neglected. Some successful efforts have however been made in recent years to improve the character of the ballet, and the introduction of the national ballets of other countries has assisted in effecting this. Still, there is too much of mere conventionality, and too much sacrifice of grace, sentiment, and the development of feeling, to exhibitions of mere agility and *tours de force*, often more surprising than pleasing.

BALLISTIC PENDULUM, a heavy wooden pendulum, in section like a gardener's spade: the lower part consisting of a heavy cubical block of wood, plated with iron at the back. It was invented and used by Mr. Robins, the celebrated writer on gunnery, for the purpose of measuring the velocity of cannon-balls and musket-balls. It must be of such a weight that the ball fired into it may not cause a vibration of very great extent. It is described at great length in Robins's 'Principles of Gunnery (we recommend Hutton's edition, London, 1805), prop. viii., and in Hutton's 'Mathematical Tracts,' vol. ii. tract. 34. Those who attempt any experiments with such an instrument should particularly attend to the cautions given by Mr. Robins, who learnt them at the risk of his life.

The principle is as follows:—The pendulum in its state of rest all but touches with its lower end a horizontal bar. To the lower end of the pendulum is attached a ribbon, which passes through an orifice in the bar, moving almost freely. When, therefore, the pendulum is raised, a quantity of ribbon is drawn out, which, if the radius be the whole length of the pendulum, is the chord of the angle through which the pendulum is inclined by the shock. When a shot is fired into the pendulum, no more ribbon is disengaged, during the oscillations which follow, than was drawn out by the first rise of the pendulum; because friction and the resistance of the air will continually diminish the extent of the oscillation. The extent of the first oscillation is greater or less, according as the momentum of the shot is greater or less; and the mechanical problem to be solved is as follows:—Given the weight of the shot, the place at which it strikes, the weight, form, &c., of the pendulum, and the effect produced upon it by the shot; required the velocity of the shot. The formula which answers this question is as follows:

b is the weight of the ball.
p that of the whole pendulum.
g distance from the pivot of the centre of gravity of the whole (after the ball).
i distance from the pivot to the point struck.
c length of ribbon disengaged.
r distance from the pivot to the ribbon.
n the number of vibrations in a minute after receiving the shot.

b and p must be measured in the same unit of weight, and g, i, c, r, in the same unit of length. Then will the velocity of the ball at the moment of striking, *in feet*, be

$$614{\cdot}58\, g\, c \times \frac{p+b}{b\, i\, r\, n}$$

The value of g may be determined by mechanical methods (GRAVITY, CENTRE OF): but if it be determined, as usual, before the shot, then the value of g after the shot is

$$g + \frac{i-g}{p} \times b$$

The ballistic pendulum, in the hands of Robins and Hutton, was useful in supplying information respecting the velocity of cannon-balls, and the resistance of the air to rapid motions. [AERO-DYNAMICS.] It has also tested the correctness of the theory propounded on that subject by Robins. [GUNNERY.] We give in the following table the results of that set of experiments, in which the greatest difference was found between the prediction from theory and the experiment, omitting all the circumstances of each charge, as no connection can be traced between them and the discordances. In the fourth and fifth examples, the barrel had previously lain by in a moist place. Considering the very great difficulty and uncertainty of the subject, the accordance is remarkable. The first two columns represent the length of ribbon disengaged (in inches and tenths), the first from experiment, the second from theory; the third is the difference between the two:

Experiment.	Theory.	Difference.
17·1	17·2	+ ·1
15·2	15·0	— ·2
15·4	15·0	— ·4
11·5	12·8	+ 1·3
11·5	12·8	+ 1·3
8·7	9·0	+ ·3
12·3	12·5	+ ·2
14·4	14·4	0·0
14·4	14·4	0·0
10·3	10·5	+ ·2
14·7	14·5	— ·2
15·7	15·3	— ·4
	Average discordance	+ ·18

When a heavier pendulum was used, the discordances were considerably less. The friction of the pivots was not taken into account in the theory.

It has been proposed to make the gun itself a pendulum, by hanging it as such, and observing by means of a ribbon, the arc of recoil. This instrument was also used by Robins as an *éprouvette* for gunpowder, by firing the same gun with successive charges of powder of different qualities, and using no ball. By first measuring the recoil without the ball and afterwards with it, it is presumed that the additional momentum given to the gun in one direction is also that given to the ball in the other. This there appears no reason to dispute; but the comparison between the gun-pendulum and the ballistic-pendulum cannot be very satisfactorily made, because between the two comes another unknown quantity, namely, the effect of the air on the ball between the instant of leaving the gun and striking the pendulum. But various circumstances, particularly described by Dr. Hutton in the tract alluded to, render the principle assumed in the use of the gun-pendulum very doubtful.

BA'LLIUM; BAILLIE, or BAILEY. This term, according to Dufresne, anciently meant an outer bulwark; but was afterwards adopted for the area or court-yard contained within one. It appears clear from the word, and its original use, that it is a corrupted form of the Latin *Vallum*.

Grose ('Antiq. of Engl. and Wales,' vol. i. pref. p. 7) says, the ditch of a royal castle was sometimes called the Ditch del Bayle, or of the Ballium, to distinguish it from the ditches of the interior works. Over it was either a standing or draw bridge, leading to the ballium. Within the ditch were the walls of the ballium, or outworks. In towns, the appellation of ballium was given to a work fenced with palisades, and sometimes masonry, covering the suburbs; but in castles it was the space immediately within the outer wall. When there was a double enclosure of walls, the areas next each wall were styled the *outer* and *inner* ballia. The manner in which these are mentioned by Camden, from the Chronicle of Dunstaple, in the siege of Bedford Castle, A.D. 1224, sufficiently justifies this position. The castle was taken by four assaults. In the first was taken the barbacan; in the second, the outer ballia; in the third, the wall by the old tower was thrown down by the miners, when with great danger they possessed themselves of the inner ballia through a chink; at the fourth assault the miners set fire to the tower, so that the smoke burst out, and the tower itself was cloven, so as to show visibly some broad chinks, whereupon the enemy surrendered.

The wall of the ballium in castles was commonly high, flanked with towers, and had a parapet, embattled, crenellated, or garretted, for the mounting of it. There were flights of steps at convenient distances, and the parapet often had the merlons pierced with long chinks, ending in round holes, called oillets.

Within the outer ballium were the lodgings and barracks for the garrison and artificers, the stable, hospital, wells, chapel, and even sometimes a monastery. Large mounts were also thrown up in this place: these served, like modern cavaliers, to command the adjacent country; these last being generally raised within the body of the place, ten or twelve feet higher than the rest of the works, and commonly within the bastion. In the inner ballium was placed the keep and the residence of the lord of the castle.

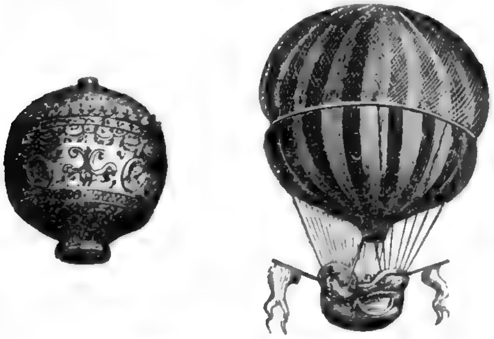
The entrance into the ballium was commonly through a strong machicolated and embattled gate, between two towers, secured by a herse or portcullis. Over this gate were rooms, originally intended for the porter of the castle; the towers served for the *corps de garde*. [CASTLE.]

The church of St. Peter in the Bailey, at Oxford, derives its appellation from having formerly stood within the outer ballium of Oxford Castle. The Old Bailey, or outer space near Ludgate, in London, received its name from its relative position in regard of the ancient wall of the city.

Froissart, in his account of the siege of Amand by the Earl of Hainault, temp. Edward III., says, the attack was so furious that the *baillies* were instantly won. Johnes, in his English 'Froissart' (4to. edit. vol. i. p. 161), translates this word barriers.

(Besides Grose's work already referred to, see Dufresne's *Glossar. ad Script. med. et inf. Ætatis.* fol. Francof. 1681, tom. i. c. 447; King's *Observ. on Anc. Castles*, Archæol. vol. vi. pp. 249, 308; *Munim. Antiqua*, vol. ii. p. 45; Ellis's *Fableaux*, edit. 1815, vol. i. p. 153, Notes; De Caumont, *Architectures Civile et Militaire*, &c.)

BALLOON, from the French *ballon*, a little ball, is a word applied, in our language, only to the well-known machine which, consisting of an envelope of silk or other stuff filled with hydrogen or other gas specifically lighter than the atmosphere, is employed to raise those who trust themselves to the chances of a safe voyage in the air. It is scarcely correct to dignify the exploits of ballooning with the title of *Aëronautics*, sometimes applied to them; for our air navigation, compared with that of the sea, is little more than on a level with the essay of the first rude men who discovered that a hollow wooden vessel might be made large enough to float a body heavier than water. The first step towards guiding the machine is yet to be made; and some little power of ascending and descending is all that has been gained. Nevertheless, the subject is an interesting one, and must briefly be traced here.



Montgolfier's first and second Balloons.

The notion of imitating the flying of birds is very ancient. We pass over the winged gods, the stories of Abaris, Dædalus, and the like, as fictions which, like many others, might have been purely imaginative, and not traditions of any previous reality. But Strabo (p. 296) mentions the Capnobatæ (or Capnioi, as has been conjectured), a Scythian people, who (so the word has been very foolishly interpreted) raised themselves by smoke, as the vulgar first imagined Montgolfier did. The Carolinians are also mentioned by the Jesuit Cantova as having a fable about a female deity who raised herself to heaven by the smoke of a great fire. We may also mention the pigeon of Archytas, the oracle of Hierapolis, which Lucian professes to have seen raise itself in the air; the fable, in British mythology, of Bladud or Baldud, the father of the well-known Lear, which resembles that of Dædalus; and many others, all of which serve to show that the notion of the possibility of raising a man or a machine was very widely extended in the ancient world. Roger Bacon ('De Mirabili Potestate,' &c.) says that there certainly is a flying machine, of which he knows the name of the inventor, but which he has neither seen himself, nor any one whom he knows. Van Helmont and others proved the possibility of flying, by very eloquent discourses, which convinced all hearers. Bishop Wilkins, in his 'Mathematical Magic,' 1680, proposes a carriage, with sails like those of a windmill, to be driven by the air; and the same thing, according to custom in the case of all inventions, has been attributed to the Chinese. We shall only mention Schott, Baptista Porta, Cardan, and Fabri, as having maintained the possibility of flying. The Jesuit Francis Lana (1670), among many other projects, has given perhaps the first idea of a real balloon, as we have defined it. He proposes to raise a vessel by means of metal balls, strong enough, when exhausted, to resist the pressure of the external air, but at the same time so thin as, in the same circumstances, to be lighter than their bulk of air. To the possibility of this he asserts that he sees no objection, except that the Almighty would never allow an invention to succeed, by means of which civil government could so easily be disturbed. A reason of this sort was all powerful in his age, which abounded in a pretended knowledge of the minutest secrets of Providence: had the good father tried the experiment, he would have found that strength to resist the external air is incompatible with the necessary degree of thinness in the material, as was observed by Leibnitz.

In the 'Ars Magnetica' of Kircher, that author describes a method of imitating the dove of Archytas, by attaching the bird by a string to the hand of a statue, over which is a large dial; a magnet revolving behind the dial would cause the dove to fly round the head of the statue, and point to the hour of the day. The oft-told story of Regiomontanus constructing an eagle which flew out from Nürnberg to meet the Emperor Charles V., and on meeting him flew back again over his head to the town, is refuted by the simple fact that Regiomontanus died twenty-five years before Charles V. was born. Although the art of flying had been diligently studied, or at least discussed, for centuries, the exceedingly simple contrivance of Montgolfier had not been tried, or even mentioned, by any of the projectors, some of whom were men of ingenuity. We consider him the inventor of the balloon who raised a mass of solid substance to some considerable height in the atmosphere. But if we were to take the licence which is so common, of disputing the right of an inventor on account of some previous experiments containing a principle common with his own, we might either say that this machine has been invented from time immemorial, in the ascent of soap-bubbles; or we might cite Candido Buono, who made one scale of a balance ascend, by rarefying with a red-hot iron the air underneath it. After Cavendish had ascertained how much hydrogen weighs less than air, it immediately occurred to Dr. Black, that a light substance, filled with the above-mentioned gas, would rise of itself. But he did not pursue the idea farther; and Cavallo, who tried to put it in practice in the year 1782, could not succeed in raising, by means of hydrogen, anything heavier than a soap-bubble. We shall see that, natural as it might appear to use hydrogen for the purpose, the experiment succeeded only with a very different agent.

Stephen and Joseph de Montgolfier were paper-manufacturers at Annonay, not far from Lyon. They had both studied natural philosophy and chemistry, and their business gave them facilities for procuring large masses of light envelopes: so that we owe the invention of balloons to one of two accidents—either to that of philosophers being paper-makers, or to that of paper-makers being philosophers. Struck with the notion of confining something lighter than air in a recipient, as the means of making the latter ascend, they tried this method at about the same period as M. Cavallo, by confining hydrogen in paper. They succeeded to some extent; but the gas so soon escaped through the paper, that they abandoned the idea of anything like permanent elevation by means of it. The next thought which struck them was, that as it was supposed the elevation of the clouds was caused by the presence of electric matter, and as it seemed to them from some experiments that electrified bodies were diminished in weight, it might be possible to raise a surface, of great extent in proportion to its specific gravity, by means of electricity. After trying various methods, they applied fire underneath a balloon, not to rarefy the inclosed air, but "as well to increase the layer (*couche*) of electric fluid upon the vapour in the vessel, as to divide the vapours into smaller molecules, and dilate the gas in which they are suspended." The experiment succeeded; and a balloon of 23,000 cubic feet (French) capacity was raised with considerable force. All this took place early in 1782; and at that time the electric theory was stated as above. But in the report made to the Academy of Sciences (December, 1783) by the commission appointed to examine Montgolfier's invention, the inventors are spoken of as simply rarefying the air contained in the balloon; probably by that time further consideration had led them to the correct view of the subject. J. Montgolfier, in his memoir, says, "Large balloons might be employed for victualling a besieged town, for raising wrecked vessels, perhaps even for voyages, and certainly, in particular cases, for observations of different kinds; for reconnoitring the position of an army, or the course of vessels, at twenty-five or even thirty leagues distant," &c. One of these ideas was put in practice at the battle of Fleurus, where the French made a reconnoissance and prevented a surprise by means of a balloon.

The first public experiment was made at Annonay, June 5, 1783. At the appointed time, nothing was seen in the public place of the town but immense folds of paper 110 feet in circumference, fixed to a frame, the whole weighing about 500 pounds, and containing 22,000 cubic feet (French measure). To the great astonishment of all, it was announced that this balloon would be filled with gas, and would rise to the clouds, which very few could believe. On the application of fire underneath, the mass gradually unfolded and assumed the form of a large globe, striving at the same time to burst from the arms which held it. At length it rose with great rapidity, and in less than ten minutes was at 1000 toises (6000 French feet) of elevation. It then described a horizontal line of 7200 feet, and gradually sank. This balloon contained nothing but heated air, maintained in a state of rarefaction by a fire, the receptacle of which was attached underneath the globe of paper, which had an orifice opening downwards. Machines on this principle were called *Montgolfiers*, to distinguish them from the hydrogen balloons, which were soon afterwards introduced. It was immediately resolved to repeat the experiment with hydrogen inclosed in lutestring, which had been dipped in the solution of Indian rubber. A subscription was opened, and the balloon was ready for filling on the 23rd of August. The gas was obtained in the usual manner, by the action of dilute sulphuric acid on iron filings. But the difficulty of filling the machine was very considerable; and it was not till after two or three trials that success was attained. The first aërial voyagers were a sheep, a cock, and a duck, who were sent up in Montgolfier's experiment of the 19th of September, in the same year, at Paris. All came down safe with the exception of the second, whose wing was hurt. It was judged prudent not to trust human life to a free balloon till the experiment of holding the machine with ropes had been tried. In this manner M. Pilâtre de Rozier ascended 100 feet on the 15th of October, and 324 feet on the 19th. The first persons who offered to leave the earth entirely were the Marquis d'Arlandes and M. Pilâtre de Rozier; and they performed this feat at the Château de la Muette, near Passy, November 21, 1783, in a *Montgolfier*. Of this most interesting of all balloon ascents, the 'Procès Verbal' gave the following account: "To day, November 21, 1783, at the Château de la Muette, took place an experiment with the aërostatic machine of M. de Montgolfier. The sky was partly clouded, wind north-west. At eight minutes after noon, a mortar gave notice that the machine was about to be filled. In eight minutes, notwithstanding the wind, it was ready to set off, the Marquis d'Arlandes and M. Pilâtre de Rozier being in the car. It was at first intended to retain the machine a while with ropes, to judge what weight it would bear, and see that all was right. But the wind prevented it from rising vertically, and directed it towards one of the garden walks; the ropes made several rents in it, one of six feet long. It was brought down again, and in two hours was set right. Having been filled again, it set off at fifty-four minutes past one, carrying the same persons. It rose in the most majestic manner, and when it was about 270 feet high, the intrepid voyagers took off their hats and saluted the spectators. No one could help feeling a mingled sentiment of fear and admiration. The voyagers were soon undistinguishable, but the machine, hovering upon the horizon, and displaying the most beautiful figure, rose at least 3000 feet high, and remained visible all the time. It crossed the Seine below the barrier of La Conférence; and passing thence between the Ecole Militaire and the Hôtel des Invalides, was in view of all Paris. The voyagers, satisfied with their experiment, and not wishing to travel farther, agreed to descend; but seeing that the wind was carrying them upon the houses of the Rue de Sève, Faub. St. Germain, they preserved their presence of mind, increased the fire, and continued their course through the air till they had crossed Paris. They then descended quietly on the plain, beyond the new boulevard, opposite the mill of Croulebarbe, without having felt the slightest inconvenience, and having in the car two-thirds of their fuel. They could then, if they had wished, have gone three times as far as they did go, which was 5000 toises, done in from 20 to 25 minutes. The machine was 70 feet high, 46 feet in diameter; it contained 60,000 cubic feet, and carried a weight of from 1600 to 1700 pounds." The Marquis d'Arlandes wrote a lively and instructive account of the ascent, in a letter to M. de St. Fond; but it is too long to be given here.

The second voyage was that of MM. Charles and Robert, Dec. 1, 1783, from the Tuileries, in a hydrogen balloon of 26 feet diameter,—all experiments on the use of hydrogen for the purpose having previously been on a very limited scale. After coming down, M. Charles re-ascended alone, and was soon 1500 toises high, or nearly two miles. A small balloon, launched by Montgolfier just before the ascent, was found to have run a totally different course, which first gave rise to the suspicion of different directions in the currents of air at different heights.

The third voyage, from Lyon, January 19, 1784, was made in the largest *Montgolfier* yet constructed (102 feet diameter, 126 feet high) by seven persons, among whom were J. Montgolfier and M. de Rozier. It had been intended for six only, and these were found too many, but no persuasion could induce any one to abandon his place. The instant after the ropes had been cut, a seventh person jumped in. A rent in the balloon caused it to descend with perilous velocity, but no one was hurt.

This amount of success led to great activity in ballooning. Shortly before the ascent of MM. Charles and Robert, a hydrogen balloon was launched in London by Count Zambeccari. In 1784 a small balloon was sent across the English Channel, travelling from Sandwich to Lisle at the rate of 30 miles an hour. In the same year, M. Blanchard ascended from Paris with a balloon provided with wings, a rudder, and a parachute; the wings and rudder were found to be useless; but the parachute, opening like an umbrella, tended to break the velocity of the descent. About the same time, MM. de Morveau and Bertrand ascended 13,000 feet at Dijon, in a balloon provided experimentally with oars. On one occasion, in 1784, two gentlemen and four ladies accompanied Montgolfier in a 'captive' balloon, held in position by ropes; and on another occasion a lady ascended at Lyon with an aëronaut in a free balloon. Before the end of that year, Lunardi ascended in a balloon from London. In 1785 Blanchard and Jeffries crossed the English Channel in a balloon, narrowly escaping precipitation in the sea. In the same year, MM. Pilâtre de Rozier and Romain ascended from Boulogne in a *Montgolfier* of 37 feet in diameter, with the intention of crossing the Channel. They had not been twenty minutes in the air when the balloon took fire. Both fell from a height of 1000 yards, and were killed on the spot. In 1802 General Money ascended at Norwich; the balloon dropped into the water, in which the traveller remained six hours before he was rescued. In the same year M. Garnerin descended successfully from a balloon by means of a parachute, near the Small-pox Hospital, St. Pancras, London. The height from which he descended was so great that he could scarcely be distinguished. At first—namely, before the parachute opened—he fell with a great velocity; but as soon as it was expanded, the descent became very gentle and gradual. In 1804, Messrs. Gay Lussac and Biot ascended at Paris to a height of 13,000 feet, provided with apparatus for making certain scientific experiments. The same year M. Gay Lussac ascended alone to a height of 23,000 feet. In 1806, Carlo Brioschi, astronomer royal at Naples, ascended with Signor Andreani, who had previously been the first Italian aëronaut. Trying to rise higher than M. Gay Lussac had done, they got into an atmosphere so rarefied as to burst the balloon. Its remnants checked the velocity of their descent; and this, with their falling on an open space, saved their lives, but Brioschi contracted a complaint which brought him to his grave.

It would be neither possible nor useful to trace the records of balloon ascents in any detail; but a few notices of the course of experiments during the last half century may be desirable.

Although much has been suggested, scarcely anything has been accomplished towards rendering balloons available for any practical use. Little has been done towards guiding a balloon. Many of the schemes which have been proposed for the purpose, evince a singular disregard of the essential difference between a ship and a balloon. The former sails in two fluids of very different density; and the action of the water, the denser of the two, upon the rudder, is a guide to the impelling power derived from the air or lighter or less dense element; but no such regulator can be applied to the balloon, which is sustained, as well as impelled, by the air.

Mr. Green has been the most successful of our aëronauts. He was the first to introduce the use of common coal gas instead of hydrogen gas for the purpose of inflation, by which an immense saving of cost is effected, and the buoyancy of the balloon may be longer maintained, as coal gas is far less liable to escape than hydrogen. Mr. Green, accompanied by Messrs. Holland and Monck Mason, made the remarkable voyage undertaken on the 7th of November 1836, with the Great Nassau balloon. Intending to cross over to the Continent, these voyagers started from Vauxhall Gardens, London, at half-past one on the above-named day, crossed the Channel, continued their voyage through the night, and descended at half-past seven the following morning in the valley of Elbern, about two leagues from Weilburg, in the duchy of Nassau. The balloon with which this feat was performed was of silk, more than 60 feet high, and about 50 feet in diameter, and contained, when fully distended, more than 85,000 cubic feet of gas.

Much ingenuity continues to be unprofitably wasted on ballooning. Year after year contrivances are brought forward which have before been shown to be unsound in theory. In 1840 Messrs. Marsh and Ranwell suggested a complicated machine, consisting of a light metallic frame, to which about twenty small balloons were attached. Sir George Cayley proposed a light kind of frame, exposing about 500 square feet of surface, to which some sort of steering apparatus was to be attached. Mr. Partridge has drawn attention to a machine which had somewhat the appearance of an ovoid balloon, with a complicated apparatus of sails and vanes, and a steam-engine fed with liquid fuel! M. Eubriot, in 1839, made an oblong balloon, with a car provided with sails. He expected that the car and sails would guide the balloon; but when the machine was tried at Paris, the balloon guided the car, as it is the wont of balloons to do. Mr. Green himself, in 1840, exhibited a model at the Polytechnic Institution, of an apparatus which he expected would suffice to guide a balloon, but nothing satisfactory resulted. About that same year, Dr. Polli, of Milan, suggested that the structure of a fish should form a model for an aërial locomotive; but he was forestalled in this obvious but fallacious idea by other parties in England. In 1842, Mr. Henson took out his patent for that "aërial machine" which lived its little day of popularity, and then went out of sight. A small steam-engine, in a car, was to propel a light framework 150 feet long; and a tail 50 feet long was to serve as a rudder at one end; but whether the machine could raise itself to a height, or could propel itself by the engine, or could steer itself by the tail, were inquiries never satisfactorily answered. Next came M. Monge's copper balloon, constructed at Paris in 1844; it was about 30 feet diameter, formed of sheet copper $\frac{1}{80}$th of an inch thick, weighed 800 lbs., and was capable of containing 100 lbs. of hydrogen. The egg-shape, the fish-shape, the fan-shape, the kite-shape, all have been proposed, time after time. Mr. Bell patented two machines—a *balloon motor*, having both a sustaining and a propelling power; and a *parachute motor*, having a propelling power which constituted its own sustaining power. The plan looked ingenious upon paper, but this is not very high praise.

Occasionally balloons have been made subsidiary to science, but very seldom. The British Association has more than once directed its attention to this matter, but with very little result. In 1843, Mr. Green made observations with meteorological instruments at five different elevations, varying from 2591 to 6758 feet; while Mr. Jones, the instrument maker, was making similar observations at the surface of the earth at the same time; such observations as these might perhaps be multiplied with advantage. Mr. Rush communicated to the British Association, in 1849, a series of thermometrical and barometrical observations, made during five balloon ascents, in 1847-8-9, at various altitudes ranging up to 20,000 feet.

A suggestion was made about the year 1851, for sending out balloons to assist in the search for Sir John Franklin; and in 1854 balloons were suggested for reconnoitring Sebastopol.

The last seven years (1852 to 1859) have shown that the hope is not yet quite extinguished among ingenious, but not very profound, machinists, of being able to guide balloons through the air. In 1852 Mr. Graham added to the list of contrivances intended to aid in the steering of balloons, by means of levers, sails, rudders, &c. In 1856 another inventor brought into notice an "Archimedian balloon," comprising a great variety of mechanical appliances, including a wooden framework, four paddle-wheels, some new kind of chemical engine to supply moving power, and a screw propeller. The inventor's hope was, that the turning of the screw would bring the balloon into any desired direction, and that the paddles would give progressive motion. The balloon was a cylinder, with hemispherical ends, placed immediately over the hull of this aërial screw-ship. The project never appears to have gone beyond the condition of a model. Dr. Lotszky, in the same year, proposed a suite of small balloons and wings, to be attached to "a slim youth," as a means of enabling him to fly over the Crystal Palace grounds. The latest enthusiast is Lord Carlingford, who in 1857 brought into notice his "Archedon," or aërial chariot. It had before been shown in model at the Dublin Exhibition; but as it obtained few admirers, the inventor afterwards made sundry improvements in it. It consists of a sort of light boat, with one wheel in front and two behind; there are two concave wings at the sides, held up by laths, cords, and hoops; and there is a tail, which can be raised or lowered at pleasure. The moving power is a winch turned by the aëronaut; the winch acts through a train of multiplying wheels, upon an Archimedian screw; this screw acts upon the cords which move the sails. The wings are covered with network and silk. It is not often that the specification of a patent contains such glowing language as that which Lord Carlingford used in reference to his invention: "Like the chariot of Jupiter, we may yet behold the eagle trained to draw the aërial chariot." In a letter to the 'Mechanics' Magazine,' his lordship thus commented on the mode in which his invention was received: "The first chariot I made was placed in the Dublin Exhibition; yet, strange to say, although clear and simple as was the principle of it, it was not understood, nor even examined, but left in such an obscure position, that no doubt it was concluded to be some nonsensical production; yet none were courageous enough to question the principle, or to approve it, though challenged to do so."

Of all these contrivances, it may simply be said that the means of guiding balloons through the air have yet to be discovered; that the higher the scientific attainments of the aëronaut, the less sanguine is he of any such means ever being devised. Balloons may possibly, some day, render more service to meteorology than they have yet done, by testing currents, &c., high up in the atmosphere; and indeed the British Association, in 1858, made a grant of money for further experiments in this direction.

BALLOT, a word taken from the French *balotte* or *ballotte*, signifying a little ball, and used to designate a mode of voting employed upon occasions where it is considered desirable to preserve secrecy in regard to the opinion of each voter. In many cases where any matter is decided by votes, there are good reasons why it should be generally known how each person has voted; but there are other cases in which there may be equally good reasons for allowing the voters to vote by ballot. Voting by ballot, therefore, cannot be called either a good or a bad system of voting, without considering the particular cases in which it is exercised.

In Great Britain it has been agitated for many years whether the election of members of Parliament should or should not be by ballot. It is a question we are not called on to decide, and much has been written and said on both sides. It may be remarked, however, that there is no strict analogy between the election of members of a private society, or even of a public association, and of members elected for political and legislative purposes. In the one, private reasons which could not be openly stated with propriety, may, and ought to, operate against the admission of an individual as an associate; while, in the other, as it is his public character that should give him the necessary qualification, there is the less reason for secrecy. His public defects, if any, should be publicly stated, to enable him to meet them; he is a representative, and ought not to be rejected on grounds that cannot be publicly stated. Again, as it is said that martyrs make a faith, it is not impossible that the ballot, by ensuring secrecy, may also create indifference, when the public mind is no longer stirred up by the excitement given by open voting; although that may too frequently lead to instances of oppression and hardship suffered in consequence.

The modes of performing the voting by ballot vary, in some respects, according to the object to be attained; as for instance, in the case of an election to an office where the choice can fall upon only one candidate, or upon a smaller number of candidates than are put in nomination, it is usual to deliver lists which are folded so as to conceal the name or names which they bear, and which, in that condition, are placed in a glass or urn, from which, after the votes are all collected, they are taken and examined, in order to determine in whose favour the greatest number of votes has been given. In cases where a simple affirmative or negative is alone required, the same method is sometimes employed, and then the papers deposited in the urn bear only the word 'Yes' or 'No.' Sometimes the original mode of voting by ballot is more strictly adhered to, and balls are used in one of two ways. One of these ways is to choose in which of two compartments into which the urn is divided, the voter will deposit the ball; the other method is to select the colour of the ball to be employed. In cases where the last-mentioned method is resorted to, each voter is furnished with two balls, one white and the other black; the black ball is used to express a negative, whence comes the expression 'to blackball,' signifying the rejection of a candidate. In determining this point of rejection, no uniform rule is observed by different bodies. In some societies or bodies, one ball is made sufficient to negative the election; sometimes a larger number of adverse votes is necessary for this purpose. Other bodies adopt as a regulation some definite proportion between the rejecting and accepting votes, such as one in three, five, ten, &c., whereby to determine upon the admission of the candidate.

This mode of election is now almost universally resorted to in England by clubs and scientific societies, as well as in hospitals for the election of medical officers, and by insurance offices and commercial associations for choosing their managers or directors. The directors of the Bank of England are thus chosen.

In France, voting by ballot is used in the election of members of the Chamber of Deputies, and the same mode of voting was used under the constitutional charter in the chamber itself whenever twenty members concurred in demanding a ballot; but in 1845, the practice was abolished by a law proposed by M. Duvergier de Hauranne, during M. Guizot's administration. The most remarkable instances, however, of the exercise of the ballot, are those of the election of Louis Napoleon to the office of president; and the ratification by the same process of the *coup d'état* of December, 1851, and the consequent elevation of the president to the throne of the empire.

M. de Tocqueville, though he discusses the constitution of the United States in all its phases, does not think the ballot of sufficient importance to give it even a notice as having any effect, while he dwells strongly on the great influence of publicity, and the passion for general and varied political discussion, which he thinks a marked characteristic of the American people as distinguishing them from Europeans.

BALSAM. This name is applied to a class of substances which are exclusively ready formed products of the vegetable kingdom. They are chiefly produced in warm climates, and consist of a mixture of ethereal oils with resinous bodies, frequently containing also benzoic or cinnamic acid, to which their aromatic odour is due. The balsams are of a semifluid or viscous consistence, and are generally obtained by making incisions in the bark of the trees which produce them. By exposure to the air the more volatile part evaporates and they become harder, but it is rarely that they thus entirely lose their viscosity. In addition to these natural productions, some artificial balsams, as balsam of sulphur, are employed in medicine. The following are a few of the principal natural balsams:—

Balsam of Canada. A terebinthinous balsam, obtained from the Balm of Gilead Fir (*Abies balsamea*). It is a transparent honey-like yellowish liquid, becoming hard on exposure to the air. It possesses the odour of turpentine and a bitter taste. Canada Balsam consists of

Essential oil	18·6
Resin soluble in alcohol	40·0
Resin insoluble in alcohol	33·4
Elastic resin	4·0
Bitter extractive and salts	4·0
	100·0

Canada Balsam is used for cementing together the constituent lenses of achromatic combinations.

Balsam of Capivi. This balsam is a resinous exudation from different species of *Copaifera*. It is a clear liquid, which thickens on exposure to the air, and has a specific gravity from ·95 to ·96. It is insoluble in water, but soluble in alcohol, ether, and oils. Alkalies convert it into an insoluble soap. According to Gerber it consists of

	Fresh Balsam.	Old Balsam.
Volatile oil	41·00	31·70
Yellow resin (*Copaivic acid*)	51·38	53·68
Brown soft resin	2·18	11·15
Water and loss	5·44	4·10
	100·00	100·63

Balsam of Peru. Two descriptions of this balsam are met with, both obtained from the same tree, ***Miroxylum Peruiferum*** : one is solid, the other liquid. The first is the true balsamic juice in a concrete state, the last is prepared by boiling the bark of the tree in water. The solid balsam is hard, translucent, and of a light-red colour. It possesses an aromatic odour and taste, due chiefly to the presence of cinnamic acid. The liquid balsam is of a syrupy consistence, reddish-brown and transparent, of a powerful but pleasant odour resembling liquid styrax, and an insupportably bitter taste. It is used in medicine and perfumery, and is often adulterated with alcohol, fixed oils and balsam of capivi.

Balsam of Tolu. The concrete juice of ***Myrospermum Toluiferum***. It is a brownish yellow resinous mass, emitting a fragrant odour. It consists, according to Kopp, of free *cinnamic acid*, a liquid hydrocarbon, *Tolen* ($C_{10}H_8$) and two resins; *Alpha Resin* has the formula $C_{36}H_{18}O_4$, and is brown, translucid, brittle, and shining. *Beta Resin* ($C_{36}H_{20}O_{10}$) is of a dull yellowish-brown colour. It is tasteless and inodorous.

BALSAMODENDRON, *Medical uses of.* Myrrh, some of which is the product of the *Balsamodendron myrrha* and *katof* [NAT. HIST. DIV.], is a gum resin, and is met with of two sorts—myrrh in tears and myrrh in sorts. The smell is peculiar and disagreeable, and the taste is bitter. The myrrha stacte mentioned in Exodus xxx. 34, was esteemed the finest kind of myrrh by the ancients, being the spontaneous exudation from the plant. Myrrh in sorts is coarser and frequently adulterated. The alcoholic tincture of myrrh mixed with equal parts of nitric acid, becomes red or violet. The tincture of the false myrrh (of Bonastre) so treated, becomes turbid and yellow, but not red.

East Indian myrrh is in large pieces, altogether opaque, frequently covered with a brownish-white powder. The source of this is unknown, but it is conjectured by Louriero, that a tree called *Laurus myrrha*, a native of Cochin China, yields it. The so-called myrrh of Abyssinia, which is *gum opocalpasum*, is yielded by the *Acacia gummifera* (Wild.), called also *Inga Sassa*, and is probably a variety of the gum of Bassora or Bagdad.

A portion of myrrh brought from Arabia by Ehrenberg, analysed by Brandes, yielded

Resin, soluble in ether	22
Resin, insoluble in ether	5
Gum	54
Bassorin	9
Volatile oil (myrrh oil), which is heavier than water	2
Traces of salts, malates, benzoates, and sulphates.	

Its specific gravity is 1·360. Water dissolves about 66 parts, one-third of which is deposited upon standing. Alcohol dissolves the remaining 34 parts; but on the addition of water, it becomes opaque and milky, but without any precipitate. Acetic acid and milk also dissolve it.

Myrrh, though containing a volatile oil, seems to act more from its bitter qualities, which approach to the character of a stimulant tonic. It increases the energy of the whole frame, giving solidity to the solids, and greater consistency to the fluids. The secretions of the mucous membranes particularly are improved by it, and diminished in quantity when excessive. Its introduction into the stomach is followed by a sense of warmth, which diffuses itself over the whole abdomen. The appetite is increased, and the digestive process is much facilitated, especially where there is weakness and torpidity of the intestinal canal, sometimes accompanied by too copious mucous secretion (constituting what is termed *diarrhœa mucosa*).

The mucous membrane of the lungs is acted upon in the same way; hence myrrh is very useful in affections of languid and feeble persons, who are unable to expectorate the abundant fluids secreted by the air-tubes (bronchia). For the humid and chronic cough of old people it is very serviceable, especially if given along with sulphate of zinc. For the cure of a cough which often occurs during pregnancy, and even continues after abortion, along with oxide of zinc, it is well-suited; as well as for hysterical coughs, in which last it may be given along with cinchona bark, or preparations of iron.

From its cleansing power in the case of external ulcers, it has been recommended in consumption (*phthisis pulmonalis*); but in the early stages, or even the later, if there be much hectic fever, it is quite inadmissible: and when allowable, it is only useful by imparting strength to expectorate, having no power to cure the disease.

In amenorrhœa occurring in feeble persons, it is of great use, along with aloetic medicines and preparations of iron.

It is best given in substance in the greater number of cases in which it can be employed; but as a means of cleansing ulcers, as well as a wash to parts in danger of ulcerating from pressure (as in patients long confined to bed, from fever, fractured limbs, or other causes), the tincture is preferable.

Myrrh is an ingredient in a great many tooth-powders.

The produce of the *Balsamodendron Gileadense*, though called a balsam, and denominated balsam of Mecca, balsam of Gilead, is not entitled, chemically, to rank as such, being an *oleo-resin*. It is of two kinds, that obtained by spontaneous exudation, and that which is obtained by boiling the branches. The former is so highly prized in the East, and so expensive, that it is never brought to Europe. That which is obtained by boiling is of different qualities and value, according as the boiling is continued for a short or long time. When for a short time only, the substance which floats on the surface is highly esteemed, and almost all of this quality is consumed in Asiatic Turkey and Egypt. The variety procured by long-continued boiling is sent to Europe in small conical, leaden bottles, the mouth of which is closed with a leaden stopper, and covered over with bladder. The fresh balsam is of moderate consistence, of a light yellow colour, odour agreeable, the taste bitterish, aromatic, and heating; specific grav. 0·950. When dropped upon water it spreads out into a thin film, which may be skimmed off the surface with a spoon. When exposed to the air for some days, it loses this property, as well as its fine smell. It has been described by Strabo (b. xvi. p. 763): "The balsam is a shrub of a brambly appearance or kind, like the cytisus and terebinthus, and possesses aromatic properties. They cut the bark, and catch the juice that exudes in vessels; the juice resembles oily milk. When put into shells it hardens, or assumes consistence. It has wonderful powers in curing headaches, incipient defluxions (he means catarrhs), and dimness of the eyes: it is accordingly high-priced. The xylobalsamum is also used as an aromatic."

Numerous fabulous statements are recorded in writers on medical substances respecting this article: such, for example, as the mode of judging of its purity by dipping the finger in it, and then setting fire to it, when, if it burns without causing pain, it is considered pure. From its high price it is often adulterated with sesamum oil, the produce of the ***Pinus balsamea*** and ***P. Canadensis***, Chian turpentine, and even tar. A portion of the purest kind, analysed by Trommsdorff, yielded

Volatile oil	30 per cent.
Resin (with some extractive)	64 „
Resin, insoluble in alcohol, a small quantity.	

It burns without leaving any residuum.

Though formerly considered a cure for many diseases, it has now fallen into disuse. Any benefit which might be derived from it can be obtained from any of the finer turpentines. Its heating qualities render it very unfit for cases where any inflammatory action exists, whether internal, as consumption, or external, as wounds. There is reason to believe that many of the cordials sold under the name of balms contain no portion of Mecca balsam; but that the most celebrated of these medicines, called Solomon's Balm of Gilead, consists of cardamums and brandy, which must be even more hurtful than any balsam.

BALSAMS. The substances commonly included under this title are of various natures: first, there are natural balsams, exuding from trees, as those of Peru and Tolu, &c., which contain benzoic acid and resin, and these only will be considered at present. There are, besides, the balsams of Copaiba, Gilead, &c.; these contain no benzoic acid, but are turpentines containing a volatile oil and resin; these will be described as turpentines. Lastly, there were in former pharmacopœias sundry very different preparations ranked together as balsams. For example, balsam of sulphur, traumatic balsam, &c.: these, when retained in modern pharmacopœias, are arranged under other forms.

Balsams are obtained from certain vegetables, chiefly of the *Leguminosæ* or pea tribe, the *Styraceæ* or storax tribe, and that section of *Amentaceæ* called *Salicineæ*. Numerous substances of a resinous nature were formerly designated *balsams*, and turpentines and balsams are still popularly confounded with each other. The term balsam, however, should be limited to such articles as contain *benzoic acid* along with a volatile oil and resin. The others, which contain only volatile oil and resin, should be called turpentines, or oleo-resins. The true balsams appear to be only five, namely, balsam of Peru and balsam of Tolu (yielded by the ***Myrospermum Peruiferum*** and ***M. Toluiferum Leguminosæ***), and benzoin, from *Styrax benzoin* (*Dryander*), and storax, from *Styrax officinalis* (*Styraceæ*), and liquidamber, from the *Liquidambar Styraciflua* and *L. imberbis* (*Salicineæ*).

The observations upon the medical uses of balsams are therefore to be understood to apply only to those specified above. To produce their characteristic effects, they must be digested and assimilated, on which account they are chiefly administered internally, their external application being followed by very limited action. They are with difficulty soluble in the animal juices, so that it is not till after they have been used for some time that the secretions acquire their peculiar odour. These facts, taken into consideration along with the enduring nature of their action, point out their greater fitness for chronic than acute diseases.

They may be regarded as stimulants of the secretory and excretory systems, which they rouse to continued action. Their influence is greatest over mucous membranes, the secretions from which they render more abundant when deficient, and more consistent when too liquid and of imperfect quality. The mucous membranes of the lungs and of the urinary passages seem to be more under their influence than that of the intestinal canal. They possess a similar power over the skin, the secretion of which they regulate according to its condition: when cool, pale, dry, and in a state of atony, they promote the perspiration; but if the weakness be so great that the skin is covered with a cold, clammy sweat, or of a colliquative kind, the balsamic medicines frequently check its flow.

When given in large and long-continued doses, they act upon the vascular system, and quicken the heart's action, as well as the extreme or capillary vessels, which last they excite when brought into direct contact with them, as in the case of wounds or ulcers.

They possess some power over the nervous system, but less over the nerves of animal than of organic life. It is in diseases referable to morbid states of the nerves of organic life that balsamic medicines are most useful, especially when they are in a state of weakness, torpor, and imperfect action. They act also on the nervous system when over-excited, calming it, and approaching in this respect to the character of antispasmodics. Under this head benzoin is the most powerful and most frequently employed, generally in the form called *paregoric elixir*.

From what is stated above, it is clear that they are unsuited to the beginning or early stages of the diseases in which they are most commonly employed by uninformed persons. So long as any acute inflammatory action exists they are decidedly hurtful; but after this has subsided they are frequently very beneficial in common colds, to lessen the cough and facilitate the expectoration, in the later stages of hooping-cough, and in the humid cough of old or weak persons; that is, in one of the morbid states popularly called asthma. Balsamic medicines are however totally inadmissible when the asthmatic symptoms are connected with any organic change of the heart or lungs. They may be advantageously employed in the later stages of influenza and suffocative catarrh. The early use of paregoric in common colds is frequently productive of much injury.

The external employment of balsams is almost completely banished from modern surgery. The evil of their employment was obvious to the eyes. *Friar's balsam, wound balsam, balsam for cuts, &c.*, as certain combinations or solutions of balsam of Tolu, storax, and benzoin in rectified spirits were called, had, when applied to recent wounds, the manifest bad effect of stimulating the edges, and interposing a mechanical impediment to their union by *the first intention*, as the direct re-union of divided surfaces is termed by surgeons. In this way they were healed by suppuration and granulation, which is a much more tedious process. To some indolent wounds and sores, especially in parts not possessed of much vascularity, their application is sometimes beneficial. Internal wounds and ulcers are in general equally injured by them. Their vaunted power of curing consumption is only maintained by ignorant and unprincipled persons, who vend their pernicious compounds to the weak and credulous among their suffering fellow-creatures, whom they delude both of health and money.

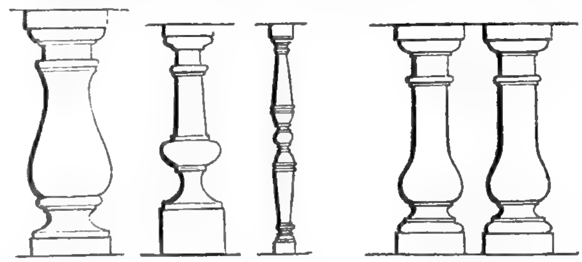
[For balsam of Canada, see PINUS BALSAMEA; for balsam of Copaiba, see COPAIFERA; and for balsams of Peru and Tolu, see MYROSPERMUM in NAT. HIST. DIV.]

BALUSTER, or BALLISTER, has been derived from balustrum, or balustrium, a place railed off in the ancient baths. (Nicholson's 'Architectural Dictionary.') It is also conjectured to be derived from 'balaustium' (βαλαύστιον), the flower of the wild pomegranate, which it is said to resemble. ('Encyclopédie Méthodique d'Architecture.') It is difficult to imagine how the word 'baluster' is derived from the Greek name of the flower of the pomegranate, when we do not even know the form of the ancient baluster, or whether it bore any resemblance to that of the moderns. We think it more probable that the word was derived from balista, an engine used by the Romans for throwing stones, &c. (Vitruvius.) Balista was the engine, and balistarium the place where the balista was put; and it is possible the balistarium was railed in. The balistarium was, according to Lipsius, the engine itself. (Plautus, 'Pœnul.', i. 1, 73; Lipsius, 'Poliorcet.' c. iii. dial. 2.) The balista, or balistarium, was in the form of a bow, and the profile of the baluster or ballister is also in the form of a bow. The Norman-French word for a crossbow is arbalastre, and the modern French word for baluster is balustre. There is so much resemblance in the form of the two objects, and in the words by which they are expressed, that we are of opinion that the word baluster, or balister, is derived from the Roman engine of war balista, or balistarium.

The baluster is a peculiar kind of column, of the form of an ancient bow in its profile; it is employed in balustrades. [BALUSTRADE.] The baluster has of late years been formed after the model of Greek and Roman columns. Balusters are placed on a plinth, and are surmounted with a cornice. (See the published works of Palladio, Vignola, Scamozzi, and others.) The proportions of balusters are given in the work of Sir William Chambers on Architecture, where they are proportioned to the orders, and are made heavier or lighter according to their destination; the heaviest balusters are given to the Tuscan, and the lightest to the Corinthian and Composite orders.

BALUSTRADE, the termination of a modern edifice. There does not appear to be any example of a balustrade in the remains of antiquity now existing; although there are examples of railing or fencing. Balustrades are most commonly placed over the cornices of large edifices, after the manner of a parapet, as at the Banqueting House at Whitehall, St. Paul's cathedral, London, and on Blackfriars and Westminster bridges when they were first erected, though these have been long since removed. Balustrades are not only employed in large edifices, above the orders of architecture, but also to inclose stairs, terraces, altars, fonts, and the balconies of houses. The balusters forming a balustrade are placed on a plinth, at equal distances from one another, with a small opening between them; they support a cornice, and are divided at intervals by a pedestal. (For the proportions of a balustrade over an order of columns, see Chambers' 'Architecture.') When a balustrade is placed over an order of columns, it is usual to set the die of the pedestal over the columns, making the breadth of the die equal to the breadth of the shaft. Balustrades are made of iron and wood, as well as stone. In Italy balustrades are of very frequent occurrence, and of prodigious extent. At Frascati there is a balustrade in the Villa Conti, more than 2000 feet in length. The colonnade of St. Peter's, by Bernini, is surmounted with a balustrade. But perhaps the most elegant balustrade in Rome is at the Villa Albani; the form of the baluster in this differs from the old and bow-shaped baluster commonly employed. Barry introduced balusters imitated from Italian forms, and his example has been since frequently followed.

Examples of Balusters employed in four different structures.



Old Westminster Bridge. Villa Albani. Wooden bow-shaped Baluster. Blackfriars Bridge (now removed).

The cuts represent four kinds of baluster; one like the bow above-mentioned, the others as if the bow-like baluster had been cut in two horizontally to form two balusters. The latter is the baluster most commonly used; but the former appears to be the oldest and earliest form; an example of it may be seen in some of the galleries of old wooden buildings in England and other countries of Europe. The court-yard at Chillingham Castle, and the gate of honour leading into Caius College, Cambridge, present examples of the bow-like baluster. There are examples also in the works of Palladio, Vignola, Scamozzi, and other architects of Italy.

BAN, BANNS. These words are found in many of the modern languages of Europe in various senses. But as the idea of 'publication' or 'proclamation' runs through them all, it is probable that it is the ancient word *ban* still preserved in the Gaelic and the modern Welsh in the simple sense of 'proclaiming.'

As a part of the common speech of the English nation, the word is now so rarely used that it is put into some glossaries of provincial or archaical words, as if it were obsolete, or confined to some particular districts or particular classes. Yet, both as a substantive and a verb, it is found in some of our best writers; among the poets, Spenser, Marlowe, and Shakspere; and among prose-writers, Knolles and Hooker. By these writers however it is not used in its original sense of 'proclamation,' but in a sense which it has acquired by its use in proclamations of a particular kind; and it is in this secondary sense only that it now occurs in common language, to denote cursing, denouncing woe and mischief against one who has offended. A single quotation from Shakspere's tale of 'Venus and Adonis' will show precisely how it is used by writers who have employed it, and by the people from whose lips it may still sometimes be heard:

> "All swollen with chafing down Adonis sits,
> *Banning* the boisterous and unruly beast.

The improvement of English manners having driven out the practice, the word has nearly disappeared. But in the middle ages the practice was countenanced by such high authority, that we cannot wonder at its having prevailed in the more ordinary ranks and affairs of life.

When churches and monasteries were founded, writings were usually drawn up, specifying with what lands the founder and other early benefactors endowed them; and these instruments often conclude with imprecatory sentences in which torments here and hereafter are invoked on any one who should attempt to divert the lands from the purposes for which they were bestowed. It seems that what we now read in these instruments was openly pronounced in the face of the Church and the world by the donors, with certain accompanying ceremonies. Matthew Paris, a monk of St. Albans, who has left one of the best of the early chronicles of English affairs, relates that when King Henry III. had refounded the church of Westminster, he went into the chapel of St. Catherine, where a large assembly of prelates and nobles was collected to receive him. The prelates were dressed in full pontificals, and each held a candle in his hand. The king advanced to the altar, and laying his hand on the Holy Evangelists, pronounced a sentence of excommunication against all who should deprive the church of anything which he had given it, or of any of its rights. When the king had finished, the prelates cast down the candles which they held, and while they lay upon the pavement, smoking and stinking (we use the words of the author who relates the transaction), the Archbishop of Canterbury said aloud: "Thus, thus may the condemned souls of those who shall violate or unfavourably interpret these rights be extinguished, smoke, and stink;" when all present, but the king especially, shouted out "Amen, amen."

This, in the English phrase, was the *banning* of the middle ages. Nor was it confined to ecclesiastical affairs. King Henry III., in the ninth year of his reign, renewed the grant of Magna Charta. In the course of the struggle which was going on in the former half of the 13th century between the king and the barons, other charters of liberties were granted. But for the preservation of that which the barons knew was only extorted, the strongest guarantee was required; and the king was induced to preside at a great assembly of nobles and prelates, when the archbishop pronounced a solemn sentence of excommunication against all persons of whatever degree who should violate the charters. This was done in Westminster Hall on the 3rd day of May 1253. The transaction was made matter of public record, and is preserved in the great collection of national documents called Rymer's 'Fœdera.'

But besides these general *bannings*, particular persons who escaped from justice or who opposed themselves to the sentence of the Church, were sometimes *banned* or placed under a *ban*. In the history of English affairs, one of the most remarkable instances of this kind is the case of Guido de Montfort. This Guido was the son of Simon de Montfort, earl of Leicester, and grandson of King John. In the troubles of England, in which his father lost his life, no one had been more active in the king's service than Henry of Almaine, another grandson of King John, and the eldest son of Richard, that king's younger son, who had been elected King of the Romans. This young prince, being at Viterbo in Italy, and present at a religious service in one of the churches of that city, was suddenly assaulted by Guido de Montfort, and slain upon the spot. A general detestation of the crime was felt throughout Europe. Dante has placed the murderer in the 'Inferno:'

"He in God's bosom smote
The heart still reverenced on the banks of Thames."

The murderer escaped. Among the rumours of the time, one was that he was wandering in Norway. This man the pope placed under a *ban;* that is, he issued a proclamation requiring that no person should protect, counsel, or assist him; that no person should hold any intercourse with him of any kind, except perhaps some little might be allowed for the good of his soul; that all who harboured him should fall under an interdict; and that if any person were bound to him by any oath of fidelity, he was absolved of the oath. This was promulgated throughout Europe. A papal bull in which the proclamation is set forth still exists among the public records in the chapter-house at Westminster. A copy of it is in Rymer's 'Fœdera.' The pope uses the very expression *forbannimus;* "Guidonem etiam forbannimus."

This species of *banning* is what is meant when we read of persons or cities being placed under the *ban of the empire;* a phrase not unfrequently occurring in writers on the affairs of Germany. Persons or cities who opposed themselves to the general voice of the confederation were by some public act, like those which have been described, cut off from society, and deprived of rank, title, privileges, and property.

It is manifest that out of this use of the word has sprung that popular sense in which now only the word is ever heard among us, as well as the Italian *bandire*, French *bannir*, and the English *banish*.

In some parts of England, before the Reformation, an inferior species of *banning* was practised by the parish priests. "In the Marches of Wales," says Tyndal in his work against the Romish Church, entitled 'The Obedyence of a Christen Man,' 1534, "it is the manner, if any man have an ox or a cow stolen, he cometh to the curate and desireth him to curse the stealer; and he commands the parish to give him, every man, God's curse, and his; 'God's curse and mine have he,' sayeth every man in the parish." Stowe relates that, in 1299, the Dean of St. Paul's accursed at Paul's Cross all those who had searched in the church of St. Martin in the Fields for a hoard of gold. ('London,' in the account of Farringdon Ward within.) Tyndal argues against the practice, as he does against the excommunicatory power in general. Yet something like it seems to be still retained in the Commination Service of the English Church.

In France the popular language has not been influenced by this application of the word *ban* to the same extent with the English. With them the idea of *publication* prevails over that of *denouncement*, and they call the public cry by which men are called to a sale of merchandise, especially when it is done by beat of drum, a *ban*. In time of war, a proclamation through the ranks of an army is the *ban*. In Artois and some parts of Picardy the public bell is called the *ban-cloque*, or *cloche à ban*, as being rung to summon people to their assemblies. When those who held of the king were summoned to attend him in his wars, they were the *ban*, and tenants of the secondary rank the *arriere-ban;* and out of this feudal use of the term arose the expressions *four à ban*, and *moulin à ban*, for a lord's bakehouse, or a lord's mill, at which the tenants of a manor (as is the case in some parts of England) were bound to bake their bread or to grind their corn. The *banlieue* of a city is a district around it, usually, but not always, a league on all sides, through which the proclamation of the principal judge of the place has authority. A person submitting to exile is said to *keep his ban*, and he who returns home without a recall *breaks his ban*.

The French use the word as the English do, when they speak of the *ban*, or, as we speak and write it, the *banns* of marriage. This is the public proclamation which the law requires of the intention of the parties named to enter into the marriage covenant, when the parties intend to be married with the rites of the church of England. The law of the ancient French and of the English church is in this respect the same. The proclamation must be made on three successive Sundays in the church, during the time of the celebration of public worship, when it is presumed that the whole parish is present.

The intent of this provision is two-fold: 1. To prevent clandestine marriages, and marriages between parties not free from the marriage contract, parties within the prohibited degrees of kindred, minors, or excommunicates; and, 2. To save the contracting parties from precipitancy, who by this provision are compelled to suffer some weeks to pass between the consent privately given and received between themselves and the marriage. Both these objects are of importance, and ought to be secured by law; and provision is made for a due publicity in all other cases of sectarian or civil marriage. The *ban*, or *banns*, may, however be dispensed with. In that case a licence is obtained from some person who is authorised by the bishop of the diocese to grant it, by which licence the parties are allowed to marry in the church or chapel of the parish or parochial chapelry in which either of them resides, in which marriages are wont to be celebrated, without the publication of banns. The law, however, takes care to ensure the objects for which the publication of banns was devised, by requiring oaths to be taken by the party applying for the licence, and certificates of consent of parents or guardians in the case of minors. Special licences not only dispense with the publication of banns, but allow the parties to marry at any convenient time or place. These are granted only by the Archbishop of Canterbury, in virtue of a statute made in the twenty-fifth year of Henry VIII., entitled an Act concerning Peter-Pence and dispensations. It is not known when this practice began, but it is undoubtedly very ancient. Some have supposed that it is alluded to in a passage of Tertullian.

BANCO. [BANK.]

BAND, in Architecture, a flat moulding, with a vertical face slightly projecting beyond the vertical or curved face of any moulding or parts of an edifice to which it is attached. It is very extensively employed in edifices, and is used apparently to bind parts of buildings together, as in the bands which are employed to bind the triglyphs of a Doric architrave. This moulding is most frequently used in the basement story of a building, where it becomes a bold and striking feature: (see the published designs of Palladio, Vignola, Scamozzi, and others.) It is for the most part plain, though sometimes enriched. The term band and bandelet, little band, is often applied to what is more properly speaking a fillet. The band is, however, broader in proportion than the fillet. This moulding is also employed to encircle the shafts of columns [COLUMN; RUSTICATED WORK]; the palace of the Luxembourg at Paris, and the Pitti palace at Florence, present very remarkable examples of banded columns. Bands were frequently employed to encircle the columns of Norman, and First-pointed, and occasionally the Middle-pointed styles of Gothic architecture. Vitruvius calls the band *tænia* and *fascia;* fascia is a term applied also to the flat faces of the architrave. A plain band is often placed in both public and private buildings, to mark the principal floors.

BANDAGE is a term employed in surgery to designate the bands or strips of cloth by which dressings are kept to wounds, separated parts are brought together, blood-vessels compressed, and weak and protruding parts of the body are supported and retained in their natural position. Bandages are commonly composed of flannel, calico, and linen cut into different shapes, according to the parts to which they are applied, and the purposes for which they are required. Thus the bandage often employed in fractures of the upper and lower extremities, and called eighteen or many-tailed bandage, is composed of a longitudinal piece of calico or linen, with transverse pieces, or tails, to fold over the injured part. Another bandage resembles in shape the letter T, and is called the T bandage. But the most common form of bandage, and one available in almost every case, is a long strip or ribbon of calico or flannel, varying in width from two to six inches. Previous to its application it is rolled together, and hence in surgical language is called *roller*, and the application of a bandage is called *rolling*. Of late years, ribbons of stocking-net, commonly called elastic web bandages, have been much used, and they appear peculiarly adapted for the purpose, as their elasticity prevents injurious consequences on any sudden increase of the size of the part to which they are applied. On the same principle caoutchouc or India-rubber, interwoven with silk and cotton, is now frequently employed in the construction of bandages.

The proper employment and management of bandages is an extremely important part of surgical knowledge, for after most operations and accidents, and in many serious local diseases and deformities, the assistance of bandages is required, and on their proper application the successful issue of the case frequently depends. The great object in the common use of the bandage is to give equal and uniform support to the part to which it is applied, and it is of course essential that it should not be easily displaced or deranged by any movement of the patient. The bandage should be put on firmly, so as not to produce pain, but to afford gentle and easy support; and above all it should never be tight in some parts and loose in others, as by partial compression of a limb mortification is easily produced. The art of bandaging has been much neglected in this country. In many of the continental schools, particularly in Germany, distinct courses of instruction have long been given on bandages, and students are required to practise their application in the presence of the teacher. At the present time more attention is paid to this subject in the London schools of surgery, but it would be well if a knowledge of the proper way of applying bandages in all cases of injury was required from every candidate for a surgical diploma.

BANDALEER. [ARMS.]

BANDANAS, or BANDANNAS, a term originally applied to a peculiar kind of silk handkerchief made by the Hindus, is the name now commonly given to silk and cotton handkerchiefs manufactured in this country, and decorated with patterns of similar character, though by a very different process. The distinguishing peculiarity of a bandana handkerchief is that it has a uniformly dyed ground, usually of bright red or blue, ornamented with circular, square, lozenge-shaped, or other simple figures, either white or yellow. These spots are produced, in real Indian bandanas, by tying up the parts intended to be white or yellow with bits of thread before exposing the handkerchief to the action of the dye, and thus protecting them from it. Rude as this process appears, British manufacturers were, owing to the difficulty of imparting a sufficiently durable ground-colour by the ordinary process of calico-printing, unable to imitate Indian bandanas successfully, until a plan was contrived for dyeing the whole surface, and afterwards discharging the colour from the spots forming the pattern by the agency of chlorine. This plan was invented by M. Kœchlin, of Mühlhausen, in 1810, and has been carried into effect on a large scale at the Barrowfield Dye-works near Glasgow, by Messrs. Monteith and Co., with a degree of perfection far exceeding the original Oriental bandanas.

The pieces of cotton cloth being dyed of the requisite colour, they are taken to an apartment containing a range of powerful hydraulic discharging-presses, each of which has a roller at the back, to receive the cloth to be operated upon, and another in front, to receive it after the pattern has been discharged; the intervening portion of the cloth resting upon the bed-plate of the press, which is about a yard square, or equal in size to a single handkerchief. This bed-plate is formed of lead, perfectly smooth and even, and is perforated with holes corresponding with the white spots of the desired pattern; and a similar plate, perforated in like manner, is fixed parallel with, but at a short distance above it. Fourteen pieces of dyed cloth, when laid carefully upon one another, are rolled together upon the back roller of the press, and acted upon simultaneously; and, when their ends are drawn over the bed-plate and secured to the foremost roller, the hydraulic apparatus is brought into action, so that the bed-plate, with the fourteen thicknesses of cloth lying upon it, is raised and pressed with immense force against the upper plate, which is firmly fixed in the press. The bleaching-liquid, which is a solution of chloride of lime, is then poured into a trough connected with the upper plate; and finding its way through the perforations of the pattern, percolates through the fourteen thicknesses of cloth, and escapes through the perforations of the lower plate, its passage through the cloth being sometimes facilitated by a powerful current of air. The extreme tightness with which the dyed cloth is compressed prevents the action of the bleaching-liquid from extending beyond the perforations; and as mechanical contrivances are adopted to ensure the perfect tallying of the perforations in the two leaden plates, the pattern produced by them is very accurately transferred to the cloth. After allowing a few minutes for the action of the bleaching-liquor, it is drawn off, the pressure is removed, and the portion of cloth which has been operated upon is wound on to the front roller. A second portion is then drawn forward upon the bed-plate, for a repetition of the process. By the use of certain chemical liquids, the discharged spots may be made yellow instead of white; and by such an arrangement of the pattern and of the channels for conducting the discharging fluid as will allow two fluids to be used independently of each other, some parts of the pattern may be made white, and others yellow by one operation. In the establishment above-mentioned there are (or were a few years ago) sixteen presses for the production of bandanas; when these are in full work the period required for the complete discharge of the colour in the first press is equal to that required for bringing the remaining fifteen into action, so that one discharger, with his assistants, can keep the whole in constant operation. The whole routine of operations occupies about ten minutes, so that the sixteen presses (each producing fourteen handkerchiefs at each operation) will produce 224 handkerchiefs at each time of working, or upwards of 14,000 in a day of ten hours—requiring, meanwhile, the services of only four men.

The fluctuations of fashion have led to the partial disuse of the bandana style of handkerchief within the last few years; but the process remains as valuable as ever, and applicable to a large variety of goods. [BLEACHING; CALICO PRINTING; DYEING.]

BANDES NOIRES. This appellation was first given to a body of German foot-soldiers, who were employed in the Italian wars by Louis XII. of France, who formed a portion of the troops called Grand Companies. Robertson alludes to them in his 'History of Charles V.' (edit. 4to. 1769, vol. i. p. 113.) They received their name from carrying black ensigns after the death of a favourite commander. (Père Daniel, 'Hist. de la Milice Françoise,' 4to. Par. 1721, tom. ii. p. 383.) Another body of troops, formed of Italians, afterwards took the same name from the same cause, *Le Bande Nère*, or, as Père Daniel calls them, *Les Bandes Noires Italiennes*, to distinguish them from the Germans. Père Daniel adds, that the French regiment of Piedmont, which had served for a long while in Italy, also took the appellation of *Bandes Noires*, after the death of their colonel, the Comte de Brissac, in 1569. The colours of that regiment, he adds, continued to his time to be black, with a white cross.

The Grand Companies were foreign mercenaries, in a great measure raised from the vassalage of Germany, and sold by their lords to whoever could pay for them. It is no wonder that such troops should have been addicted to plunder and even greater atrocities. From France itself they were led into Spain by Du Guesclin, to the support of Henry de Trastamare against Philip the Cruel and the English Black Prince, and never afterwards figured in that country; but in Italy they continued to exist for nearly another century.

BANDITTI. This word, though seldom used by the Italians in our sense, for 'bands of robbers,' is derived from the Italian verb *bandire*, to banish or put to the ban, whence the participle *bandito*, banished or outlawed and the substantive *bandito*, an outlawed man (plural *banditi*), or outlawed men. Correctly, therefore, the word should not be banditti, but banditi. The term seems to have been introduced into our language at least as early as the time of Shakspere; but whoever first imported it and confined its signification to robbers, departed from the original extensive sense of the word, which means a man banished on any account, as for political delinquencies or opinions, plots, religious notions, partisanship, &c. &c. Thus, after Danté and the Ghibellines were expelled from Florence by the Guelphs, they might be called *banditi*, though they were honourable men, representing a defeated political party or faction, and never robbers. Bembo and other *teste di lingua*, or classical writers, who form authority on the subject of Italian idiom, employ the term *banditi* almost exclusively in speaking of political exiles. The great Tuscan dictionary *della Crusca* gives *esiliato* as the synonym of *bandito*, and *exilio damnatus* as the Latin for both. In the 'Dic. di Firenze,' 1819, the definition is an outlaw, an exile, a highwayman. In the south of Italy, the only part of the peninsula where such lawless associations have existed for many years, the robbers are popularly called *briganti*, and never, by any chance, banditi. The French, during their long and sanguinary warfare for the subjugation of Calabria, called by the name of *brigands* both those who were professional robbers, and those who were partisans of the Bourbon King of Naples, Ferdinand, whom the arms of the French had driven out of his continental dominions to Sicily.

These organised bands of robbers have been fostered in Italy by the mountainous nature of a great part of the peninsula, by the division of the country into numerous small states, which too often enabled the robbers, by crossing a frontier, to put themselves in safety; by frequent revolutions, and by weak governments. In modern days, however, their excesses have almost been confined to Lower Italy, the States of the Church, and the kingdom of Naples, and to the islands of Sicily and Sardinia; and regular or numerous bands of robbers have been unknown in Upper Italy, in Lombardy, Piedmont, and Tuscany, for many years. Their principal haunts in recent times have been the country about the frontiers of the Roman and Neapolitan states, from the southern end of the Pontine marshes to the districts of Terracina, Itri, and Pondi; and the valley of the Ponte di Bovino, a narrow mountain-pass, through which runs the high road from Naples, the capital of the kingdom, to the vast plains of Apulia, and the rich provinces of Bari, Lecce, and the Terra d'Otranto. In the first of these positions they were beaten up and almost exterminated by the Austrian troops in 1823, and a little later the valley of Bovino was wholly cleared of them. There have been occasionally highway robberies since then; but organised societies, with their captains, their lieutenants, and chaplains, like those between 1812 and 1823, have not been again formed, except, for a time, during the political agitation of 1848. The most remarkable Italian bandit chiefs of later times were the three brothers Vardarelli, and Don Ciro Anicchiarico. They were all Neapolitans, and the last of them (Don Ciro) a priest, an abbé, and a man of considerable education, who was accustomed to celebrate mass to his band on solemn occasions, and who quoted Latin and Virgil in defences that he sent in to the judicial authorities. The history of this priest-robber, who, not contented with being a successful leader of banditti, which he was for many years, put himself at the head of a secret political society, or rather a series of secret societies, that aimed at nothing less than entirely revolutionising the whole of Italy from the extremity of Calabria to the Alps, and establishing a federal republic, is one of the most astonishing authenticated records of modern times. In January 1818 he attempted a revolutionary movement, but it was suppressed easily, and he was captured and executed.

During the Peninsular War, the general insecurity of the country occasioned the formation of numerous bands of brigands; as they occasionally attacked the French, they endeavoured to cover their crimes under the pretence of being guerillas, but plunder from any party was their main object. With the restoration of order they were suppressed. Neither banditti nor brigands, can exist in a well-regulated, civilised country, where every individual is interested in supporting the supremacy of the law. Wherever such bands exist, we may be certain that the government, and probably the laws, are harsh, oppressive, and unjust. They are unmistakeable proofs of want of true civilisation.

BANIA'NS. The word Banian is a corruption of the Sanscrit *banij*, or *banik*, 'a merchant, a trader,' and is the term by which Hindoos visiting foreign countries for mercantile purposes are generally designated. We find Hindoo merchants noticed at an early period during the Middle Ages in several of the most distinguished trading towns of the East. Marco Polo mentions Hindoos among the foreign traders who visited the fair of Tabriz; and in speaking of Aden, he describes it as "an excellent port, frequented by ships arriving from India with spices and drugs." He was acquainted with the mode in which these commodities were transported from Aden to Lower Egypt, namely, first on Arabian vessels up the Red Sea, to an Egyptian sea-port (Kosseir); thence by camels to a place on the Nile (Kus; afterwards to Kene); and from thence, on boats, down the river to Cairo, and finally to Alexandria. Indian merchants appear also to have settled, during the Middle Ages, on the eastern coast of Africa; Vasco de Gama, on his first voyage, met with several Indian trading-vessels in the port of Melinde (De Barros, 'Asia,' Dec. I. liv. iv. c. 5); and it is not improbable that the information which they afforded may have been of material utility to the early Portuguese navigators in discovering the passage by sea to India. In some of the principal towns of Persia and Arabia, the Banians appear to have sometimes formed a considerable class in society, and to have possessed much political influence. It is said that the Portuguese were driven from their possessions at Muscat through the treachery of a Banian, who thus resented an insult offered to his family. (Niebuhr, 'Beschreibung von Arabien,' p. 297.) In 1765 there were no more than twenty Hindoo merchants settled at Shiraz; but a new caravanserai was at that time built on purpose to be appropriated to their accommodation, in order to induce them to visit Shiraz in greater numbers. Some Hindoos are settled as far to the north and west as Astrakhan. (Niebuhr's 'Reisebeschreibung,' &c. vol. ii. p. 270.) The Banians do not at the present day form a distinct class or caste in India, nor are they accounted as such in the ancient Hindoo law-codes. Some travellers, for example, Tavernier ('Voyages des Indes,' liv. iii. c. 3), have used the name Banian as synonymous with Vaisya, the designation of the whole caste of merchants, husbandmen, and mechanics; but this seems unsupported by Oriental authority. They, however, form a class, adopt a peculiar and picturesque costume, and are remarkably strict in observing the fasts prescribed by their religion, even on their sea-voyages altogether refusing to eat flesh, whence the English sailors have derived 'Banyan-days,' for those when meat is not served out. They also have now a character for great integrity in their commercial transactions, which they have extended from Bombay to Cashmir.

BANISHMENT, expulsion from any country or place by the judgment of some court or other competent authority.

The term has its root in the word *ban*, a word of frequent use in the middle ages, having the various significations of a public edict or interdict, a proclamation, a jurisdiction and the district within it, and a judicial punishment. Hence a person excluded from any territory by public authority was said to be banished—*bannitus, in bannum missus.* (Ducange, *voc.* 'Bannire, Bannum;' Pasquier, 'Recherches,' pp. 127, 732.)

As a punishment for crimes, compulsory banishment is unknown to the ancient law of England, although voluntary exile, in order to escape other punishment, was sometimes permitted. [ABJURATION.] The crown has always exercised, in certain emergencies, the prerogative of restraining a subject from leaving the realm; but it is a known maxim of the common law, that no subject, however criminal, shall be sent out of it without his own consent, or by authority of parliament. It is accordingly declared by the Great Charter, "that no freeman shall be exiled unless by the judgment of his peers or the law of the land."

There are, however, not wanting instances in our history of an irregular exercise of the power of banishing an obnoxious subject by the mere authority of the crown; and in the case of parliamentary impeachment for a misdemeanor, perpetual exile has been made part of the sentence of the House of Lords with the assent of the king. (Sir Giles Mompesson's case, *temp.* James I., reported by Rushworth and Selden; Comyn's 'Digest,' title 'Parliament,' l. 44.) It may be noticed also, that aliens and Jews (formerly regarded as aliens) have, in many instances, been banished by royal proclamation.

Banishment is said to have been first introduced as a punishment for crime by a statute in the thirty-ninth year of Elizabeth, by which it was enacted, that "such rogues as were dangerous to the inferior people should be banished the realm;" but an instance occurs in an early statute of uncertain date (usually printed immediately after one of the eighteenth of Edward II.), by which butchers who sold unsound meat might be compelled to abjure the village or town in which the offence was committed. At a much later period the punishment called transportation was sanctioned by the legislature, and in many cases made the condition on which the crown has consented to pardon a capital offence. [TRANSPORTATION.]

Banishment, in some form, has been prevalent in the criminal law of most nations, ancient as well as modern. Among the Greeks two kinds were in use:—1. Perpetual exile (φυγή), attended with confiscation of property, and employed as a punishment for crimes; 2. Ostracism, as it was called at Athens, or Petalism, the term in use at Syracuse, a temporary expulsion, unaccompanied by loss of property, and inflicted sometimes upon persons whose influence, arising either from great wealth or eminent merit, made them the objects of popular suspicion or jealousy.

Among the Romans there were three forms of banishment:—1. *Relegation*, which was the mildest form, obliged the offender to reside in some assigned place abroad, either for a fixed time or for life, but subjected him to no other civil disability or loss. Of this nature was the banishment to which we owe the plaintive poetry of Ovid. 2. *Exile*, or the 'interdiction of fire and water,' prescribed no particular place of abode, nor did it directly or expressly sentence the culprit to expatriation; but by depriving him of every possible means of living in his own country, it indirectly compelled him to seek another, and eventually stripped him of the rights of citizenship. 3. The last kind of banishment, *Deportation*, was introduced in place of the interdiction, and by it the criminal incurred all the civil forfeitures of exile, and was usually conveyed to some remote island (Tacit. 'Hist.' i. 2), in which his life was rendered painful by fetters, by forced labour, or by the natural effects of the climate. Deportation therefore differed little from the punishment known among us as transportation, except as far as regards the healthiness of the spot selected; and it was further attended by the same consequences of civil death during the continuance of the term of punishment. Hence it was that the day of the exile's return was called his second birth-day. (Heinecc., 'Antiq. Rom. Syntagma,' lib. i. tit. 16; 'Digest,' lib. xlviii. tit. 22.)

BANISTER is a corrupt term for baluster [BALUSTER]. It is used to express the wooden railings inclosing the stairs of a house.

BANK, in barbarous Latin *bancus*, literally signifies a bench or high seat; but as a legal term it denotes a seat of judgment, or tribunal for the administration of justice. In a rude state of society, justice is usually administered in the open air, and the judges are placed in an elevated situation both for convenience and dignity. Thus it appears that the ancient Britons were accustomed to construct mounds or benches of turf for the accommodation of their superior judges. (Spelman, *ad verbum.*) It is clear, however, that in very early times in this country there was a distinction between those superior judicial officers who, for the sake of eminence, sat upon a bench or tribunal, and the judges of inferior courts, such as hundred courts and courts baron, the latter being analogous to the *judices pedanei* of the Roman law—a kind of inferior judges, whose duties are not very clearly defined, but who are expressly stated to have derived their denomination *a pedibus, quod pede plano judicarent non pro tribunali.* (Calvin's 'Lexicon Juridicum,' *voc.* 'Pedanei.')

In consequence of this distinction, the judges, who were immediately appointed by the crown to administer justice in the superior courts of common law, were in process of time called justices of the bench, or, as they are always styled in records, *justiciarii de banco.* This term, in former times, denoted the judges of a peculiar court held at Westminster, which is mentioned in records of the reign of Richard I., and must therefore have made its appearance, under the name of *bancum* or bench, not long after the Conquest. This court probably derived its name from its stationary character, being permanently held at Westminster, whereas the *curia* or *aula regis* followed the person of the sovereign (Maddox's 'History of the Exchequer,' p. 539), and may have been the origin of the modern Court of Common Pleas, the judges of which court retain the technical title of 'Justices of the Bench at Westminster' to the present day. The formal title of the Queen's Bench judges is "the Justices assigned to hold pleas in the court of the Queen before the Queen herself." For many centuries, however, the judges of both courts have been described in Acts of Parliament and records in general terms as "the judges of either bench" (*judices utriusque banci*); but the barons of the Court of Exchequer have never been denominated judges of the bench, though, in popular language, a new baron, on his creation, is like the other judges, said to be raised to the bench.

The phrase of sitting *in banco*, or in bank, merely denotes the sittings of the court during the law terms, when the judges sit together upon their several benches. In this sense it is used by Glanville, who wrote in the reign of Henry II., and who enumerates certain acts to be done by justices *in banco sedentibus.* Sittings *in banc* after term are held by virtue of statutes authorising the courts to appoint such sittings. *Days in bank*, or *Return days*, are days particularly appointed when parties served with writs are to make their appearance in full court, on the return of the writ in real actions. The day in bank is so called in opposition to the day at *Nisi Prius*, when a trial by a jury takes place according to the provisions of the statute of Nisi Prius. [ASSIZE.]

BANK; BANKER; BANKING. These three subjects are so intimately connected, that it would hardly be possible to give any clear description of them separately. By the term "bank" is understood the establishment for carrying on the business to be described; the "banker" is the person by whom the business is conducted; and the expression "banking" is commonly used to denote the system upon which that business is managed, and the principles by which it should be governed or regulated.

In all populous and civilised communities, and especially in such as are to any great extent commercial, the business of banking is one in the proper understanding and right conducting of which the public generally is, beyond all other businesses, interested. Errors, however grave, committed by those who are engaged in the business of importing and exporting, or in manufacturing and dealing in goods, are for the most part mischievous only to the parties immediately concerned, and to those with whom they may individually hold commercial relations. But errors with regard to the principles or practice which should govern the trade of banking, extend their evil consequences to a far wider field, and in such cases the mischief cannot fail to be felt in some degree by great numbers of the community.

This fact appears so obvious upon the slightest reflection, that it must afford matter for surprise when we consider in how trifling a degree the better informed among the mercantile body, and even the greater part of those who are actually engaged in the business, have attempted to gain any knowledge of the true theory of banking; while the remaining portions of the community, as well those whose station in life renders attention to matters of business unnecessary, as those whose humble rank affords them no opportunity of acquiring a practical knowledge of extensive money transactions, with but very few exceptions appear to have considered the question as one with which they have no concern. It is foreign to our purpose to enter at large upon the discussion of any of the controverted points connected with the theory of banking. In the few remarks of a general nature that may be here offered, our design will principally be to awaken attention to the subject; while by bringing forward some of the more prominent facts and principles connected with it, we may be able to afford that degree of knowledge which will form the best and most practical groundwork for speculative investigations, and at the same time, we trust, prove a preservative against the mischiefs which are likely to result from plausible fallacies.

We propose to consider the subject of banks and banking under the following heads:

I. Brief historical notices of the origin and progress of banking in various countries of Europe and of the British Colonies, with some account of the present state of banking in the United States of North America.

II. An explanation of the objects and general principles of banking.

III. The history and constitution of the Bank of England.

IV. The art of banking, as carried on by private establishments and joint-stock associations in London and other parts of England, and in Ireland.

V. A description of the Scotch system of banking.

I. *Historical Sketch of the Origin and Progress of Banking.*—The vague notices which are found in ancient history, both sacred and profane, connected with dealings in money as a separate business, appear fully to warrant the belief, now generally held by scholars, that banking, in the sense wherein it is now understood, was but little known or practised in very remote periods. In times when nations were chiefly engaged in pastoral or agricultural pursuits, the trade of banking would hardly suggest itself to anybody as a profitable calling; and until, in the progress of a community towards civilisation, the extent of its commercial dealings had become very considerable, none would be led to give their attention to the occupation of facilitating the money operations of the rest of the mercantile community. At first this office would doubtless be undertaken for others by the more considerable traders, and a further period would elapse before it would become a separate business.

It is probable that the necessity for some such arrangement would be first experienced, in consequence of the different weights, and degrees of fineness, of the coined monies and bullion which would pass, in the course of business, between merchants of different nations. The principal occupation of the money changers mentioned by St. Matthew, was doubtless that of purchasing the coins of one country, and paying for them in those of their own, or of any other people, according to the wants and convenience of their customers. It is likewise probable that they exercised other functions proper to the character of bankers, by taking in and lending out money, for which they either allowed or charged interest (Matthew xxv. 27).

There has been supposed to be some allusion to the operations of Oriental banking in the parable of the slothful servant: "Thou oughtest to have put my money to the exchangers, and then at my coming I should have received my own with usury." The banking of those days probably consisted chiefly in exchanging small coins for large ones, and the money of one country or district for that of another, charging a small commission for the accommodation. But all this is very obscure; and we cannot be said to know anything very certainly upon the question of what was the nature of the money dealings among the ancient Jews.

Greek Banking.—The information which is extant upon the subject of money dealing in ancient Athens may be summed up as follows: A class of persons,—called τραπεζῖται, from the stands or tables (τράπεζαι) at which they attended to do business in the market-place of the city,—were chiefly occupied in changing money, at an Agio—[Agio]: but yet a considerable part of their business consisted in taking money on deposit, allowing interest on it, and of course lending it again, or employing it in some other manner, at higher interest. They sometimes also lent out money of their own on deposits of goods. On the whole they seem to have been a thriving class, and even to have had a system of correspondents and business connections in the chief cities of Greece, and generally to have been held in high estimation. We read of one Pasion, a manumitted slave (afterwards presented with the freedom of the city by the Athenian people), having attained wealth as an Athenian banker: he is stated to have owned land to the value of 20 talents, and besides to have had money at use to the amount of 50 talents, out of which, 11 talents were deposits of his banking customers; or in other words (taking the talent at equal to 250*l.* sterling), his landed property was worth 5000*l.*, the money he had out on interest was 12,500*l.*, and the part of that which came to him from his banking business was 2750*l.* He appears also to have carried on a manufactory of shields or targets, and on one occasion presented the republic with 1000 bucklers and five triremes fully equipped. His name was celebrated; he was a man of unquestioned integrity, and his friendships and connections were extended through the whole of Greece. He is very frequently spoken of by Demosthenes and the contemporary orators ('Oratores Attici,' 1127, 1132, 1224). We find mention also of other eminent bankers. The rate of interest they exacted appears to modern political economy quite enormous: 36 per cent. is stated to have been no unusual amount.

The only trace we believe of an ancient Greek bank of a *public* character occurs at Byzantium, where the republic (at a time of great financial pressure) amongst other devices adopted for the purpose of raising money, established a monopoly of money-changing at a single bank or table, and then let it out to hire (Aristot. 'Œconom.' lib. ii.. p. 502. edit. Paris, 1619). It will be observed that the vast variety of the coins used in the different Greek states necessarily rendered the business of money changer, notes and paper money being unknown and forming no part of the circulation, one of great importance as well as profit.

Roman Banking.—The money dealers at ancient Rome seem to have been divided into two classes: one called *argentarii* (the currency being silver), or *argenteæ mensæ exercitores:* or *argenti distractores:* or *negotiatores stipis argentariæ:* the other class was called *mensarii*, or *mensularii*, or *nummularii*. 1, the argentarii were private money dealers who, in numbers fixed by law, carried on their business consisting chiefly in changing coins, in shops or stalls round the Forum, which appear to have been under the control of the censors, and sold by them in the nature of a monopoly. The earliest mention of this trade occurs, B.C. 350; but it probably must be dated much earlier (Liv. 'Hist.' vii. 21; xl. 51). From certain passages in Cicero's 'Letters,' it has been concluded that the Romans of his times were in fact acquainted with the bill of exchange as a medium for the transmission of money, and the settlement of accounts; and it is said that the argentarii for this purpose were in the habit of receiving money in Rome, and by drawing a bill upon a correspondent in Athens (ex. gra.) to be able thus to transmit without the passing of coin, and with all the ease of modern mercantile and banking transactions. But this, we must own, appears to us to be no more than a fanciful conjecture: the reader must judge for himself by a comparison of the following passages from which this startling inference has been drawn. (Cic. ad Att. xii. 24, 27; xv. 15; v. 15; xi. 1, 24. Cic. 'ad Famil.' ii. 17; iii. 5. Cic. ad 'Quint. Fra. Q.' i. 3. Cic. pro Rabir. 14.) It is more certain that they received deposits, out of which they made the depositor's payments for him; and in that case paid him no interest on the deposit. When a payment was to be made, the depositor either desired the *argentarius* by word of mouth, or in writing, to make it; or money was lodged with the argentarius on the footing of his paying interest for the use of it. In this case it was called *creditum*, in the former *depositum;* the written order to pay, or cheque (as it may perhaps be considered equivalent to) was *perscriptio*. We are told also, that if the person in whose favour the order was made dealt with the same banker, the payment was made by a transfer in the banker's book, called *perscribere*, or merely *scribere*. The *argentarii* also would make payments for persons who had not deposited money previously with them; and on such advances they also made large profits. The books of these people seem to have been kept with great accuracy, and to have been looked upon in the courts of justice as most credible sources of evidence; and the imperial law enforced their production in evidence in the courts when necessary. They also not uncommonly joined with their proper business, that of acting as agents or brokers at sales and auctions. In the times of the later emperors, this body was under the superintendence of the *præfectus urbi*. Several of the ancient writers speak of the occupation of *argentarius* as respectable and even honourable. (Cic. pro Cæcin. 4; Aurel. Vict. 72, &c.) Suetonius commemorates the fact, that the grandfather of the Emperor Vespasian was a *coactor*, or collecting clerk at a banker's; and that his father followed the business of money lending with the troops stationed among the Helvetii; the biographer's general object manifestly not being to cast any imputation on the emperor's ancestry. However, the *argentarii* in Latin comedy, seem to have been always treated as contemptible; but perhaps this is no more than what may be said of the stage soldier, who is always made to be a boaster, and stage father, who is conventionally a tyrant and close-fist.

2. The *mensarii* were distinguished from the *argentarii*, in being appointed by the state; like them, they had their banks or tables

round the Forum; and their business was to lend the money of the state to persons who could give security. The system arose out of circumstances of urgent pecuniary and political pressure. The plebeians, about B.C. 352, were desperately indebted: it was customary for them to borrow from one person in order to pay off a debt to some other person, and so on, and it was to meet this state of things that *quinqueviri mensarii* were appointed with power to make loans on cattle or land; and state officers of this description, triumviri mensarii, continued to be appointed from time to time and for a limited period, in seasons of monetary distress all through the republican period. The *mensularii*, or *nummularii* were a permanent body also appointed by the government, and more properly approached to modern notions of what bankers are, or ought to be; both the treasury of the government and individuals appear to have deposited money with them, on which they paid and received interest. They were also engaged like the *argentarii* in changing coins for a commission, and further, in examining and deciding upon the intrinsic fineness and genuineness of all coin submitted to them. Under the empire they formed a distinct corporation, and, like the argentarii, were subject to the *præfectus urbi.* There is a curious account of a collapse of credit at imperial Rome, and of the measures taken by the government for the resuscitation of confidence, in Tacit. 'Annal.,' vi. 17.

Mensarii are also mentioned as being appointed by the people in the city of Temnos, in Asia Minor, (Cic. 'pro Flac. 19.'

During the middle ages, in which commerce was but little developed, there could be no field open for banking business; but on the revival of commerce in the 12th century, and when the cities of Italy engrossed nearly all the trade of Europe, the necessity again arose for the employment of bankers. These at first carried on their business in the public market-places, or exchanges, where their dealings were conducted on benches, whence the origin of the word bank, from *banco*, the Italian word for a bench. The successful manufacturing efforts of the Florentines brought them into commercial dealings with different countries in Europe, and thence arose the establishment of banks. In a short time Florence became the centre of the money transactions of every commercial country in Europe, and her merchants and bankers accumulated great wealth.

The banks here mentioned were private establishments. The earliest public bank established in modern Europe was that of Venice, which was founded in 1157. Its origin was briefly this: Between 1156 and 1171, on the occasion of great impending danger from a war with the Greek empire, at the head of which was Manuel Comnenus, money being greatly wanted by the republic to meet the exigencies of the crisis, forced loans were levied on the most wealthy citizens, and the Chamber of Loans (la Camera degl' imprestiti) was established, to which the contributors were made creditors at an annual interest of four per cent.: a rate far below the standard of the age. These creditors, in process of time, were incorporated into a company for the management of their joint concerns, and thus formed the basis upon which was afterwards erected the bank of Venice. This method, by which the above-named loan was acknowledged, is believed to be the earliest instance on record of the funding system, and the first example, in any country, of a permanent national debt. The bank was therefore an incorporation of public creditors, to whom privileges were given by the state as some compensation for the withholding of their funds. The public debt was made transferable in the books of the bank, in the same manner as the national debt of England is transferable at the present time; it was made obligatory upon the merchants to make their contracts and draw their bills in bank-money, and not in the current money of the city. [For an explanation of this difference, see AGIO.] The effect of this regulation was, that all payments of that nature were made by a transfer from one name to another in the bank-accounts, of the funds deposited in its coffers. This establishment, which was always essentially a bank of deposit and not of issue—the difference between which functions will be described further on—existed for more than six centuries, or until the subversion of the republic in 1797. Its money at all times bore a premium, or *agio*, over the current money of the city.

About the year 1350, the cloth-merchants of Barcelona, then a wealthy body, added the business of banking to their other commercial pursuits; being authorised so to do by an ordinance of the king of Aragon, which contained the important stipulation, that they should be restricted from acting as bankers until they should have given sufficient security for the liquidation of their engagements. In 1401, a bank was opened by the functionaries of the city, who declared their public funds answerable for the safety of money lodged in their bank, which was a bank of deposit and circulation, the first of the kind established in Europe.

The Bank of Genoa was planned and partially organised in 1345; but was not fully established and brought into action until 1407, when the numerous loans which the republic had contracted with its citizens were consolidated, and formed the nominal capital stock of the bank. This bank received the name of the Chamber of St. George, and its management was intrusted to eight directors, chosen by the proprietors of the stock. As a security for its capital in the hands of the republic, the bank received in pledge the island of Corsica, and several other possessions and dependencies of Genoa. The Bank of St. George was pillaged by the Austrians in 1746; and in 1800, when the French were besieged in Genoa, they appropriated the treasure of the bank to the payment of their troops. Since that time the prosperity of the establishment has been at an end; it is no longer used as a place of deposit for money, and its shareholders are but ill-repaid, by the assignment of a portion of the revenues of the town, for the robberies committed upon them.

The banks of note next established, of which we possess any account, were opened in Holland and in Hamburg in the early part of the 17th century. The most celebrated of these was the Bank of Amsterdam, established in 1609, simply as a bank of deposit, to remedy the inconvenience arising from the great quantity of clipt and worn foreign coin which the extensive trade of the city brought there from all parts of Europe. This bank, which was established under the guarantee of the city, received foreign coin, and the worn coin of the country, at its real intrinsic value, deducting only a small per centage which was necessary for defraying the expense of coinage, and the charges of management. The credit given in the bank books for coin thus received, was called bank-money, to distinguish it from the current money of the place. The regulations of the country directed that all bills drawn upon or negotiated at Amsterdam, of the value of 600 guilders (about 55*l.*) and upwards, must be paid in bank-money. Every merchant was consequently obliged to keep an account with the bank, in order to make his ordinary payments.

The Bank of Amsterdam professed to lend out no part of its deposits, and to possess coin or bullion to the full value of the credits given in its books. The necessary expenses and profits of the establishment were provided for by means of certain fees, payable by the merchants upon opening accounts, and upon making transfers, and from small fines for irregularities. In 1672, the French armies advanced to Utrecht, and a panic at Amsterdam took place; the depositors in great numbers demanded their money, when it was repaid with such ease, that every one was satisfied as to the solvency of the establishment.

In 1775, the treasure in its keeping was estimated to have been 33 millions of florins. In December, 1790, they declared that they should retain ten per cent. of all deposits, and would return none of less amount than 2500 florins. In 1794, on the invasion of the French, the bank was obliged to declare themselves to have lent to the states of Holland and West Friesland, and the West India Company, more than 10,500,000 florins. Bank money, which previously bore an agio of 5 per cent., fell immediately to 16 per cent. below the current money. Thus fell an institution which had obtained, and it was of course thought had deserved, boundless credit.

The Bank of Hamburg was established in 1619, on the model of that of Amsterdam originally. It is purely a deposit bank, for the transfer of sums from the account of one to the account of another of those who deal with it. No deposits, however, are received in coin, but only in bullion. Down to 1845, the bank charged four-ninths, or nearly one-half per cent., for the care and custody of the deposits; but since that date, its charge is one mille for expenses. It advances money on jewels, up to three-fourths of their value. The city is responsible for all deposits, which may be sold by auction if they remain one year and six months without any interest paid; if the value be not claimed within three years, the property in the deposits is lost, and passes to the poor of the city.

Next in point of date among these establishments we find the Bank of England, which was opened in 1694. As we propose to devote a separate section to the description of the principles and practice of this bank, we shall not further notice it in this place.

The Bank of Vienna, established in 1703 as a bank of deposit and circulation, subsequently (1793) became a bank of issue. This institution has now in a great measure lost its commercial character, and has become an engine of the government for managing the public debt and finances.

The notes of the Bank of Vienna, which had become the sole circulating medium in Austria, having fallen to a considerable discount by reason of their excessive quantity, a new bank, called the Austrian National Bank, was established in 1816, with the two-fold object of diminishing the paper currency, and of performing the ordinary banking functions.

The Banks of Berlin and Breslau were erected in 1765, under the sanction of the state. These are banks of deposit and issue, and likewise discount bills of exchange.

During the reign of the Empress Catherine, three different banks were established at St. Petersburg; these were, the Loan Bank, the Assignation Bank, and the Loan Bank for the nobility and towns. The first, which was established in 1772, makes advances upon deposits of bullion and jewels, and allows interest upon all sums deposited for at least a year. The operations of this bank, as a Monte de Piété, are carried on for the profit of the Foundling Hospital in St. Petersburg. The Assignation Bank, opened in St. Petersburg in 1768, and in Moscow in 1770, issues the government paper-money, and is in all respects an imperial establishment. The Loan Bank for the nobility and towns advances money on real security. It is likewise a discount-bank, and acts as an insurance company. The Aid Bank, established in 1797, advances money to relieve estates from mortgages, and to provide for their improvement. The punctual payment of interest upon its advances is enforced by taking their estates from the possession of defaulters until the debt is discharged.

The Commercial Bank of Russia, which was established in 1818, receives deposits of coin and bullion, and has a department for transferring credits from one account to another, in the manner of the banks of Amsterdam and Hamburg. It is also a bank of discount, and makes advances upon merchandise of home production. Its capital, about a million and a half sterling, is declared to be sacred on the part of the Russian government, and free from all taxation, sequestration, or attachment, as well as from calls for assistance on the part of the State. This bank has branches at Moscow, Archangel, and other important commercial towns in the empire.

The Bank of Stockholm, in its present shape, was founded about the year 1688, when its direction was assumed by the Assembly of the States of the kingdom of Sweden, and under their regulations the bank became a bank of deposit, discount, and circulation, the king declaring himself and his successors protectors of the bank, but renouncing all interference in the disposal of the money. Depositors were allowed interest at the rate of 6 per cent.: the deposits, together with notes of circulation, were appropriated to discounts on collateral securities at 8 per cent. The king's revenues were deposited free of interest. The institution obtaining much business, the interest on deposits was gradually reduced, until, by the year 1700, it had reached 2 per cent., whilst the discounts had fallen to 3 per cent. The wars of Charles XII. operated as a drain upon the resources of the bank, and its credit fell, and the king was obliged to make a declaration that no further demands should be made upon it by him until its credit was fully re-established. This effect was shortly afterwards produced, it is said, in consequence of this declaration and the king's adherence to the spirit of it; and the bank was divided into two departments—the Loan and Exchange Banks: the first being in fact an establishment for lending money on certain goods and produce, its own stock, lands, &c.; the other a bank of deposit, discount, and circulation on money deposited. The bank allows 2 per cent. interest; it issues notes and discounts bills of exchange. In 1766 the affairs of the bank fell to a very low state; when it was assisted by the States with a loan of three millions of rix dollars, to pay off the excess of its notes in circulation. Since that period a committee, composed of members of each of the three States—nobles, clergy, and burghers—is appointed triennially to inspect its affairs.

The Bank of France, originally founded in 1800, was placed upon a more solid basis in 1806, when its capital was raised to 90 millions of francs, divided into 90,000 shares or actions, of 1000 francs each. Of these, 67,900 are held by individuals—the remaining 22,100 having been as it were bought in by the bank itself out of surplus profits; and having been cancelled. Down to 1848 therefore its capital amounted to 67,900,000 francs, or 2,716,000*l.*, with a reserve fund of 12,980,750 francs. The bank is now the only authorised source of paper money in France. Its charter and exclusive privileges have been conferred, varied, or continued, by different governments, and under various laws; at present, 1897 is the term fixed at which the terms made with the bank by the public may be put an end to. The bank has branches scattered through the departments. The revolution of 1848 was a period of great crisis to the bank; it had made advances to the provisional government and the municipality of Paris; there was an increasing want of confidence in the existing order of things; and the whole issued in a drain upon the bank for gold, which arrived at such a height that the government at length felt it to be necessary to interfere; and by a decree of March 16, 1848, they authorised the bank to suspend payment in cash, the notes being made a legal tender, and the maximum amount of issues being fixed at 350 millions. This measure also included an authorisation to issue notes of 100 francs and 200 francs each, instead of being restricted to notes for 500 francs, as was the previous rule. But this was not all: for banks having been established in Lyon, Marseille, and other great towns, upon the model of the Bank of France, it was determined that these should become absorbed or incorporated into the Bank of France, and by decrees of the same year, the shareholders in nine banks of this description were permitted to receive, for every 1000 francs of nominal value of their shares, a share of 1000 francs nominal value in the stock of the Bank of France. This raised the capital to 91,250,000 francs, divided into 91,250 shares. In 1851 the bank resumed, and has since maintained, cash payments. The effect of the above-mentioned absorption was to suppress the local circulation of the departments in which the issues of these nine provincial banks were current; and their place has been supplied in some measure by the establishment of branches of the Bank of France. The war with Russia, the drain of silver for the East that has been felt generally in Europe for some years past, and the rage for speculation which to some extent has appeared in France of late years, exposed the bank to considerable difficulties. A law of 9th June, 1857, doubles the capital of the bank, with a view of increasing the strength of its position; that capital now consists of 182,500 shares of 1000 francs each. Till the above date the bank was prohibited from raising the rate of interest, either on loans or discount, above 6 per cent. The consequence was, that for three or four years before the change, all the gold they purchased, being worth more in another market, they were unable to keep up a proper stock of bullion; but now the charge may be whatever the bank deems expedient, except the advances to the government, the interest on which is limited to 3 per cent. as a *maximum*, and in September, October, and November 1857, its rates of discount were to the public generally 8, 9, 10 per cent. respectively. The bank is further authorised to issue notes as low as 50 francs each, and to make advances on railway shares, &c. It is obliged to open an account current with any one who desires. On these accounts no commission is charged; and the chief part of the profits are probably derived from the discount of bills of exchange, which is done on all bills not having more than ninety days or three months to run, and provided they bear three signatures. In 1855 the total amount discounted was 3262 million francs. Besides discounting, the Bank of France advances upon deposits of stock and pledges of a miscellaneous kind. It also undertakes the safe custody of valuables—as plate, jewels, title deeds, &c., charging ⅛ per cent. on the value for every period of six months, and under that, during which the goods, &c., are kept by them. A council of twenty-one members conducts the direction of affairs; namely, a governor and two sub-governors, who are to be nominees of the Emperor; fifteen directors, and three censors, nominated by the shareholders. There is a large surplus capital or rest. The shareholders received a bonus of 200 francs and 272 francs respectively, in each of the years 1855, 1856.

Total circulation of notes from 1848 to 1856 inclusive:—

1848	409,120,000 francs.
1849	431,022,000 "
1850	481,552,000 "
1851	583,040,000 "
1852	689,910,000 "
1853	644,280,000 "
1854	636,970,000 "
1855	612,237,000 "
1856	612,332,000 "

The management of this bank is generally allowed to be admirable; the only objection made is on the score of the too intimate connection with the government. Their management is said to be especially good with respect to the payment of dividends on the government stocks: from seven to ten days is the whole time which they occupy in preparing for the payment of the dividends on each of the quarterly payments. The Bank of England requires a month for this purpose previous to each quarterly dividend day. The contrast is very striking, though of course, the quantity of business to be done in the two cases is enormously different. The Bank of France publishes a monthly debtor and creditor account of its affairs in 'The Moniteur.'

Banks of the United States of North America.—The people of the United States have heretofore suffered largely by the failure of their banking establishments throughout the country; this may be the better imagined when we state that in 1837, as is alleged to be the belief of the best informed authorities, every bank in the Union, without an exception, stopped payment. In 1839-40, another crash occurred, continuing until 1842, when it was supposed about 180 banks fell, including the Bank of the United States. With the view of preventing the evils arising from these disastrous results (which were much aggravated in intensity by reason of the small note circulation, which many of the banks issued largely in nearly all the States), but with least incomplete success in New York, efforts have not been wanting on the part of the government, and measures have passed into law, having this purpose in view. In the state of New York, the banks are said to have been divided into two classes—the incorporated and the free banks; the former, which are incorporated by statute, and whose charters have not yet expired, are obliged to contribute one-half per cent. per annum upon their capital to a security fund, which is applied to the payment of the notes of such of these banks as fail; but this plan (it is said) is now rarely acted upon. Under the free banking system, every one may become a banker who will deposit government securities for the payment of the notes he issues; the lowest sum allowed as such deposit by way of commencement being 100,000 dollars; and on the deposit of securities to this amount, he may issue notes to the same value. It is a matter of complaint with the government of the United States, that many of the State governments should have taken up the policy of encouraging the issue of small notes by sanctioning the establishment of the banks of the class we have just described with deposits of mortgages, stocks, &c., on which the notes issue, and it is observed by the Treasury Department, that though these as an ultimate security, may be of some avail to the broker who buys them at a discount, and can afford to hold them for months or years until they resume their value in the market, yet the labouring man who has these State security bank notes in his possession when they stop payment, is apt to find that the ultimate security for the redemption of the promises to pay on demand "does not prevent his losing 25 cents, 50 cents, or even 75 cents in the dollar." In the State of New York, in 1856, the securities held by the Government Superintendent of Banking amounted to a value of 39,359,071 dollars. In that year the securities for six banks of the State of New York, which had stopped in 1855 were realised; but the produce in no case sufficed to pay the notes in full, whilst a period of from two to four years would have to elapse before the affairs of these banks could be finally wound up and settled.

In 1857, *all* the banks in the Union again stopped payment. In New York State the discounts of the banks had risen to 122,077,252 dollars, against deposits to 94,436,417 dollars in their possession. This maximum of both was reached on the 8th of August. On the 24th, the Ohio Life and Trust Company, great bankers in the city of New York, stopped payment, and so caused much distrust to spread abroad; the failure of other banks followed, increasing the panic till it rose to a run upon the banks; not so much, however, to get cash for the notes as for the deposits. To meet this state of things, the banks so reduced their discounts and advances, that on the 17th of October, they had fallen to 97,245,826 dollars, the sudden contraction of accommodation causing the fall of many merchants who had depended on the banks for supplies of money upon discounts, &c. The drain of deposits however still proceeded. The deposits on that day were only 52,894,623 dollars, a decrease of 41,546,784 dollars in nine weeks. The banks are said to have been guilty of improvidence in advances, partly in the injudicious manner in which they had allowed too high a rate of interest upon sums deposited on current accounts or at call, which is said to have caused the bankers in the Western States and others to keep large balances at New York. The effect of this was to tempt, and indeed force, the New York bankers to make advances on questionable security, in order to make a profit on the large sums lodged with them. A tendency to panics is said to be a feature of the American system of banking, and one reason assigned is the small quantity of coin with which American bankers in general carry on their business. This does not relate to the banks of the city of New York, where the action of the foreign exchanges compels them to keep up a stock of specie. In 1857, the 56 banks of that city had 8 million of dollars of notes in circulation, and 12 million dollars of cash in their coffers; but the 255 country banks of that State are returned as having 24 million dollars of notes in circulation, and 1,200,000 dollars only in specie. In 1856, in Massachusetts there were no fewer than 135 banks (exclusive of Boston), with 6,601,130 dollars deposits; circulation 13,106,068 dollars; specie in tills only 1,092,463 dollars. In Illinois, in 1857, the State Bank had out notes to 725,000 dollars, and 61,000 dollars in the till. The Graville Bank was circulating notes to the value of 471,556 dollars, and had 18,951 dollars in coin to support that immense currency upon. Other banks of that State had considerable circulations abroad, *with nothing* but their credit to rest on. In fact, the present American system is condemned by the voice of their own general government; the President having observed, in his Message to Congress of December, 1857, that the obligation of the banks holding an amount of United States, or State securities, equal to their circulation, furnishes no adequate security: "However valuable these securities may be in themselves, they cannot be converted into gold and silver at the moment of pressure, as our experience teaches, in sufficient time to prevent bank suspensions, and the depreciation of bank notes." It has been suggested that the returns made to the American government by the banks are not always deserving of full credit, a suggestion of great importance to be borne in mind by capitalists in this country, where American securities were supposed at this time to be held to 80,000,000*l.* value. We will conclude this part of the subject by the mention of a feature in the American crisis of 1857, which appears to possess much significance. In the State of New York all the banks, with the exception of the old incorporated banks already mentioned, are obliged to deposit State stock against every promissory note which they issue, and any bank which wishes to increase its issue, must, before it can do so, lodge with the Superintendent of the Banking Department an additional amount of State stock to the value of the contemplated issue. Accounts of all the transactions of these banks are published weekly by the Banking Department of the State, from returns made by the banks; within the two or three years previous to the crisis, the amount of subscriptions to the banks, and also the amount of deposits, had greatly increased, indicating increasing confidence in the stability of these establishments. But what showed in a still more remarkable manner the confidence was this, after the suspension of the banks, there having been a partial run for gold for their notes before the suspension, the notes continued to be taken and received, and to pass from hand to hand in the business of life, at little or no discount; though a person having a bank note which he wished to get gold in exchange for, could only obtain it upon a payment of one per cent. for the accommodation, which, of course, was given him by private individuals and not by the bank, and which per centage, therefore seems to mark the lowest degree in which the notes were depreciated. It should be mentioned also, that by a provision in the law of that State, the noteholder of a bank has a prior claim on the assets above all other creditors whatever, independently of the government securities deposited. The same thing took place, it appears, in most of the other States of the Union: after the suspension of cash payments by banks, the notes still continued in circulation, passing freely at little or no discount when they were notes issued on the deposit of an equal amount of State securities or of bullion. These banks are called Subscription Banks, from the mode in which they usually originate. The promoters of a scheme for a bank, put out a list of supporters, with the amount of capital intended to be raised. The list is exposed in the Stock Exchanges, and is filled up with the names of persons willing to take shares, until the full amount is subscribed. It is understood that in all cases the liability of the shareholders is limited to the extent (it seems) of the subscriptions or shares of each. The management is in the general form of a chairman, a cashier or secretary, and twelve directors. The number of shareholders is unlimited, and before they can commence business, all the shares must be paid up in full. In New York the usury laws prevent a higher rate of interest than 7 per cent. In other States there are also usury laws, under which various rates are enforced. (See 'Report of Committee of House of Commons on Bank Acts, &c.' 1858.) The history of the crisis seems to be deserving of study; it presents curious phenomena, both with respect to the confidence displayed by the noteholders, and still more by the depositors; in some instances, depositors were known to have returned the day after the suspension, and replaced their deposits in the very banks from which a day or two before they had withdrawn them; and in general, the banks of America, notwithstanding their frequent insolvencies, hold large amounts of deposits.

Banks of India.—Banking, as conducted by natives in the interior of India, is chiefly confined to the issuing and discounting of bills of exchange. These native bankers are called Shroffs, and the bills in which they deal are called Hoondees. They do not issue promissory notes payable to bearer. There is a very considerable circulation of hoondees, the interior inland business being principally conducted by their means. The great banking-houses at Benares have branches of their establishments in almost all the principal cities of Hindostan; by their means remittances from one part of the country to another are greatly facilitated. Europeans have not yet undertaken this branch of business, except at Calcutta and Madras. An attempt was made some years ago, by an English house in Calcutta, to establish a bank at Bhauleah, but without success.

There were at one time four private banks in Calcutta managed by Europeans; but two of them have ceased to operate. Only one of these banks issues notes: its circulation was at one time between 40,000*l.* and 50,000*l.*, but its issues have lately been much contracted.

A government bank, under the title of the Bank of Bengal, was opened in 1809. Its capital is 500,000*l.*, one-fifth of which was subscribed by the East India Company. This bank is said to have proved a great convenience to the community and the Bengal government, especially in Calcutta, where its notes chiefly circulate. This establishment receives deposits, discounts bills, and effects remittances to and from country districts, as well as issues its own notes: the amount of its paper in circulation is about 800,000*l.*, in notes varying in amount from ten rupees to 20,000 (1*l.* to 2000*l.*); the largest part is in notes of 100 rupees and upwards. In 1823 the bank obtained a new charter for five years, but exists now under the sufferance of the government. The management is vested in nine directors, three of whom are nominated by the Indian government. The president is chosen from among their own body by the directors. Natives are eligible to become directors, none of whom are paid for their services. A statement of its affairs is submitted twice in each year to the proprietors, and sent to the government. This bank has at times lost considerably through having advanced money on forged documents to natives, who are great adepts at this kind of dishonesty. Although thus closely connected with the government, the bank does not transact its money business. The government keeps its own treasury quite distinct, but frequently holds a considerable sum in the notes of the bank. The average dividend made to the proprietors has been from nine to ten per cent.: the stock bears a high premium.

There is a bank at Madras which is altogether a government concern. It receives deposits, discounts bills, and issues notes which have no circulation beyond the limits of the city of Madras. It yields an annual profit of about 10,000*l.* to the East India Company.

The Bank of Bombay divided, for the half-year ending 31st Dec., 1858, of rupees forty-five per share, being at the rate of nine per cent. per annum on the capital stock of the bank.

Colonial Banks.—In several (not all) of the British colonies the banks pay interest on the deposits made by their customers. The practice has been discontinued in New South Wales, as far as accounts current are concerned; it has never been in operation in Tasmania, and has not yet (1859) been carried into effect in South Australia.

The Bank of Australia was established in 1835. Since 1841, the capital (which was enlarged in that year) has been 900,000*l.*, on which the dividend of 20*l.* per cent. per annum is now paid.

The Bank of New South Wales paid, for the half year ending 30th Sept., 1858, at the rate of 20*l.* per cent. per annum: this was the sixteenth half-yearly meeting of the company.

The Colonial Bank (established twenty-two years) divided last year at the rate of eight per cent. per annum, on a paid-up capital of 500,000*l.*

The Union Bank of Australia, for the year ending 31st Dec., 1858, divided at the rate of ten per cent. per annum on a paid-up capital of 920,000*l.*

Most of these, as well as various other banks whose business lies chiefly in the colonies, are managed by boards of directors sitting in London. For particulars respecting the law as relates to them, see Grant's 'Law of Bankers.'

II. *Objects and General Principles of Banking.*—From what we have already stated, it will be seen that banking establishments are undertaken with very different objects, and are prosecuted by very different methods. The whole may be divided into three classes, namely, banks of deposit, banks of issue, and banks which exercise both these functions.

Banks of deposit, strictly speaking, are those which, like the old Bank of Amsterdam, simply receive the money or valuables of others into custody, and keep them hoarded in their coffers till called for by the depositors. However convenient such an establishment may be to the persons by whom it is used, it must be evident that it can contribute nothing to the general wealth of a community, and that the only means of profit which it provides for those who conduct it, must arise from payments made by its customers in the shape of commissions, or fines which partake of the nature of commissions. If, instead of burying the clipped and worn coins of which its hoards were composed, the Bank of Amsterdam had converted them into money of the proper standard, and had lent the same at interest upon proper securities, no commissions need have been required from its customers, who would in so far have been benefited; and a considerable capital being set free for the prosecution of commercial enterprises, the country might have thence derived continued additions to its wealth.

Banks of deposit, in this confined sense of the word, are now very little used; and the term is generally understood to mean an establishment which *lends* as well as *takes* the property of others, and derives its profits from charging a higher rate of interest than it allows. Some banks of this description, such as most of the private banks in London, do not allow any interest upon sums placed in their custody.

In like manner there are few, if any, establishments which are purely banks of issue. A banker sends forth his promissory notes, after incurring the necessary expenses, that he may employ to his own profit, during the time that the notes remain in circulation, the money or property for which he may have exchanged them, and by this course he gives to his establishment the mixed character of a bank of issue and of circulation. The expression, bank of circulation, is frequently understood to signify a concern which issues its own notes, but it seems better, for the sake of perspicuity, to draw the distinction here made. In general, those bankers who issue their own notes and circulate the money of others, which by that means comes into their possession, likewise receive deposits: this at least is the practice in this kingdom. In each of the cases described, with the exception of the first, the practice of which has become nearly obsolete, the object of the banker is to raise a borrowed capital, which he holds at call, and with which he supplies the wants of others who are willing to pay for its use.

Persons who follow this line of business, and more especially associations formed for the same purpose, usually possess considerable wealth, and are thought deserving of confidence on the part of the public; and there can be no doubt, that so long as they conduct their business with integrity and prudence, they are of material service in giving life and activity to commercial dealings. They are, in fact, the means of keeping that portion of the uninvested moneys of a country fully and constantly employed, which but for their agency would frequently lie dormant and unproductive for uncertain periods in the hands of individuals.

The relation of a banker to his customer is that of debtor and creditor: the customer's account consists in ordinary cases of money which he lends to the banker upon call, that is, demandable at any time, in whole or in part, by means of a cheque drawn by the customer and payable by the banker, at sight, whenever it is presented to him within the banking hours of his establishment. It is extremely important to bear in mind that in all cases of ordinary banking, where the customer has an account current with the banking house, the obligation under which the banker lies is to pay his customer's cheques at all times within his usual banking hours, to the full extent of the amount of the customer's credit account at the time that each cheque is presented for payment. For the more fully effecting this object, the law looks upon the banker as bound to know what is his customer's hand-writing, and what writing is not his: so that if the banker should negligently cash a cheque purporting to be signed by a customer, the customer's signature being in fact forged, the banker must bear the loss, and not the customer. Also, if the banker should negligently refuse to pay a customer's cheque, thinking that the customer had at the time of presentation no funds in his (the banker's) hands, and it turns out that the customer in truth had funds at the time in the banker's hands to the amount of the cheque, the banker is liable to an action at the suit of the customer, although the latter may not be able to show that he has suffered any real loss from the refusal to cash his cheque. Such cases depend on the leading rule which governs the settlement of most of the questions that arise between bankers and their customers, and which is simply this: When a loss arises, and it is found that one of two innocent parties must suffer the loss, it is to fall upon that one of the two whose conduct led the way and opened the door to the fraud which caused the loss to be effectuated.

A banker's business consists in borrowing the money of some in order to lend to others. In banking conducted on pure principles, the banker's capital is not used for the purpose of profit in the same way in which he uses a part of the moneys that his customers deposit with him; his capital ought to be invested in government securities, yielding him 3 per cent. per annum interest, which securities he can readily convert into money in case of an unexpected demand upon him by his customers, for the return of the sums they have left in his keeping. Their deposits, for the larger part, he employs in such a manner as to derive interest from the loan of them to persons who are willing to pay for the use of the money thus advanced to them. The mode of doing this is usually by the discount of bills of exchange, not having long periods to run, and the amount of which the banker receives from the acceptor of each bill when it has arrived at maturity. The rest of the deposits made by his customers in ordinary times, to the extent of one-third or one-fourth of the whole sum deposited by all his customers, he keeps in cash in his till, to meet the daily claims made upon him by his customers by cheques. This, in ordinary times, is found to be sufficient, because in such times the payments out and the receipts are found nearly to balance every day.

A banking business consists therefore in dealing in money and credits, and in order that his credit may never for an instant become impaired, he will always have a sufficient capital as a reserve, which, being invested as above-mentioned, he can always be able to realise at a short notice, when a season of pressure or mercantile crisis renders it apparent, that demands are coming upon him more rapidly than he shall be able to meet, by withdrawing the moneys of his customers that he is making use of, and profit by, in the way of loans. The influence upon the public as affecting their opinion of the stability of the bank, arising from their having a superabundant capital, is immense. The best and safest mode of employing the funds deposited with the banker is considered to be, by the highest authorities on this subject, the discount of good mercantile bills of exchange, that is, bills which represent *bonâ fide* transactions of trade and commerce. Advances are also sometimes made by bankers on the deposit of Exchequer bills, or other government securities, or railway debentures, and sometimes on goods, produce, or dock warrants; but these last three descriptions of securities are not considered to be of the most eligible class, because they are attended with more risk, trouble, and delay in converting them into money. Mortgages on land are, for similar reasons, also regarded as securities which it is unwise in a banker to invest his customer's money largely in; but it is not meant to lay this down as an invariable rule. In a large business, where experience shows that, in ordinary times, but a small proportion of the whole amounts deposited is necessary to be retained in the shape of cash in the till—that is, Bank of England notes, gold, silver and copper coins—to meet the average daily outgoings, it may not be altogether objectionable that investments, to some extent, should be made in mortgages on land: the extent to which this should be done being matter for the discretion and judgment of the banker, founded upon his knowledge of the character of the borrower, the value of the land, whether it is already under mortgage to any extent, and other considerations, of various kinds, depending on the nature of each transaction.

The qualities, therefore, which are required to be possessed by every banker, are prudence, caution, vigilance, assiduity, together with knowledge of the character and dealings, and the particular descriptions of business, of the persons to whom he advances loans. Besides this, dealing in credits as he does, the most scrupulous integrity and fairness is exacted from him by the law. "It appears to be assumed, that a failure of a banker *is by itself* evidence that he has been acting dishonestly. The customers of a banker have a right to look to him for the exercise of cautiousness and circumspection, for undeviating adherence to the purest good faith and strictest integrity, in the use of their money which they have lent him as a banker; they have a right to expect that he will confine his trade to its legitimate field, namely, of discounting bills, and of purchasing, or advancing money upon, proper securities." (Grant's 'Law relating to Bankers and Banking,' pp. 315, 316.)

Hence all engaging in pursuits of a speculative character, such as mining, is invariably declined by prudent bankers. A very large proportion of the failures that have taken place in banking concerns, are traceable to errors of this description. Banks, in the commencement perfectly sound, have often sunk from the results of having been led on in such business as the following:—A customer manufacturing largely applies for an advance, offering a mortgage of landed property on advantageous terms as security; the advance is made, but after a time the customer returns representing that he has made bad debts which cannot at present be realised, and that he is in want of cash to carry on his concerns, and that if he is not accommodated the result will be that he must stop, in which case, in the present posture of affairs, the banker will in all probability be a loser. The banker, therefore, consents to a further loan, taking perhaps as security a bill of sale of the manufacturer's plant and machinery. Such cases too frequently end in the banker suffering great loss, which becomes known; his credit is accordingly impaired, the customers become alarmed for the safety of their deposits, a run upon the bank ensues, and it is obliged to stop payment, and the end is bankruptcy and ruin. Then in cases of bankruptcy, the disclosure of reckless dealings of this nature, or other misconduct, such as allowing a partner greatly to overdraw his private account with the bank, without exacting from him proper security; permitting unnecessary litigation, wrongful dealings by way of transfer, pledge, or any kind of conversion, with a customer's securities that may have been lodged at the bank for safe custody; failure to keep proper books, ignorance of what the books show to be the real state of the bank; are all matters which press sorely against the bankrupt, and some of them may be made the grounds of criminal proceedings, and lead to severe punishments.

Private bankers (meaning thereby firms formed by voluntary association, in distinction from the bodies formed under the statutes regulating banking co-partnerships and joint-stock banking companies respectively) do not, in general, allow interest to their customers on the sums lodged with them, as the last-mentioned bodies are almost universally in the habit of doing throughout the United Kingdom. Public banks are those which are established under the statutes above referred to, and hereafter to be more fully explained. They are for the most part bound to make periodical statements to their shareholders: in effect, to publish such statements as the legislature has thought to be adapted to disclose the real condition of the banks, and the actual mode in which they are doing business; but the history of banking shows, that whilst most of these concerns are prosperous and enjoying most extensively the confidence of the public, no device that has yet been discovered can guard either customers or shareholders from the ruin that has occasionally been caused by the mismanagement, either through ignorance and incompetency, or from a fraudulent disregard to their duties, of those who have the direction of the affairs of a bank. The disasters which have arisen from the insolvency of large joint-stock banks have not arisen from any inherent vice in the system itself, nor from any inaptness of the joint-stock principle for dealing with banking concerns, but from the criminal want of integrity of those who guided the affairs of the establishments which have fallen. The joint-stock banks are in general willing to receive smaller sums, by way of opening accounts with customers, than private bankers; in many cases as low as 10*l.*, and this circumstance, together with the attraction of the interest which they very generally allow on their deposits, and the confidence which the public place in the great number of persons who hold shares in each bank of this description, liable to the whole extent of their fortunes for the debts of the concern, have led to vast increase in the sums deposited with this class of bankers within the last ten or twelve years, so that the lowest estimate which is made by good authority, of the aggregate amount of money held in deposits in the various banks of the United Kingdom, reckons it at 500,000,000*l.* sterling.

One of the great benefits which is produced by a widely spread system of banking lies in this, that it provides the means by which the surplus capital of one part of the country is transferred to another part where it is wanted, and where its use is of the highest value in increasing the activity of trade, and giving employment to industry. Thus the agricultural districts affording but little opportunity for the employment of money, bankers in business there, finding no means of employing their deposits in the discounting of local bills of exchange, or in loans on other eligible securities, are in the habit of sending to their agents in London such sums as they can spare with due regard to the requirements of their tills. On the other hand, in the great centres of commercial and manufacturing activity, of the cotton, woollen, and iron trades, and in the mining districts, the merchants are in the habit of drawing bills of exchange in payment for the goods they have sold to their customers, and a large proportion of these bills come up to London to be discounted, which is done with the money above mentioned as having been sent up from agricultural localities, and with the deposits in the hands of the London joint-stock banks, which are chiefly made by the small traders of the metropolis, and by widows, servants, mechanics, artisans, &c. It is in this way that banks aid the rapid and continual circulation of money between parts of the country where it is not wanted for immediate use, and parts of the country where the demand for its immediate use is pressing and urgent. Another mode in which the utility of banks, and the general diffusion of the habit of keeping accounts with bankers instead of hoarding money at home, is displayed, is this: If every payment were required to be made in coin or Bank of England notes (which, since 1844, are a legal tender everywhere except at the Bank of England, as will be more fully explained hereafter), the expense and trouble, and risks attending on such a system would be incalculable. Banking to a very great extent prevents the necessity of this, and therefore effects a great economy as regards the currency or necessary supply of the circulating medium. [CURRENCY.] A customer of a bank, when he has a payment to make, instead of taking the necessary amount in coin or Bank of England notes out of his strong box, simply writes a cheque or order upon his banker desiring him to pay the creditor the required amount. This the creditor presents to the banker, and if the creditor has an account with his house, the banker may satisfy the cheque by transferring in his book the specified sum from the account of the debtor to the account of the creditor, and so it will not be necessary that any money should pass in the transaction. But if the creditor, or payee of the cheque, has not an account with the same banker, it may, it is true, be necessary that the cheque should be cashed, by handing the specified sum over the counter to the payee. In London, however, the great centre of the money transactions of the realm, even in this case, by means of the institution of the Clearing House (which will be explained in detail hereafter) the system of cheques has the effect of causing immense savings of expense and trouble as regards the circulation. The effect, upon the whole, in this direction of the great development which has taken place of late years in the practice of using bankers throughout the kingdom, is seen in the following statement contained in the Report of the Select Committee of the House of Commons on the Bank Acts, which sat in the session of 1858:—"While, on the one hand, the great increase of retail transactions has caused an increased demand for the smaller notes (of the Bank of England) concurrently with the increased demand for gold, yet, on the other hand, so great has been the effect of increased facilities in banking, that a saving of a corresponding amount has been effected in the larger notes. The effect has been so great, that notwithstanding the great increase of trade, the whole amount of Bank of England notes has actually diminished since 1844, and under the present law still continues gradually to decline."

With regard to the notes of the private banks of issue, it is manifest, at first sight, that a large portion of their profits must be derived from the interest which they make upon the money which these notes represent; for, suppose a private banker to issue a note for 1000*l.*, he only parts with it to some one from whom he has obtained a security for its repayment, with interest. The banker has therefore exchanged his promise to pay 1000*l.* on demand for an obligation of equal amount, bearing the current rate of interest: therefore, so long as the note, the intrinsic value of which does not exceed sixpence, remains in circulation,—that is, until it is presented for payment,—and the banker is obliged to pay the 1000*l.* in return for it, he will, supposing the interest he makes to be five per cent., have derived an income of 50*l.* from the note. Or, to put the case in another point of view: a customer asks for a loan of 1000*l.* upon a deposit of railway debentures or consols; the banker makes the loan by handing over the counter one of his own notes for 1000*l.*, and if the debt is not repaid according to the terms of the agreement, he may sell the securities and place the proceeds out at interest, which interest, whatever it be, is in fact the interest of his note, because he has never disbursed anything. No money has as yet passed out of his coffers; he has coined, as it were, a prospective liability; and, until the note is returned upon him, with a demand to be paid in gold or Bank notes, or credited in account, he enjoys the interest upon it. This view however does not appear to be coincident with that which private bankers, who issue notes, in general entertain of the value to them of their note circulation; for it was alleged before the above-mentioned committee, by various witnesses connected with private banking, to be the opinion generally entertained among them, that if they were obliged, according to a proposal that has often been suggested, to make a deposit with government of consols to the amount of their issues, they would prefer to sacrifice the issues altogether.

The most scrupulous attention to correctness and integrity, and fidelity to the interests of those who confide in him, have been partially shown to be the duty of a banker; but it may be necessary still further to elucidate this subject by showing some of the consequences which may follow even slight departures from correctness, and, though no moral guilt be incurred, may nevertheless press most heavily on the offender or on his family. The books of a banker are always kept on the principle of perfect correctness; that an alteration shall never be needed; that from first to last they shall show clearly and incontestably that which they are kept to show,—namely, the state of the affairs of the bank down to the minutest particular. The banker is held to be under the obligation of knowing what is in his books; he cannot, for instance, escape from the consequences of making or joining in a representation of the affairs of the bank different from that which the facts authorise, by alleging that he was not in the habit of looking into the books, and did not know that what he stated or sanctioned was untrue. It is his duty—a duty that the law does not allow him to shake off—to be aware of the position in which the bank stands before he undertakes to make statements respecting that position, by relying on which, other persons may suffer. The following example will render more clear what has been said: In the city of W. a bank had been established for many years. It had acquired considerable provincial celebrity, and was said to have enriched more than one of those who had been partners in it. In 1850 the then partners, A. and B., took into partnership C., who was to have one-third share of the profits and assets. A. was not an active partner, though he sometimes attended at the banking-house, without however seeing customers or taking any ostensible part in the management or conduct of the business. B. was a practising solicitor, who nevertheless attended closely to the business of the bank. C. was a retired solicitor: he paid a sum of money upon being admitted a partner to the business, the nature and liabilities relating to which, it turned out, had been grossly misrepresented to him by A. and B. But for these misrepresentations he would not have become a partner. The courts of equity held that, notwithstanding it was clear that A. knew nothing of any fraud in the representation of the state of the concern which he made, being himself totally in the dark, and having relied entirely on a confidential clerk (subsequently discovered to have been engaged in a long course of dishonesty and fraud), and therefore that he was to be entirely acquitted of any moral culpability; yet, being bound to know the truth of what he advanced, in such a case, he was as much personally liable to C. as if he had known the falsehood of what he asserted,—that is to say, he was liable to indemnify C. from the loss which he had suffered, or to put him into the same position as if he had never entered into the partnership. B., the other partner, knowing the real state of affairs at the time the misrepresentation was made, was of course liable to the same extent.

A bank is very commonly used by customers as a place of security to deposit plate, jewels, government and other securities, title-deeds, &c., for safe custody; and the banker frequently manages the customer's public stock for him, receives the dividends, and sells out or buys in according to his directions, and in the case of selling it is necessary for the banker to have a power of attorney from the customer to enable him to effect the sale. Now, in any of these cases any malversation on the banker's part is severely punished. If, being in charge of goods, &c., for safe custody, he sells or pawns the goods, or negotiates the securities, or pledges them, or deals with either in any way with a fraudulent intent, or if, having a power of attorney, he fraudulently uses it for his own purposes, he is in any of these cases punishable as for a misdemeanour (20 & 21 Vict. c. 54); and the reason why a banker is held by the law up to so rigid a standard of correctness, and why he is so severely punished in case of departure from it, is that complete confidence is the essence of his vocation,—he deals not with his own but other people's property; the consequences of a departure on his part from the rules which experience has shown to be indispensable, are incomparably more grave in the misery, and distress, and ruin which it causes, than in cases of ordinary offenders against the law. Then he has not a valid excuse in ignorance. Bankers, it is said, are in possession of peculiar means by which to become acquainted with the position, the character, and capacities of those who deal with them; and it is their duty to employ all those resources to distinguish between the applicants for accommodation who can bring security in one of the best forms, namely, that of their character, energy, and prudence, and the reckless and improvident trader. Provided they make reasonable inquiry, it is not probable that they will often be deceived in their judgment of individuals in this respect; and provided they act with caution, it is impossible that they can ever suffer themselves to be so far involved, even with the most respectable customer or firm of customers, as to be themselves injured in case of failure of the latter.

It perhaps may be difficult to form an estimate of the amount of money held as deposits by bankers in the United Kingdom; very high authorities estimate it at an enormous number of millions sterling, and have considered that probably 500 millions sterling is not much above the proper mark, of which probably one-half is payable at call. This gives some idea of the vastness of the trust which the community repose in the banking body, especially when we consider that this enormous sum is lent to them without security; and, indeed, the growing practice of opening accounts with bankers—in other words, lending to bankers so much money to be returned on demand—has been looked on by some as a most embarrassing question, owing to the difficulty of deciding whether the evils inherent in the system do not countervail the advantages; and considering it on the whole, as at present conducted, to bear the character of a formidable evil, the remedy suggested has been to enact that all sums bearing interest, lodged with bankers, brokers, &c., should not be demandable without a month's or six weeks' notice; and it is alleged that a regulation of this sort would not interfere with anything that is valuable in the existing system, while it would confer on it some portion of that solidity of which it is at present so miserably deficient. It would protect all classes against the effects of sudden and unreasonable fears and panics: it would give time to the borrowers to collect their resources, and to the depositors calmly to inquire into the character and situation of those to whom they had intrusted their money.

III. *History and Constitution of the Bank of England.*—This establishment, unquestionably the largest of its kind in the world, was projected by a Scotch gentleman, Mr. William Patterson, in 1694. The scheme having received the sanction and support of the government, to whom the whole of the capital was to be lent, the subscription was filled in ten days from its being first opened. The government being at the time much embarrassed for want of money, partly from the abuses of taxation and the defective modes of impost that were prevalent in those days, and partly from the difficulty of borrowing, owing to the feeling of insecurity and the want of confidence in the stability of the revolutionary establishment, the Bank arose out of a loan of 1,200,000*l.* for the public service. The government paying to the subscribers 8 per cent. on the sum advanced, and 4000*l.* a year for management, or 100,000*l.* a-year in all, agreed to incorporate them by the name of the Governor and Company of the Bank of England. The charter was granted to continue (by virtue of an Act of Parliament of that year) for eleven years certain, or till a year's notice after August 1, 1705.

Under the auspices of the then chancellor of the exchequer, Montague, a complete re-coinage of the circulating medium had taken place in 1696; and in the course of this year the Bank fell into great difficulties, and, in fact, was compelled to suspend payment of its notes, which had fallen to a heavy discount. By means, however, of the prudent course adopted by the directors, and by aid from the government, the Bank contrived to weather the storm; but it was determined to increase the capital from 1,200,000*l.* to 2,201,171*l.*, which was accordingly done.

In 1708, the Bank undertook to pay off and cancel 1½ million of Exchequer Bills, which they had circulated two years before at 4½ per cent., with the interest upon them—in all 1,775,028*l.*; so increasing the permanent debt due from the public to the Bank (including 400,000*l.* then advanced as payment for the renewal of the charter) to 3,375,028*l.*, on which they were to be allowed 6 per cent. The Bank capital was also then doubled; that is, it became 4,402,343*l.* It was in this year also that the Bank obtained the famous provision to the effect that, during the continuance of the corporation of the Bank of England, no partnership or body consisting of more than six persons should "borrow, owe, or take up any sum or sums of money on their bills or notes payable on demand, or in any less time than six months from the borrowing thereof," and the exclusive privileges were continued till 1733; and they have since been prolonged to the 1st August, 1855, with the proviso that they may be withdrawn on a year's notice to that effect being given to the Bank by the House of Commons, through the Speaker, after the 1st August, 1855.

In 1727, we find that the capital had increased to nearly 9,000,000*l.*

In 1746 it was 10,780,000*l.*

In 1782 it was increased by 8 per cent., or became 11,642,400*l.*

In 1816 it was raised to 14,553,000*l.*, at which it at present stands.

The Bank of England, as is well known, has had to struggle with severe pressure at particular periods of panic, as they are called. We cannot, consistently with the proper limits of this article, do more than refer to the most striking of them. The first of these was that of 1745—the Black Friday, as the day was long called in the City—when, news having arrived that the Pretender had advanced to Derby with his Highlanders, a run upon the Bank by the holders of its notes took place, which it is said the directors succeeded for the time in staving off by the device of paying each note in shillings and sixpences. They received more solid advantage from the effect of a resolution which was very numerously signed at a meeting of the merchants of London, that they would receive the notes of the Bank of England to any amount in payment of debts due to them, &c.; on which, and on the arrival of information of the retreat of the rebellious army, confidence returned.

In 1796, and the early part of 1797, there had been confident assertions of the intention of France to invade this country, and runs had taken place in consequence on many of the provincial banks, until the panic spreading, extended itself, as always takes place in such cases, to London, and the demands for cash on the Bank of England multiplied so fast, and to such an extent, that on Feb. 25, 1797, only 1,272,000*l.* of cash and bullion remained in its vaults. This was Saturday, and there was no prospect or hope that the run would have subsided on Monday. This being the state of things, an order in council was issued on Sunday, prohibiting the directors from paying their notes in cash until the sense of Parliament could be taken. The result of the discussions in Parliament was, that it was agreed that this restriction should continue until six months after the signature of a definitive treaty of peace, and an Act of Parliament was passed accordingly. The apprehensions which the order in council of restriction had caused were again allayed by a meeting of principal merchants, agreeing to accept and use every means to induce others to accept, Bank notes as money in all transactions. A committee of Parliament, which investigated the subject, reported that, at the moment of issuing the order in council, the Bank was possessed of property to the extent of 15,513,690*l.* after all claims had been satisfied. Bank of England notes were not, it is to be observed, expressly declared to be legal tenders; but they were in effect made so. In 1801-3 their issues are stated to have been so much increased that the notes fell to a discount of as much as from 8 to 10 per cent. In 1804 the notes recovered their ostensible value, but from that time to 1808 they were again at a discount of 2½ per cent.

Hitherto the issues had not exceeded 17½ millions sterling or fallen lower than 16½ millions, in any one year from 1802 to 1808; but in 1809 they became 18,927,833*l.*, and in 1810 reached 22,541,523*l.* The issues of country bank paper were also much enlarged, without, as it appears, there having been any adequate increase of business or activity of demand for money in the community to make such steps justifiable; the consequence was, that Bank notes in 1809 and 1810 were at a discount of from 13 to 16 per cent. Hence arose a corresponding fall in the foreign exchanges; and the matter seemed deserving of the attention of the legislature, so far as that a committee of the House of Commons being appointed in the latter year, recommended an early return to specie payments; but this recommendation not being acted on, the notes of the Bank were at an average discount in 1812 of 20¾ per cent. as compared with bullion; in 1813, of 23 per cent.; in 1814, of 25 per cent. The mode by which they regained by 1816 nearly a par with gold, was the following: In 1797, at the period of the restriction, it had been supposed that there were about 280 country banks in operation; but in 1813 these had increased to upwards of 900. Wheat had been unusually high during the five years ending with that year, but the harvest of that year turning out to be above an average one, and the continent being again opened to British commerce, a heavy fall took place in prices at the end of 1813 and the beginning of 1814. This having brought many farmers into insolvency, caused a want of confidence in the rural districts; and it is said that, in 1814, 1815, 1816, no fewer than 240 country banks stopped payment, and 89 commissions of bankruptcy were issued against bankers. Hence the field for the circulation of Bank of

England notes was necessarily much increased, as the void in the currency caused by the destruction of so many banks of issue (there being at that time no legislative restraint upon the establishment of a bank of issue except what has been mentioned) must needs be filled up, and the value of the note was in 1816 raised nearly to a par with gold. This facilitating very much the return to cash payments, by Mr. Peel's Act of 1819 (59 Geo. III. c. 78) it was fixed that the resumption should be made in 1823; in the interval the Bank was to pay its notes, if required, in bars of standard bullion of not less than 60 ounces weight. However, a large amount of gold having been accumulated in the Bank vaults, the directors recommenced specie payments on May 1, 1821. As regards the practical operation of this Act on the currency much speculation and discussion has taken place, into which we cannot here enter. [CURRENCY.]

In the latter end of December, 1825, occurred that collapse of credit and confidence which is known as the panic of 1825, in the course of which the pressure upon the Bank for cash for the country banks was so great that the gold in its vaults was reduced extremely low; insomuch that, but for the fortunate discovery of an old box containing a quantity of one pound notes which had been overlooked, and which were now brought out and issued, to the amount of one million, in payments, the Bank must, according to the evidence of one of the directors before a committee of the House of Commons, have suspended payment. The Bank directors appear on this occasion to have applied to the government for an order in council restraining payments in gold; but this the government, throughout the period of pressure, steadily refused to grant.

This crisis was owing chiefly to the immense number of speculative schemes which had been set on foot in the course of the year 1824. From a published table of these, we find the total amount proposed to have been subscribed for these schemes (or bubbles, as many of them were) was 248,000,000*l.*; that the amount actually paid up was 43,062,608*l.*; and that the balance due on the whole, at the end of 1825, was 204,937,392*l.*

In 1826 the Act of 1708 was partially repealed, so as to admit of the formation of banking copartnerships for the issue of notes with more than six partners, at any distance exceeding 65 miles from London; but these establishments were restrained from having any branches in London; and it was expressly declared that the partners, jointly and severally, should be held liable for all the debts of the bank with which they might be connected.

On the other hand, the Bank of England had the privilege given them of establishing branch banks in the provinces. This was viewed with such alarm by the country bankers, who saw in it "the object of supplanting the existing banking establishments, and thereby rendering the Bank of England masters of the circulation of the country;" but these apprehensions have not been borne out by the results. In some places where the Bank had established branches, the experiment has failed, and the branches have been discontinued; and it is doubted whether, upon the whole, the business done at those establishments has been a source of much advantage to the Bank. The present number is believed to be eleven. An agent or manager is placed in charge of each branch, which is visited at uncertain periods by an inspector. The agents at all the branches communicate daily with the Bank of England, advising every transaction which has been entered into during the previous day, the total amount of moneys paid out, the total amount received, the total amount of the bills discounted, the total cash balances remaining, the notes received and cancelled, &c. In places where branch banks are established, revenue payments are made through them. They also receive many dividends that were formerly received by the provincial banks.

In 1833 considerable alterations were made in regard to the relations of the Bank to the public by 3 & 4 Will. IV. c. 98, by which it was provided that no association, having more than six partners, shall issue bills or notes payable on demand in London, or within 65 miles of that city, during the continuance of the exclusive privileges granted to the Governor and Company of the Bank of England. But associations, "although consisting of more than six persons, may carry on the trade or business of banking in London, or within 65 miles thereof, provided they do not borrow, owe, or take up in England any sum of money upon their bills or notes payable on demand, or at any less time than six months from the borrowing thereof, during the continuance of the privileges granted by this Act to the Governor and Company of the Bank of England."

All promissory notes of the Bank of England, payable on demand, issued at any place in England, out of London, where the business of banking shall be carried on for or on behalf of the Bank, must be made payable at the place where such notes are issued; and it is made unlawful for the Governor and Company of the Bank of England, or for any person on their behalf, to issue, at any place out of London, any promissory note payable on demand, not made payable at the place where the same is issued.

Bank of England notes shall be a legal tender except at the Bank and its branches.

One-fourth part of the debt owing from the public to the Bank, amounting to 3,671,700*l.*, was to be paid back to the Bank. It was on this occasion proposed among the directors, that a sum equal to this sum should be distributed rateably to the proprietors of Bank stock, on the ground that the existing capital was amply sufficient to answer all the purposes of a banking capital.

In 1844 the enactment under which the Bank of England is still (1859) regulated was passed. Sir R. Peel, in introducing the measure to the House, explained the magnitude of the questions connected with banking and the currency, in these terms: "There is no contract, public or private; no engagement, national or individual, which is unaffected by it. The enterprises of commerce, the profits of trade, the arrangements to be made in all the domestic affairs of society, the wages of labour, the transactions of the highest amount and of the lowest; the payment of the national debt; the provisions of the national expenditure on the one hand, and the command which the coin of the smallest denomination has over the necessaries of life on the other, are all affected by the decision to which we may come on this great question."

The Act 7 & 8 Vict., c. 32, is intituled "An Act to regulate the issue of Bank Notes, and for giving the Governor and Company of the Bank of England certain privileges for a limited period;" and the most important enactments of it are those which provide for the issue of notes. This is to be carried on in a separate department from the banking department; and the issue department can only be carried on according to a system of rules and regulations prescribed in the Act. The issue department is constituted by transferring, appropriating, and setting apart to it, securities to the value of 14 millions, of which the debt due by the public to the Bank is to be deemed part, and also by transferring, appropriating, and setting apart to it, so much of the gold and silver bullion *then held* by the Bank as was not required by the banking department; and this being done, there was to be delivered out of the issue department such an amount of notes as, with those then in circulation, should be equal to the aggregate of the securities, coin, and bullion so transferred to the issue department. Then it was enacted, that "the whole amount of notes then in circulation, including those delivered to the banking department, should be deemed to be issued on the credit of the said securities, coin, and bullion." Also the Bank was prohibited from increasing the amount of securities for the time being in the issue department, except as will be mentioned presently; but permission was given to diminish the amount of such securities, and *again* to increase them to any sum not exceeding 14 millions, from time to time, as the Bank should see occasion. After the constitution of the issue department, the Bank was not to issue notes either into the banking department or to any person or persons whatsoever, save in exchange for other Bank of England notes or for gold coin, or for gold or silver bullion received or purchased for the issue department under the Act, or in exchange for securities acquired and taken in the issue department.

Under the banking department it was permitted that the Bank might issue all such notes as they should at any time receive from the issue department or otherwise, in the same manner as ordinary banks of issue. With regard to bullion they were limited to retain in the issue department, at any one time, an amount of silver bullion not exceeding one-fourth of the gold coin and bullion at that time held in the issue department; and all persons were to be entitled to demand from the issue department notes in exchange for gold bullion, at the rate of 3*l.* 17*s.* 9*d.* per ounce of gold of standard fineness, the gold to be melted and assayed, if necessary, at the expense of the party tendering it.

An increase of the security in the issue department was permitted to be made, in case any banker, who on May 6, 1844, was issuing his own notes, should cease to do so; then, on the application of the Bank, an order in council might authorise an increase of the securities beyond the 14 millions, and an issue of notes thereon to the extent of one-third of the private bank notes withdrawn from the circulation. Finally an account was to be published weekly, in a prescribed form, of the amount of notes issued by the issue department, and of the gold coin, and of gold and silver bullion respectively, and of securities in the issue department. Also an account of the capital stock, and the deposits, and of the money and securities belonging to the Bank in the banking department.

By these arrangements, the functions of the Bank with regard to the circulation were very materially remodelled; and under the operation of the Act it became, properly speaking, no longer a bank of issue, but in its issue department was made merely the agent to carry into effect the rules imposed by Parliament, without possessing any discretion or power of action of its own in the matter. An average amount of about 20 millions' worth of Bank of England notes appears at present to be permanently with the public for the purposes of circulation, and over this quantity of notes the Bank has no power, either to increase or diminish it; for if the Bank sells securities in order to draw in a portion of the notes out with the public, those securities would either be paid for by the withdrawal of deposits from the Bank, or by cheques, in which case no notes would pass at all; and if the Bank tried by any means to increase the number of notes in circulation, the surplus would immediately be returned in deposits: so, in either case, the total with the public remains unaltered.

The great object of these regulations was to place the convertibility of the Bank of England note into gold at all times on a secure basis, to cause the note circulation to fluctuate precisely in the manner that a purely metallic circulation would have fluctuated, and give the power to the Bank of England of acting upon the foreign exchanges when unfavourable to this country; and the Bank has been enabled, it is alleged, under the operation of the Act, to give much greater accommodation to the mercantile community, and also to various banks, by means of discounts and advances upon securities, in seasons of monetary crisis, than it could have done if it had been left without the support of the Act, in which case it must have regarded solely the security of its position as a mere banking establishment. The convertibility of the note is put beyond question, it will be observed; because it is hardly possible to conceive a drain upon the treasure in the Bank to be carried so far as to reduce the outstanding notes below 14,000,000*l*.

It may be well to mention here, that when the bullion in the Bank of England is spoken of, the bullion in the issue department is intended. When persons speak of the reserve of the Bank of England, the aggregate amount of the notes and coin in the banking department is intended. In ordinary times, the Bank thinks the right course is to keep a reserve to the amount of one-fourth of the deposits placed by bankers, merchants, traders, and private customers in their hands. It is the practice for the London banks, instead of keeping in their own tills the whole of the sums which they regard it to be right to have constantly under their control in order to meet the demands of their customers from day to day, to keep a portion of those sums in the Bank of England. The Bank also opens drawing accounts with merchants, traders, and others, upon which they draw cheques, and pay in such cheques as come into their hands, in the same way as in the case of an ordinary bank; and for persons keeping such drawing accounts the Bank discounts bills of exchange, provided they have on them the name of two or three persons of approved credit, and provided that in case any one of the persons whose names are on the bill fail before the bill has arrived at maturity, the Bank shall be entitled to demand and receive the amount of the bill from the person for whom it was discounted: this the Bank has no legal right to enforce, but in case compliance is refused, it closes that person's discount account, and declines to discount for him in future.

The deposits in the Bank consist of the government balances, which rise from small amounts at one period of the quarter, up to five or six millions higher at another period of the quarter, and then again subside to a low condition. The private deposits consist in a great degree of the reserves of the London banks, being the amounts which those banks require to have always at hand to work their own business. The rest consist of the deposits of merchants, traders, and others who have drawing accounts with the Bank. Of late, many old forms which stood in the way of persons desirous to open such accounts have been abolished; cheques are no longer limited to a minimum of 10*l*., but may be drawn of any amount; and every class of banking business is conducted for the private customer with ease and despatch, the Bank taking charge of Exchequer Bills and bills of exchange, of the collection of bills of exchange, receipt of dividends, &c.

Plate, title-deeds, &c., may be deposited by customers for safe custody. The Bank allows no interest on deposits of money, but, on the other hand, looks to the average balance of the customer's account as the source of repayment for the trouble and risk of keeping it, &c.; and in this respect is not more exacting than ordinary bankers, as no particular sum is required to be lodged on opening an account: the party must be known to be respectable, and in a position to require a banking account. The Bank has a printed code of regulations, under which drawing accounts are managed. No one is allowed to have a discount account who has not a drawing account.

Having premised these explanations, what we have to say respecting the two occasions of monetary crisis which have occurred since the Act of 1844 came into operation will be rendered somewhat more readily intelligible. It is the more important to the reader to be made acquainted with some of the leading particulars of these panics (as they are called), because each of them has occurred during the present law; each of them was met by the singular expedient of a government authorisation to the Bank to violate that law; and because it is not easy to meet with accounts of either of them, especially that of 1847; and, in fine, they are most advantageously studied when taken in connection, and the course which events took on each occasion brought closely into comparison and contrast.

All panics in this country have been preceded by the symptom of a gradually increasing withdrawal of bullion from the Bank. In the summer of 1846 a drain of this kind began to be perceivable; partly owing to the vast amounts required for the payment for the importations of corn and flour from abroad, and partly due to the construction of numerous railways then going on. Then the harvest of that year failed, and the potato crop failed, and the cotton crop failed; therefore it became necessary again to import corn largely: there was, besides, a still continuing demand for capital for railways, accompanied by a decline in the exports of manufactured goods. A heavy drain of gold therefore set in, and went on increasing up to January, 1847, the bullion in the Bank having, until that time, sufficed to meet the demands on it, without ever having been reduced so far as to create alarm. But in that month the drain steadily increased; the rate of interest in the general market was rising; the Bank raised its rate, which had been 3 per cent. since the middle of 1846, to $3\frac{1}{2}$, and then to 4 per cent.; it was not until April that they raised it to 5 per cent. The dividends were paid in July, and on July 30th the notes out with the public read 18,900,000*l*. On August 5th the Bank raised the rate of discount to $5\frac{1}{2}$ per cent., as their minimum rate for short bills; and then began failures of various great commercial houses, at first of those chiefly who were engaged in the corn trade, the price of corn having fallen 50 per cent. between May and September in that year. Several of the fallen houses, however, were stated to have been for some time in an unsound state. In September the pressure on the Bank for advances went on increasing, and early in that month the Bank had declared its readiness to make loans at 5 per cent., until the 14th of October, on the security of government stock. On that day the dividends are payable. On the last two days of September the advances were 149,000*l*. and 362,000*l*. respectively; but on the 2nd of October it was found necessary to declare that it was impossible to increase the amount of advances, and that the advances already made must be repaid before the day for the next payment of dividends. The whole commercial world was seized with alarm; confidence began to fail; and, as has been observed, "the consequences of sudden alarm cannot be measured; they baffle all ordinary calculation. Cash is then withdrawn, not because the circulation is excessive, but by the country banks and the town bankers, for the purpose of meeting possible demands upon them, and by the community at large, either directly from the Bank of England, or indirectly through the former channels, for the purpose of hoarding, from the dread of some imaginary or contingent danger. In such a crisis, every reduction in the amount of bank paper is so far from checking the drain that it aggravates the general distress." (Lord Overstone's Pamphlet, 1844.) It was stated to be quite impossible to repay the advances as required (they were, however, so repaid); there was, in fact, a general inability to meet commercial engagements, as it seemed; yet the Bank had gone farther in granting accommodation than they had done in the autumn of 1839, also a period of panic or collapse of confidence, arising, however, out of an unprecedented drain for the purchase of foreign corn, but unaccompanied by any severe pressure upon the commercial and mercantile interests. On the 1st of October, 1839, the notes and Bank post bills in the hands of the public were 16,800,000*l*.; on the 2nd of October, 1847, the whole amount of notes and Bank post bills in the hands of the public was 19,500,000*l*. On the former day the Bank held private securities to the amount of 13,290,000*l*.; on the latter day the amount was 21,260,000*l*. There was therefore, it may be said, an increase to the extent of 8,000,000*l*. in the accommodation afforded by the Bank in 1847 as compared with 1839. How was this accommodation afforded? The Bank is the bank of the government, with which the government constantly has a drawing account, and sums paid on account of Customs, Excise, and other taxes are immediately lodged in the Bank. Accordingly, towards the end of each quarter, when the dividends on the government stock are payable, the government balances in the hands of the Bank greatly accumulate, and the Bank takes advantage of this circumstance to extend accommodation to the public, by lending out sums on securities, to be repaid before the time when the dividends become due, and when the money will be wanted to discharge them. When the Bank makes loans of this kind, for a period determined by its own convenience, and not by the desire of the borrower, the practice is to make them at a lower rate of interest than the then rate of discount. On the whole, then, there was no want of accommodation on the part of the Bank, where no bill was ever, during the whole of the pressure, refused discount, which would have been discounted in an ordinary season and under usual circumstances, though the whole demand for discount was thrown upon the Bank; the difficulty arose from the wholly anomalous and abnormal circumstances arising from an expenditure in the purchase of foreign corn of no less than 33,563,476*l*. within the previous fifteen months, of which 14,240,000*l*. had been paid between July and October; whilst during the same fifteen months 80 millions or 90 millions had been abstracted from other pursuits to be expended on railways. Moreover, the country bankers had required large quantities of bank notes, in order to be provided, not so much against the demands of their note holders, as of their depositors. The Scotch banks especially, with their enormous deposits, were obliged to make heavy drains of gold; and it was in evidence that all this was much aggravated by the hoarding of gold and notes to a very large extent in the hands of individuals.

On the 25th of October, the government thought fit to interpose, and a letter was addressed to the Governor and Company of the Bank by the First Lord of the Treasury and the Chancellor of the Exchequer, recommending and advising the directors, if it should become necessary for the accommodation of the public, to advance their notes upon approved security; and that if thereby the Act of 1844 should be infringed, the government would apply to Parliament and ask for an indemnity for those who had violated the law, and for the ministers who had advised it. The government also mentioned the rate of interest, viz., 8 per cent., at which these advances ought to be made. As soon as the letter became known the panic at once ceased.

The rate of interest at this time, it is to be observed, was in general higher than that (especially considering the commission) charged by bill-brokers, and which must be added to their nominal rates of discount; interest was at from 6 to 7 per cent. in Hamburg, and not much lower throughout Germany: the rate of 7 per cent., obtained at New York, and in the United States generally the rate was upwards of 7 per cent. The object of the government interference was not the vain hope of *creating* capital, still less to buoy up a fictitious credit, but it was to restore credit, to resuscitate confidence, to set loose the circulation of the country, which, as it were, was frozen by alarm. Persons who had means of their own, and securities to offer, immediately found available the assistance placed at their disposal in consequence of this measure, so as to be able to carry on their business without further difficulty. In fact, every body seeing that the convertibility of the bill of exchange was no longer at hazard, or matter of difficulty, and that for sound commercial paper there were ample means of discount, confidence returned; trade gradually fell back into its usual channels: the interference of the government, in fact, prevented a general and contemporaneous failure from inability to meet immediate demands, not from insolvency.

At the time at which the letter was issued, there were eight millions of bullion in the bank; the foreign exchanges had turned so as to be decidedly in favour of this country, so that an influx of bullion was well assured. Now for nine months the drain had been going on; and it was only to the operation of the Act of 1844 that the country was indebted for the possession of that mass of wealth after such a long process of exhaustion; not above a quarter of a million of bullion was purchased by the Bank during the summer; in fact, it was to the operation of that Act during the early part of the year, that the country was saved from the necessity of a suspension of cash payments, one of the most distressing calamities that can befal it; for, though on the 25th of October, the bullion in the issue department was 7,865,000*l.*, yet the reserve was 1,994,516*l.*: and though the Court of Directors by a formal resolution conveyed to the government their conviction, that as far as the Bank was concerned they could comply with the provisions of the law and maintain their position, yet at the same time they confessed that if an application for assistance came to them from the great provincial banks, or from other quarters, they could not grant the accommodation, and that they might possibly be obliged to curtail the accommodation they had already given.

The next occasion of monetary crisis which befel this country was in 1857. As we have observed, all panics in this country are found to be preceded by a withdrawal of bullion from the coffers of the Bank.

The following table will show the relative amounts of bullion and reserve in the Bank, and the rate of discount during the latter half of the year 1857, the panic or pressure having occurred in November of that year.

1857.	Bullion.	Reserve.	Rate of Discount at the Bank.
	£	£	
June 5 . . .	9,451,000	5,782,000	6½ per cent.
June 18 . . .	10,409,000	6,981,000	6 ,,
July 16 . . .	11,242,000	6,408,000	5½ ,,
October 8 . . .	9,751,000	4,931,000	6 ,,
October 12 . .	8,991,000	4,115,000	7 ,,
November 9 . .	7,719,000	2,834,000	10 ,,
November 10 . .	7,411,000	2,420,000	10 ,,
November 11 . .	6,666,000	1,432,000	10 ,,
November 12 . .	6,524,000	581,000	10 ,,

Now one indication of the difference in the state of the cases of 1847 and 1857 is the following. It will be found on closely comparing the two periods that the 25th Sept., 1847, held an analogous position as regards the progress of the panic of that year with 19th Oct., 1857, as regards that of the latter year. But the state of the bullion and reserve was as follows in the two years:—

	Bullion.	Reserve.	Rate of Discount.
	£	£	
September 25, 1847 .	8,782,000	4,112,000	5½ per cent.
October 19, 1857 .	8,991,000	4,115,000	8 ,,

So that with the same bullion and the same reserve, virtually the rate of interest had sustained an increase of no less than 2½ per cent., but it is necessary to bear in mind that the country had been accustomed for the whole period of the Russian war to rates of 6 and 7 per cent., which were higher than ever had been known previously; therefore there is not so much room for astonishment as if the rise had been at once from 5½. Before going further into the comparison between the two periods it will be necessary to trace the rise of the panic of 1857, and point out what was the conduct of the Bank and the Government in regard to it. In the month of August of that year the Bank had not had any reason to apprehend any necessity for taking measures to prevent the efflux of bullion. The prospects of harvest were very good; there was no apprehension that commerce at that time was other than sound. The merchants, it was true, were importing, notwithstanding the enhanced prices caused by the war, but they had done the same successfully in the same circumstances in the previous years. Things were in this state up to Sept. 15, when news arrived from America of the great depreciation of railway securities to the extent of 10 or 20 per cent., it being supposed that American securities to the value of 80 millions sterling were held in this country. The Ohio Life and Trust Company, which acted as bankers to a very large extent, had also failed. The real value of the exports from this country to America, in 1856, was 21,476,000*l.*, of which much was unpaid at this time. In the beginning of October, further accounts from America stated the artisans to be falling out of employment; discounts had risen from 18 to 24 per cent. On the 7th, news came of the suspension of the banks in Philadelphia and Baltimore. On the 8th, the bullion was fast leaving the Bank of England; its discounts and advances were as high as 11,648,000*l.* The rate of discount was raised to 6 per cent., the rate at Hamburg being 7½; and on the 12th, the Bank rate was raised to 7 per cent., which was further raised on the 19th to 8 per cent.; but in the meantime, further bad news came from America, where many additional failures had taken place. The Bank of France had lost in one week upwards of one million sterling. On the 20th Oct. an application was made to the Bank of England for assistance from the Borough Bank of Liverpool, but upon terms that were inadmissible, and were rejected. On the 26th, a deputation came up from the Western Bank of Scotland, but their deposits being 6,500,000*l.*, their issue of notes 480,000*l.*, bills discounted 3,600,000*l.*, of which it was estimated 970,000*l.* would not be paid at maturity, and loans on open account having been made to 2,560,000*l.*, and also a large quantity of liabilities falling due in London, the Bank of England declined to undertake the responsibility of helping them through their difficulties. They were supposed to have lost very largely from the failure of American houses with whom they were involved. There was at this time a run on the banks in Ireland, and on the 5th Nov. the rate of discount was raised to 9 per cent.; there having been on the 30th Oct., a demand for assistance from other banks in Scotland, and 50,000 sovereigns had been sent down to one bank there, and 80,000 to Ireland. Between the 5th and the 10th Nov., took place the failure of Dennistoun's house, whose acceptances were supposed to reach nearly 2,000,000*l.* Also on the 9th, the Western Bank of Scotland stopped, the failures in London were on the increase, and the discount was raised to 10 per cent. On the 10th a leading discount-broker's house applied to the Bank for accommodation, to the extent of 400,000*l.* The City of Glasgow Bank suspended. The discounts and advances at the Bank of England for that day were 1,116,000*l.*, and on that day and the next there was sent down to Scotland gold to the value of one million sterling, to enable the banks there to strengthen their tills.* The run on the banks in Ireland was on the increase. On the 11th, Sanderson & Co., large bill brokers (who had stopped payment in 1847, but had afterwards paid every one, and recommenced business), failed, their deposits being supposed to be four millions, and their liabilities on bills of exchange five millions.

On the 12th, about three o'clock, the Bank received a letter signed by the First Lord of the Treasury and the Chancellor of the Exchequer, informing the directors that if they should be unable in the emergency to meet the demands for discounts and advances upon approved securities without exceeding the limits of their circulation prescribed by the act of 1844, the government would propose to Parliament a bill of indemnity for any excess so issued, and expressing an opinion that the rate of discount should not be reduced below the existing rate (10 per cent.). At that time the bullion was 6,524,000*l.*, and the reserve 581,000*l.*; the Bank having sold 3,000,000*l.* of government securities, besides exchequer bills. But there had been for some time a continued pressure on the Bank for accommodation. On the 24th of October, the loans and advances were 10,100,000*l.*; on the 5th of November, they had risen to 12,808,000*l.*; on the 11th, they were 15,900,000*l.*; and after the issue of the letter they went on increasing until they attained the maximum, on the 21st of November, when they were 21,600,000*l.*: exceeding the amount of the deposits, which were 20,823,000*l.* But for the aid of the Treasury letter, the Bank would not have ventured to carry the accommodation given to the mercantile community so high. What then was the practical operation of the letter? It was this: it enabled the Bank to transfer from the issue department to the banking department such a quantity of notes as might be sufficient to meet the emergency, whatever that quantity might be. The Bank took actually from the one department to the other 2,000,000*l.* in notes, and thus they had so much additional means of discounting and advancing upon securities. In point of fact, not quite 1,000,000*l.* of this sum was needed, or used; because, as soon as the commercial world became aware that the letter was issued, and that the supply was unlimited from whence to obtain accommodation to those who had good securities to offer, or good bills to be discounted, confidence began to revive; the fears for the convertibility of good paper subsided, and the panic might be said to have passed away. This was the mode in which the issue of the letter operated; in other words, this was the advantage gained by violating the Act of Parliament.

What was the advantage of having adhered to it up to that time? The answer is, that if the bullion had been much lower than it was on the 12th, and had borne any appearance of going lower still, the Bank would not have ventured, even with the letter in their hands, to go on making the subsequent advances which they did, for in such case they would have felt that it became necessary to provide for the convertibility

* The pressure from the Scotch Banks was also an element in the panic of 1847. See 3 'Hansard's Debates,' vol. 95, col. 398.

of the note; and it was the provisions of the Act which prevented the Bank from issuing more notes than in the proportions to the bullion which the law requires, and so gold would have gone out faster by the action of the foreign exchanges, and the directors would have been left with less gold as the panic increased. The Act therefore secured for the public the power in the Bank to give more aid at the time when the pressure was the severest than it otherwise would have possessed, and thus rendered the directors more careful in securing and retaining the bullion than they were before 1844, and enabled them to resist the influence and pressure which the mercantile community would otherwise possibly exert upon them with success, and which would end to lead them into less judicious courses, or at least leave them less free to act on their own discretion than now they are able within the statutory limits to act. The authorities of the Bank appear to consider the statute to operate, not as a clog, but as a support,—not as a hindrance, but as an aid. It is material however to observe the state of the foreign exchanges during this period; because, through the whole of it, they were not, according to the best authorities, such as apparently to pay for sending gold abroad. Thus, on the 10th of November, the exchanges were: Hamburg, three months, from 13·12 to 14; Amsterdam, short, from 11·16 to 19; Paris, short, 25·35 to 45; and therefore the Bank was freed from any apprehension that the advances they made in consequence of the Treasury letter could have any adverse effect on the foreign exchanges with this country. The American exchanges however were very unfavourable to this country during all this time, and the exchange would have given a large profit on the transmission of gold; but on the above day, the failure of the American banks being known here, there was very little probability of gold flowing from this country to America: indeed, the distrust between the two countries was such, that gold both came and went. Both the Bank and the commercial world, there is little doubt, governed their conduct in the middle period of the pressure,—that is, after it was undeniable that there was an actual stagnation of credit and confidence,—by the conviction that a letter would be issued, as had been done in 1847, and that accounts for the contrast between the two panics: in 1847 there was more of alarm, and of unreasonable alarm or panic; in 1857 there was greater commercial distress, but less panic. In the former year, however, the letter was issued at such a period of the pressure that it never became necessary to act upon it so as to exceed the limit of issue laid down by the statute. In 1857, but for the expectation of the letter issuing, the Bank must have refused to discount considerably before the 12th, and would have protected themselves by retaining the notes as they came in from the payments of the bills already discounted, or, as it is called, the run off of the discounts. Some of the indications of alarm respecting the state of monetary and business affairs in London during this period may be mentioned. Well-established solvent houses were found bringing their bills to be discounted by the Bank, who were known not to be actually pressed for money; but the apprehension of being left without the means of meeting future possible pressure made them lose no time in realising their securities. The London bankers' deposits—the Bank of England being the bankers' bank, where they keep the larger portion of their cash reserves—very much increased all through the alarm period. The same was found to be the case of the merchants' and traders' deposits. This is a decided symptom of alarm, at least since the Act of 1844. In the last quarters of the years 1838 and 1839, which were periods of prosperity and of pressure and distress respectively, the deposits of the London banks with the Bank of England were 812,000*l.* and 615,000*l.* respectively, showing the deposits to have sunk materially during the period of crisis. In periods of apprehension and collapse of credit, everyone is urged to contract his operations, and endeavours to draw in his resources, in order to be prepared as much as possible for any demands that may come upon him; and the bankers are content in such a season to forego the usual profits that they make on their deposits rather than be without the means of answering any amount of demand that it is at all probable will be made upon them. Accordingly, instead of discounting bills, as usual, with their deposits, the bankers very generally discontinued giving discounts between the 9th and 12th of November, and the whole of the discounting of London nearly centered in the Bank of England,—another proof of apprehension. The bankers' deposits with the Bank at the close on the 12th read 5,458,000*l.*, and subsequently, and before the end of the year, the amount rose beyond that sum: and between the 7th and the 19th of Nov. the balances of merchants, traders, and private persons in the Bank books were increased by one million. Another symptom of alarm is found in this, that consols continued to rise during the most critical moments of the period, which is attributed to timid persons withdrawing their deposits from banks in order to have the better security of the government.

If the letter had not issued, what would have been the consequence? The Bank must have refused to discount any more bills; this would have materially augmented the alarm of the London mercantile community. It is probable that the demands of the depositors and creditors of the banks in London would have increased upon them so much as to have compelled them to withdraw portions at least of their deposits from the Bank of England. Now, as the Bank had been employing largely these bankers' deposits in giving accommodation by the discounting of bills, unless the notes had come back to the Bank by the running off of the discounts more rapidly than the bankers' claims for their money increased upon the Bank, it must have stopped payment in the banking department. Then, persons having acceptances to meet payable at their bankers, on the supply of notes being stopped at the Bank of England, would have been unable to have met those acceptances, and widely-spread failures would have ensued. It seems clear that this must have been the result, inasmuch as the Bank had only at that time (without the letter) power to pay away about 2,000,000*l.*; that was the whole that it had the power to pay away, whether at the Bank or at its branches all over England. It was assuredly not in a condition to answer the claims that not very improbably might have been made upon it by bankers and other persons, and it must therefore have suspended payments in the banking department. But even this would not have affected practically the question of the convertibility of the Bank note, because by the operation of the Act of 1844, to insure that, the Bank had nearly 7,000,000*l.* in the issue department. It must be borne in mind, however, that the Bank would not have acted as it did in giving assistance to the mercantile community, but for the impression that at the worst what had taken place in 1847 might occur again; it would still, it appears, have considered it to be its duty to make common cause with commerce, but it might both have raised its rate of discount earlier and have diminished the *echéance* of the bills discounted, and possibly might have succeeded without the aid of the letter, but for the unexpected demand from the banks in Scotland to an immense amount for sovereigns, which demand had the effect of a foreign demand in this respect, that the sovereigns could not be expected to return to this country, and therefore were so much abstracted from the English circulation.

In another view the effect of the letter was to place the Bank in excess of its statutory issues by 2,000,000*l.* for the whole period, from 13th Nov. to 24th Dec., both days inclusive; on which day the 2,000,000*l.* was returned to the issue department, and the Bank found itself in a position to lower the rate of discount below 10 per cent. The whole sum advanced to the public by the Bank between the 12th Nov. and the 1st Dec., 1857, was 12,645,000*l.* The course of the rates of discount for 1858 was the following:—

The Bank rate which in November 1857 was 10 per cent., as has been said, had been reduced between that date and the end of December to 8 per cent., was in January, 1858, varied to 6, and eventually to 4 per cent., until on the 11th of February, it was 3 per cent. Then the Bank of France having reduced its terms of accommodation to 4 per cent., the influence of the change was felt in the continental cities, and the average terms for accommodation at Hamburg had in the interval fallen to 1½ and 2 per cent.; at Amsterdam to 3½ per cent. In the course of September and October the Bank of France had adopted the rate of 3 per cent. Early in December the Bank of England reduced its terms of discount to 2½ per cent.

As in 1847, a vast number of fictitious bills were discovered by the panic of 1857 to be in existence: the number was supposed, however, to be much greater in the latter year, and by many persons this was said to be an effect of the new mode of banking under which the Joint Stock banks took money on deposit accounts from persons who put small sums into their hands for the sake of the interest which these banks pay upon such accounts, in fact, using those banks, not for the ordinary purposes of banking, but as a medium of investment; the effect of which was said to be, to cause the bankers and their brokers to be less cautious as to the character of the bills they discounted, inasmuch as the deposits being placed with them at call, and also bearing interest, it became essential for the bankers to employ the money immediately, and therefore, without having the same opportunity for circumspection and inquiry, as is had in ordinary banking transactions. On this we shall have some remarks to offer under the head of *Joint Stock Banks*. But it was the complaint in 1847, as it also was in 1857, that persons having good mercantile bills to offer, respectable persons, could not obtain the means of converting them into money. There was no question in that year, any more than in 1857, as to the convertibility of the Bank note. It is believed to be the meaning of Parliament in the Act of 1844 to make the bullion in the issue department, and also the securities there placed, responsible to the holders of notes, and available in support of the notes with the public, exclusively of the claims of the depositors in respect of their deposits, as such, in the banking department.

One principal effect of the Act of 1844 is this: it enables every person to convert into Bank notes any amount whatever of bullion that he may choose to carry to the Bank, and authorises the issue of notes besides to the extent of 14 millions sterling upon security; or any one taking his bullion to the Bank may receive back the value in gold coin at the rate of 3*l.* 17*s.* 9*d.* an ounce, a charge of 1½*d.* an ounce being in addition made by the Bank as remuneration for the loss of time and the trouble of getting the gold turned into coin. The reason why the sum of 14 millions was fixed upon by the framers of the Act, was the following: Previous to 1844 the circulation of Bank of England notes seldom reached 20 millions or fell so low as 16; and therefore Sir R. Peel assumed that the circulation which was necessary for the country, and which could not be materially reduced in any ordinary state of society, was about 14 millions. This amount the Bank was allowed to issue upon securities; and it was also provided that, in case of the note-issuing banks ceasing to issue, the Bank might, by order in council, be authorised to issue on securities to two-thirds of the value of the circulation previously authorised to be issued by such country banks. This provision has raised the total secured issue of the Bank from 14,000,000*l.* to 14,475,000*l.* Under the system established by the Act of 1844, for every note which the issue department may at any time issue over and above the last-mentioned sum (issued on security), an equal amount of coin or bullion must be paid into its coffers. Probably, however, in framing the measure, the operation of deposits and the question of the reserve were not sufficiently considered either by those who were for or against the alteration. The pressure of 1847 was, it has been said, caused by the conduct of the directors in making immoderate engagements and neglecting to provide an adequate reserve for their own protection. "I do not deny" (said Sir R. Peel in 1847, Hansard's Debates, 95, col. 656) "that one of the objects contemplated by the measure of 1844 was the prevention of the convulsions that had heretofore occurred in consequence of the neglect of the Bank of England to take early precautions against the withdrawal of its treasure." But he owned, at the same time, that there was no imperative obligation on the directors to take these precautions, and he admitted that the Act had failed in effecting this first object. The other two objects, of maintaining and guaranteeing the convertibility into gold of the paper currency, and the prevention of the difficulties which arise at all times from undue speculation, being aggravated by the abuse of paper credit in the form of promissory notes, according to the provisions of the Act for limiting the issue of notes by the private bankers, which we shall treat of in full under the head of *Private Bankers*,—both these objects, he affirmed, had been secured. But it is certain that the Bank is placed in a very peculiar position by the operation of the Act. We cannot, perhaps, as the Act has been administered on two occasions, which strongly tested its efficacy, any longer be in danger of such a peril as was imminent in 1825, when, as Mr. Huskisson said, the country was within twenty-four hours of a state of barter; and when, as Lord John Russell assures us, "it is certain that the Bank had prepared a notice that its payments were to be suspended for a time" (Hansard's Debates, 95, col. 631); but still the responsibilities of the Bank are materially increased. It is utterly impossible that an establishment possessed of so large a capital should not exercise a most powerful influence, either for good or for evil, on the commercial interests of the country, and it is therefore a matter of vital importance that the management of the Bank of England should be conducted soundly and wisely. "If by our legislation we had provided that the Bank should at all times consider the interests of the public and not of their proprietors; if, on the other hand, the public were generally agreed that the Bank should look to its own interests only, and that on occasions of distress no man need go to the Bank for any other accommodation than he would have as a customer in ordinary times: in either of these cases their duty would be simple and the problem easy to solve. But acting at one time as proprietors, employing the money in their hands to objects of mercantile profit, and then being suddenly called upon to consider the great interest of the state, their position is difficult and perplexing beyond what can be easily explained." (Id. cols. 635, 636.)

Having now brought down to the present time our account of the principal events in the history of the Bank, with the view of dwelling chiefly on those points which seemed the best qualified to afford useful information to the reader, we proceed to state what is the internal constitution of the Bank.

By the original charter, the management and government of the corporation is committed to a governor, deputy governor, and twenty-four directors. The directors are elected, on the 1st of May in each year, by the proprietors of Bank stock, who vote in proportion to the quantity of Bank stock which they hold, provided that no proprietor shall have a vote who holds less than 500*l.* Bank stock, and no proprietor shall give more than four votes. The governor is to hold 4000*l.* of stock, the deputy governor 3000*l.*, and each director 2000*l.*, during office. In practice, no director holds more than the above amount; and the governor and deputy governor, when their year of office is ended, immediately reduce their several amounts of stock to the sum which qualifies a director. The directors are elected from such of the proprietors as are merchants of the city; a banker is seldom or never admitted to a seat in the direction. It is believed that no director has ever been allowed to derive advantage, by special accommodation or otherwise, in his private concerns, from his position as director. In the panic of 1857, not a shilling was advanced to any one of the directors. The directors, it is to be observed, though by law elected by the proprietors, are not appointed in virtue of anything in the nature of a popular election or nomination of the proprietors. In practice, a selection is made by what is called "The House List," which contains the names of the persons whom the existing Board of Directors deem proper to be appointed, and this list is always adopted by the proprietors at the annual meeting on the 1st of May; eight directors going out of office each year. But this arrangement has not been found to be quite convenient for the general interests of the institution, and a majority of the Board of Directors lately came to a resolution which was communicated to the government of the day, suggesting that one-sixth instead of one-third should go out annually. Thirteen directors (of whom the governor or deputy governor are always to be one) are a quorum, to constitute a Board of Directors. Four general courts are to be held in every year, in the months of April, July, September, and December; and special general courts may be summoned at all times, upon the requisition of nine qualified proprietors.

The total number of proprietors is between 5000 and 6000. There are half-yearly meetings of the proprietors held for the declaration of dividends on the capital stock of the company, which are fixed by the directors.

The chief cashier is the banker; under whose superintendence takes place the business of receiving and paying money: he or his deputy are bound to reside on the Bank premises.

The accountant-general of the Bank superintends the accounts of the public creditors, and all the business connected with the management of the National Debt.

The *dividends* on Bank stock from the establishment of the company down to the present time have been as follows:—

1694 . . .	8 per cent.	1767 . . .	5½ per cent.
1697 . . .	9 "	1781 . . .	6 "
1708 to 1729	varied from 9 to 5½ per cent.	1788 . . .	7 "
1730 . . .	6 "	1807 . . .	10 "
1730 . . .	5½ "	1823 . . .	8 "
1731 . . .	6 "	1839 . . .	7 "
1738 . . .	5½ "	1852 . . .	7½ "
1747 . . .	5 "	1853 . . .	8 "
1753 . . .	4½ "	1856 . . .	9½ "
1764 . . .	5 "	1857 . . .	10 "
		1858 . . .	11 "

The Bank is bound to give gold for its notes, both in Threadneedle-street and at its branches, to any one who requires it; but it besides takes upon itself the function of facilitating the supply of the silver coinage to the public, that supply being chiefly derived from the Bank of England through the provincial and London bankers. The Bank also performs the same duty when required with respect to the copper coinage.

The Bank acts as the agent of the government in the management of the National Debt. It receives and registers transfers of Stock from one creditor of the public to another, and makes the quarterly payments of dividends on the debt.

The balances of money belonging to the state are kept by the Bank, which receives all payments on account of the revenue made by the receivers-general to the credit of the government, and makes payments for the government in the same way that a private banker acts for a customer.

The Bank of England never re-issues any of its notes. The cost of the note circulation is about 160,000*l*; though the expense is much augmented by the above practice, what is lost in economy is considered to be more than compensated by the advantages. The Bank is enabled by this practice to make all its issues of notes to bankers and other large customers in consecutive numbers; which gives great facility and saves the Bank much time in recording the notes issued, which is always done; it also saves the bankers much time in enabling them to record the numbers of the notes which they issue to their customers, and facilitates the detection of forgeries. The notes, when returned, are immediately cancelled, and in this way about 29,000 or 30,000 notes are destroyed daily.

IV. *The Art of Banking, as carried on by private establishments and joint-stock associations in London, in other parts of England, and in Ireland.*—The Italian merchants who, under the name of Lombards, settled in England during the 13th century, and previously to that time the Jews, performed the greatest part of the money business of the country. They were not, however, bankers, in the modern acceptation of the word, and in fact the business of banking does not appear to have been carried on among us earlier than the middle of the 17th century. The goldsmiths of London, who before that time had restricted their trade in money to the purchase and sale of foreign coin, then extended their business by borrowing and lending money. The latter part of their business—that of lending—was principally transacted with the king, to whom they made advances on the security of the taxes. They allowed interest to the individuals from whom they borrowed, and the receipts which they gave for deposits passed from hand to hand in the same manner as Bank notes have since circulated.

The taking of interest for the use of money was not rendered legal in England until 1546, when the rate that could be demanded was fixed at 10 per cent. In 1624 the legal rate was reduced to 8 per cent., and a further reduction to 6 per cent. took place in 1651. At this rate it still remains in Ireland, but was lowered in England to 5 per cent. in 1714, at which it now continues. These limitations have always been productive of evil. Money-lenders by profession will always be ready to take advantage of the necessities of borrowers, and being left without competitors among the more conscientious capitalists, demand not only a monopoly price for the use of their money, but also a further sum proportioned to the risk and penalties attending discovery. The Lombard merchants were accustomed to demand 20 per cent. interest, and even more, according to the urgency of the borrower's wants.

The merchants of London had been used to deposit their money for security at the Mint in the Tower of London, whence they drew it out as occasion demanded; but in the year 1640 King Charles I. took possession of 200,000*l.* thus lodged, which of course put a stop to that practice. This state of things preceded and most probably led to the extension of the business of the goldsmiths, as just explained.

This business soon became very considerable, and was found convenient to the government. In 1672 King Charles II., who then owed 1,328,526*l.* to the bankers, borrowed at 8 per cent., shut up the Exchequer, and for a time refused to pay either principal or interest, thus causing great distress among all classes of people. Yielding to the clamour raised against this dishonesty, the king at length consented to pay 6 per cent. interest, but the principal sum was not discharged until forty years afterwards.

Private Banking.—There are three private banking-houses still carrying on business in London which were established before the Bank of England. The London bankers continued for some time after that event to issue notes, but have long since ceased to do so, acting solely as depositaries of money, discounters of bills, and agents for bankers established in the country. No restriction has ever existed which prevents private banks in London, having not more than six partners, from issuing their notes payable to bearer; that they have ceased to do so has arisen from the conviction that paper money, issued on the security of only a small number of individuals, could not circulate profitably in competition with that of a powerful joint-stock association. Private bankers in London do not make any charge of commission to their customers, and generally grant considerable facilities to them, both by discounting bills and by temporary loans, either with or without security. Even where this kind of accommodation is not required, it is almost a matter of necessity for every merchant or trader carrying on considerable business to have an account with a banker, through whom he makes his payments, and who will take from him the daily trouble of presenting bills and cheques for payment.

The profits of London bankers are principally derived from discounting mercantile bills either for their customers, or, through the intervention of bill brokers, for other parties. They have great facilities as regards the security of this business, from the unreserved confidence which they are accustomed to place in one another as to the credit of their respective customers.

The great amount of money transactions daily carried on in London has led to the invention of a simple and ingenious method for economising the use of money. Almost all these payments are in the form of cheques upon bankers, or of bills of exchange addressed to bankers for payment, or accepted payable at their banking-houses. At three o'clock every afternoon a clerk from each banking-house being a member of the clearing-house, proceeds to a house in Lombard Street, called the clearing-house, taking with him all the drafts on other bankers which have been paid into his house that day, and deposits them in drawers allotted to the different bankers. Another clerk is afterwards sent who delivers to the first all the drafts paid into the banking-house up to four o'clock, and these are distributed in the manner already described. He then gives credit to each respectively for the amount of drafts on his own bank which he finds in his own drawer. Balances are then struck, and the claims thus found are transferred from one account to another, and so wound up and cancelled, that each clerk has to settle with probably only two or three others, and transactions to the extent of millions are settled ultimately by means of cheques upon the Bank of England, without the intervention of any notes or coin whatever. Each banking-house that is a member of the clearing-house has an account with the Bank of England, and so the claims of any one of these banks upon another are satisfied by transfers in their respective accounts at the Bank of England. Other London bankers who are not members of the clearing-house have similar accounts with the Bank of England, and pay the claims of the City bankers by cheques on the Bank of England. The oldest banks in Fleet Street, the Strand, at Charing Cross, and generally the banks in Westminster, are not members of the clearing-house, but pay the demands of the City bankers by notes handed over the counter. It is to be observed that the use of cheques, which has of late increased so much, the clearing-house system, and all the various forms of transfers of credits by which country bankers settle their balances in London with each other, and by which London bankers settle their balances with each other, are various modes of economising the use of Bank notes and of time; and the prevalence of this course of business accounts for the fact of the Bank of England notes with the public remaining generally so near the same amount; for these banking expedients have met the increased requirements of the increased trade of the country for more circulating medium, which they supply the place of, confidence being the base of the improved system. In seasons of panic, however, it may possibly appear that in proportion as in ordinary times monetary transactions are habitually thus conducted, superseding the use of coin or Bank of England notes, so in a condition of collapse of credit and confidence when every creditor is anxious to be paid in coin or notes, the difficulties of the period will be multiplied.

The country bankers have lately taken up the idea of having a clearing-house in London for the purpose of obviating many inconveniences which country bankers incur in realising cheques drawn upon other country bankers, whose banking-houses are not in the same town. The course of business in such cases has been, for the banker receiving the cheque to transmit it by post to the banker on whom it is drawn, with a request that the amount may be ordered to be paid in London, to the credit of the remitting bank with their London correspondents or agents. An arrangement has lately been brought nearly to completion by which this business will in future be effected through the present clearing-house in Lombard Street. The bills or cheques which bankers do not choose to cash are returned, after the clearing, to the houses by whom they were presented, and by whom the amount is then refunded. Drafts which are not paid in until after four o'clock are sent to the banking-houses upon which they are drawn to be marked for payment on the following day; and this proceeding, which has been adopted for the convenience of the bankers in making up their accounts daily at a certain hour, is of the same effect as regards the drawers and the persons by whom the drafts are paid in, as if the payment had actually been made.

There were very few country bankers established previous to the American war, but after the conclusion of that contest their numbers increased greatly. In 1793 they were subjected to heavy losses, consequent upon the breaking out of the war, and twenty-two of them became bankrupt. The passing of the Bank Restriction Act was the signal for the formation of many establishments for banking in the country. In 1809, the first year when bankers were required to take out a licence, the number issued was 702, which gradually rose to 940 in 1814. In that and the two following years 89 of these bankers failed, and their numbers fell off greatly. In each of the years 1825 and 1826 there were about 800 annual licences issued, but their numbers were again reduced by eighty bankruptcies, and in 1832 only 636 licences were demanded.

Country banks in England are all of them banks of deposit and of discount; they act as agents for the remittance of money to and from London, and for effecting payments between different parts of the kingdom. Some of them are also banks of issue, and their notes are in many cases made payable at some banking-house in London, as well as at the place where they are issued.

The Bank Charter Act of 1844 (7 & 8 Vict. c. 32), besides the provisions regulating the Bank of England, the effect of which has been already stated, contained various enactments in regard to private banks by which they are at present regulated. As regards the issue of notes, with the intention of finally extinguishing all issues of paper currency except the notes of the Bank of England, no banker, it was enacted, except he were issuing on the 6th of May 1844, was in future to issue notes in any part of the United Kingdom; it was not to be lawful for any banker to draw, accept, make, or issue in England or Wales any bill of exchange, or promissory note, or engagement for the payment of money payable to bearer on demand, or *to borrow, owe, or take up* in England or Wales any sum on the bills or notes of such banker payable to bearer on demand; but any banker on the above date issuing under the authority of a licence in England or Wales his own bank notes, was to continue to issue (under conditions to be mentioned presently). Also, the right of any company or partnership to continue to issue was not to be prejudiced or affected by the personal composition of the company or partnership, either by the transfer of shares or by the admission of any new member or partner, or by retirement of any present member or partner, provided that no company or partnership consisting, on the 19th of July 1844, of only six or fewer persons, was to issue at any time after the number of partners should exceed six. Any banker who should, after that date, being entitled to issue, become bankrupt, or cease to carry on the business of a banker, or discontinue to issue, was disabled to issue in future. Then the extent to which each bank was to be entitled to issue was limited in this way: the average amount of notes which the bank had in circulation during a period of twelve weeks preceding April 27, 1844, was to be ascertained from the returns made by the bank under a previous statute (4 & 5 Vict. c. 50), and this amount it was bound not to exceed,—that is to say, the average of the circulation for a period of four weeks was not to exceed that amount. In case however of two or three banks, each consisting of not more than six persons, uniting, the aggregate of the issues which they were previously authorised to have is to be the limit, which the average of their four weeks' circulation is not to exceed; but no such united bank is to retain the privilege of issuing after the number of its partners exceeds six. The penalty upon exceeding the limit so appointed for the monthly average is fixed at the value of the notes in excess; and every issuing banker is to transmit weekly to the Stamp Office an account of his notes in circulation on every day during the week ending on the next preceding Saturday to the day on which he transmits the account; and, also, he is to send therewith an account of the average amount of his notes in circulation during the same week, and on completing the first period of four weeks, and so on, completing each successive period of four weeks, he is to annex to such account the average amount of his notes in circulation during the four weeks, and also the amount of notes he is authorised to issue; and refusal or neglect to make the return, or making a false return, is punishable by a penalty of 100*l.* The average is obtained by dividing the aggregate amount of notes in each period of four weeks (which is always to end on a Saturday) by the number of days of business in the four weeks. There were some other minor provisions for the purpose of inducing issuing bankers to surrender the privilege of issuing on certain terms of compensation, which it is not material to state at length. On the other hand, it was permitted to any society, or company, or partnership, though exceeding six in number, carrying on the business of banking in London, or within 65 miles, to draw, accept, or endorse bills of exchange not being payable to bearer on demand, repealing all former Acts to the contrary.

A moderate rate of interest is allowed by some country bankers upon deposits which remain with them for any period beyond six months; some make this allowance for shorter periods. Where a depositor has also a drawing account, the balance is struck every six months, and the interest due upon the average is placed to his credit. Upon drawing accounts, a commission, usually of a quarter per cent., is charged on all payments. The country banker, on his part, pays his London agent for the trouble which he occasions, either by keeping a certain sum of money in his hands without interest, or by allowing a commission on the payments made for his account, or by a fixed annual payment in lieu of the same.

The portion of funds in their hands arising from deposits and issues which is not required for discounting bills and making advances in the country, is invested in government or mercantile securities in London, which, in the event of a contraction of deposits, or demands by the note-holders for gold, can be made immediately available.

The establishment of banks throughout the kingdom has contributed materially to the growth of trade. Without them it would hardly be possible for a manufacturer employing any great number of hands to collect the money required to pay the weekly wages of his people. It is not a valid argument against their utility that occasionally, by the facilities they have afforded, the tendency to overtrading has been encouraged; but it is to be hoped that the light which has of late been thrown upon the nature of this branch of business will be the means of checking the evils, without much diminishing the good, which it is calculated to effect.

The framers of the act of 1844 undoubtedly contemplated a period when the only source of the paper circulating medium should be the Bank of England; and the Bank seems accordingly to act towards the provincial banks of issue as though they were intruders upon its special province, and does not think fit in general to afford bankers of that class the accommodation in some respects which it extends to others. "It is very well known that the Bank of England will never discount a bill of any quality whatever for a note-issuing banker." (Evidence before Committee on Banks, &c., 1858, Q. 2785.) The Bank, it seems, has laid down rules which preclude it from discounting even Rothschild's acceptance brought for discount by a banker of this class. In consequence of this, these bankers are compelled to hold in their tills, in seasons of pressure, a much larger amount of bank notes than they would otherwise be under the necessity of keeping, if they had the usual facilities of discounting with the Bank of England. The disastrous condition in which a country banker issuing his own notes might have been placed by this regulation during the panic of 1857, will be seen at once when we remember that, according to the statement of the authorities of the Bank, all discounts ceased for three days in London, except at the Bank. The country banks of issue are therefore obliged to rely on their own resources; and when the aspect of the foreign exchanges, and the state of the unemployed notes in the hands of the Bank of England give warning that a season of peril may be expected, they commence realising, collecting their debts, and hoarding the Bank of England notes and coin, which by these means they have accumulated. The reason why bankers ought to look to the state of the foreign exchanges is the same reason as that on which a merchant watches the state of imports and exports as affecting the commodity in which he deals; and the banker ought to scrutinise the one as carefully and as closely as the merchant watches the other; for the foreign exchanges indicate the increasing plentifulness or scarcity of the article—money—in which the banker deals.

The theory of the Act of 1844 was, that as the exchanges fall you ought to contract the circulation in order that prices may fall, and so exportation of commodities take place, and thereby a rectification of the exchanges come about. But under the actual operation of that measure, the Bank's course is perhaps not quite so accurate a guide at all times for the country bank of issue to look to as it was certainly intended to become; because, although the foreign exchanges be in favour of this country the Bank is compelled by the Act, if there is a domestic drain, from political or whatever other causes, to restrict its issues just as severely as under an equivalent drain when it is the result of an adverse foreign exchange. The Act prescribes no different rule for the Bank to follow when there is an abstraction of bullion from its coffers because at that time it is profitable to send gold abroad, and when there is an abstraction of bullion during periods when it does not pay to send gold abroad, the cause being different in the two cases though the result is the same. The Act of 1844 is said to have produced substantial benefits in causing much greater caution in bankers generally in the management of their business. The limitation of the issues is also stated to be a valuable result of the Act; but the last seems to be of the less importance if it be conceded to the present opinion of all the best authorities, both in and out of parliament, that it is quite impossible for a banker to increase permanently his issue, that is, to keep out in the hands of the people of the district over which his notes circulate and pass as money, a larger quantity than the habits and wants of the district require for their daily transactions. In fact, experience teaches a note-issuing banker this lesson the moment he attempts to increase his issue: for instance, if he makes an advance or loan of 1000*l.* upon security, by handing out one of his 1000*l.* notes, in the expectation that he shall enjoy the interest upon that note for a lengthened period, if that amount of money is in excess of the wants of the district, the effect is that, very shortly, that note or notes in the aggregate of the same amount, are brought in for payment in gold, and he finds that where he meant only to make a profit upon his credit, he is obliged to part with his capital, and the transaction turns out not to be of a character to induce a repetition of it. Usually, however, the issuing bodies throughout the country have afforded to them, by the operation of the Act of 1844, and in the weekly returns of the Bank of England published in the 'London Gazette,' some index of the probable state of the money market: they are in the habit of regarding the reserve of unemployed notes in the Bank of England, as shown in those returns, to indicate the power of the Bank to afford accommodation by discount or loan on securities; and so to infer whether it is safe or not for themselves to give much or little accommodation to their own customers: and this before 1844 there was no equal means of ascertaining.

As regards the limitation of issues the practical operation of the statute is, to keep the amount really issued considerably below the maximum permitted. At the times of fairs, and the periods when farmers' rents are usually paid, and other special seasons, there is always a greater demand for the notes current in the district than is usual; now it is not always easy for a banker at these times to keep the amount of notes, that are sent into circulation, within the specific limit of the Act, and the consequence often is that the fear of incurring the penalty above mentioned, which attaches for exceeding his legal issue, causes the banker, in the last week of the four, to pay as much as possible in Bank of England notes, or in gold, in order to keep within his maximum. This fear, therefore, also causes him to keep by him a greater quantity of gold and Bank of England notes, than otherwise probably he would feel to be necessary.

In opposition to the plan of a single central bank of issue for the whole kingdom, it is alleged that the public would suffer, inasmuch as the alteration would subtract from the private banker's means of affording accommodation to those who were in the habit of regarding his notes as money, and finding they could use them as money. This further inconvenience would occur, it is said, to retail dealers and others, in case the circulation were exclusively composed of copper and silver, and, as to the larger sums, of gold and Bank of England notes; there would be no obligation on a banker or any one to give gold for notes; the consequence of that would be that a banker (and this is the case it is stated at present in some districts so circumstanced) will not give sovereigns in exchange for a Bank of England note without the charge of sixpence or more. ('Evidence before Committee on Banks,' &c., 1858, Q. 1328.) There appears to be enough of hardship in this state of things, to make it deserving of consideration with a view to remedy.

A desire has been frequently expressed by English writers on political economy, that Parliament should make it obligatory on banks of issue to lodge with the government, securities to the amount of their issue of notes, as we have described is done in the United States; and the ground on which this requirement is principally rested, is the hardship on the traders and others in the districts in which any particular banker's notes are in circulation, of being practically obliged to receive those notes from their debtors, whilst they have no guarantee whatever that they may not turn out to be worthless. They are, therefore, it is argued, entitled to have the assurance of that which is put upon them for money being really what it assumes to be, so that in case the bank fails, they should be secured from loss, and their case is distinguished from that of the depositor in the bank, and they are said to be justly entitled to a priority over him, and to have their claims paid in full, whatever may be his fate, because he is a volunteer; in coming forward to place his money in the banker's hands he acts quite spontaneously, and without coercion or obligation of any kind. The country bankers, however, are understood to consider that it would be better for them to abandon issuing altogether, than to go on issuing, subject to the deposit of the same amount of security with the government. At present, they look upon their capital as under their own control; generally, it is true, invested in government securities, but always saleable at the price they choose, and to be dealt with at their own will; but if they impounded this capital with the government, it would be beyond their control, and they would not feel secure of getting it out again when it was wanted. Practically, it would amount to paying the notes in advance, by the security given, whilst at the same time, there must be an amount of cash kept in reserve to pay them over the counter when presented at the bank, besides making provision for paying them in London. There would, in fact, be three provisions to be made for the payment of the notes instead of two, as at present is the practice.

As regards persons who commence banking now, in a neighbourhood where there is a bank of issue already established, it is manifest they start under great disadvantages; for the bank of issue has the means of giving accommodation to its customers which are afforded by its deposits, plus its circulation; but the others have only the means which their deposits afford, supposing each bank to follow the rule already stated, of investing the capital of the concern in government securities. In order to obviate the injustice which it is said arises in this way from the operation of the existing law the theory of free trade in banking has been started: the right of issuing bank notes or promises to pay, it is urged, ought to be left entirely unfettered; for country Bank notes are on the same footing in principle as cheques and bills of exchange, and the power of issuing them, consistency requires should be as free as that of issuing cheques or bills of exchange. Now, when the Bank of England begins to restrict its advances, in order to avoid the issue of more notes, as far as possible the country bankers, even the most powerful houses will begin to hoard Bank of England notes, in order to be prepared for any pressure which may come upon them; the consequence is immediately observed to be a large increase in the amount of the bills of exchange, which are always in circulation, and this increase is made in order to supply the void in the currency, which is occasioned by the Bank of England diminishing the frequency of its discounts and loans, and so withholding its usual supplies of notes to the mercantile world. It would seem, therefore, that such cases present quite clearly the fact, that bills of exchange form a part of the currency, and in truth, the experience of large traders and bankers is, that in ordinary times when confidence exists, the vast majority of the commercial payments are made by means of cheques and bills of exchange. These instruments, therefore, form part of the currency: for if they were put down, the value they represent must necessarily be represented by coin or Bank of England notes. What then, it is asked, can be the justice of limiting and fettering one portion of the paper currency when you leave wholly free two other parts of it, in the whole representing immense amounts of money; and why does not the reason assigned for limiting the issue of banker's notes, namely, that when unlimited, the issue of them operates unfavourably on the currency and in trade, equally apply to the other two cases? But this question must be left to the reader's investigation, with the remark that the operation of bills of exchange and cheques on the currency, certainly has not as yet received the notice, which, in the opinion of competent authorities on these matters, it deserves.

It does not seem possible to lay down a rule in regard to the amount of reserve which a banker issuing notes ought to keep by him in order to be safe, both as regards the claims of the note-holders and the depositors: the state of the money market at the time, and the nature of the business or occupation in which the population of the district in which the Bank is, is engaged, are matters which enter largely into the question. In times of complete quiet and confidence, it may be possible to go on, for a period, almost without any reserve at all; especially, for a house of large connections and numerous customers; because in such cases, it is found that the payments in and the payments out nearly balance each other every day. Again, a banker, carrying on business in a great centre of industry, whose customers are manufacturers, merchants, and tradesmen, and where there are not unlikely to be sudden demands to considerable extents made upon him, is bound to keep much more cash or Bank notes in hand than would be necessary in general, if he were banking in an agricultural district.

With respect to the payment of interest upon deposits, this is very seldom done by private bankers in London and the neighbourhood; the system is quite exceptional as regards private bankers in that locality: in the country, especially in the North of England, it is not so unusual.

Banking Copartnerships.—This description of banks, which is frequently but improperly confounded with joint-stock banking companies—bodies with very different attributes, characteristics, and powers—arose out of a statutory enactment, 7 Geo. IV. c. 46. A banking copartnership is also perfectly distinguishable from an ordinary banking partnership. By the combined operation of that statute and the statute 20 & 21 Vict. c. 49, s. 12, these banking copartnerships may now be erected, consisting of ten or fewer partners. Every member is liable for all the debts of the copartnership, whether he be a member when the debt was incurred, or whether he only became so after it was incurred, but before it is satisfied. In words, therefore, the Act considerably enlarges the responsibility of a member of one of these copartnerships, beyond what he would have lain under as a member of an ordinary partnership; but, in practice, the difficulty, expense, and delay of realising the intended boon to the creditor is found to make it of little avail. These copartnerships are empowered and must sue and be sued in the name of a person whom each of them is bound to appoint, and who is called the public officer of the copartnership: and the creditor, having brought his action against such public officer and obtained judgment, sues out execution against any existing member or members: if these executions are ineffectual, he may issue execution against any persons who were members at the time the contract was entered into; secondly, against any persons who were members at any time before such contract was executed; thirdly, against any persons who were members at the time the judgment was obtained: provided only, that execution cannot issue against any of the persons designated in these three classes, if three years have elapsed. Such of these bodies as were issuing their own notes on 6th May, 1844, may make their notes or bills of exchange payable in London by their agent, or may draw any bill of exchange or note payable on demand or otherwise in London, for any less amount than 50*l.* (3 & 4 Will. IV. c. 83, s. 2). These bodies are also allowed to carry on the business of banking in London or within sixty-five miles, provided they do not borrow, owe, or take up in England any sum on their bills or notes payable on demand or at any less time than six months from the borrowing, during the continuance of the privileges of the Bank of England (3 & 4 Will. IV. c. 98, s. 3); and the acceptance of a customer's bill at less than six months' date, on account of a balance in favour of the customer, is a borrowing in point of law forbidden by the statute. The average date of bills drawn in this country by traders or by bankers in this country is within three months, except the bills of the manufacturing districts: this enactment therefore has an extensive operation. These bodies are obliged to make an annual return of the names, &c., of all their members, verified on oath; also returns of persons newly becoming members, persons ceasing to be members, &c.; and it is most important for every member to see that these returns are properly made, because upon their accuracy may often turn the question of the liability or non-liability of a shareholder, when a judgment has been obtained against the company. The internal concerns of these bodies are commonly regulated by what is called a deed of settlement, to which all the partners are parties; their affairs are superintended by directors, but the real effective officer, in truth the banker, is usually called the manager. The capital is usually divided into shares, which are transferable commonly, under the restriction that the consent of the directors shall be a requisite to the transfer. Hence the purchase-money of a share can only be safely paid over to the vendor of the share, *after* the transfer has been fully completed.

It is extremely important for directors to be at all times aware of the transactions of the copartnership: it has been found to be far too much the practice to leave everything to the manager, who, in that state of things, by want of skill or knowledge or foresight, may involve the concern to ruinous extents. On the other hand, directors may incur heavy responsibilities by travelling out of the strict line of their duty as bankers: thus, where some of the directors of one of these bodies, by reason of unauthorised speculations in shipping, &c., and of a fraudulent transaction by deed of arrangement with a debtor of the copartnership, had involved it in losses, so that the copartnership was insolvent and ceased to carry on business, it was considered that the public officer might, notwithstanding that the body was in a state of suspended vitality, recover from these directors the amounts of the losses incurred through their misconduct; the sums recovered to be applied for the liquidation of the claims upon the copartnership. Directors cannot bind the shareholders severally by any instrument or writing which they may utter: thus, "We for ourselves and the other shareholders of the company jointly and severally promise to pay," signed by directors, is a document of no validity to bind the shareholders individually; though such a document appearing on the face of it to be intended to bind the copartnership, would have that effect, provided the directors signing it were authorised to sign promissory notes.

We have mentioned instances in illustration of the strictness with which the law enforces, against private bankers, the rules it lays down: these bodies are not less strictly dealt with: If a manager of a branch, wholly without the knowledge of the directors or any member of the copartnership, by fraud or circumvention of any kind, deceives a customer of the bank who acts in reliance on his position as manager of the bank, and loss ensues to the customer, the copartnership must make it good. If a body of this class, in acknowledgment of money deposited with them by a customer, gives an accountable receipt signed by a clerk, the course of dealing being that the parties to whom such receipts were given returned them to the Bank once a year to be cancelled, when they were paid off, or allowed the interest for the past year, and took fresh receipts in the room of those delivered up; and after the death of a customer, and pending a contest for the administration of his estate, the receipt comes into the hands of a stranger, who fraudulently obtains payment for it at the Bank, when the receipt was given up and cancelled by tearing off the signature, still the courts of equity hold that the company must pay over again to the real owner of the receipt.

These bodies, as we have observed, must not be confounded with ordinary partnerships. The essential distinction between a banking copartnership, on a large scale, and an ordinary common law trading partnership, consists in the power and privilege which, by the provisions of the deed of settlement of the former, are given to a proprietor to retire and withdraw his capital from the concern, without a dissolution of the partnership, by transferring his shares. This power and privilege constitute very main inducements to the investment of capital in such concerns, and thereby enable the society, or partnership, to raise a capital and carry on transactions, which it would be impracticable to raise or carry on upon the basis of an ordinary mercantile partnership. The consequences which, as between a shareholder and the company, arise, by operation of law alone, upon a transfer of shares, cannot, therefore, be inferred from those which attach upon the dissolution of an ordinary partnership. The consequences arising upon a transfer of shares must be sought for in the provisions of the deed of settlement, or in some rule of law not repugnant to those provisions. (See the law stated, Grant's 'Law of Banking,' &c.)

Joint-Stock Companies are regulated by an Act of 1844, 7 & 8 Vict., c. 113, according to which the mode of becoming a Joint-Stock Banking Company is the following:—The persons who wish to be formed into such a company are to petition the Queen in council, and on the report of the Board of Trade that the statutory requirements have been complied with, a charter will be granted: then a deed of settlement is to be executed, containing a number of provisions set out in s. 4 of the statute (which still continue to be law, with this exception, that now by a subsequent statute, 19 & 20 Vict., c. 100, the re-election of retiring directors is permitted), which deed must be executed by the holders of at least one-half of the shares into which the capital of the company is divided. But the liability of the shareholders in this class of joint-stock banks is not to be limited (we shall speak presently of the new legislation permitting the establishment of joint-stock banking companies with limited liability of shareholders); and actions may be brought by, or against, the company or shareholders reciprocally, and every judgment against the company being enforcible against it, and under certain restrictions prescribed in the first-mentioned statute, against shareholders and former shareholders, of which the effect is, that a shareholder is not liable to be sued upon the dealings, covenants, and undertakings of the company; he is only liable upon a judgment against the company. If a judgment is obtained against the company, and execution against it proves unproductive, then by certain legal processes execution may be had against any shareholder, and in the event of *that* proving unavailable to realise the sum due, the creditor may proceed to execution against any person who was a shareholder at the time the cause of action arose, with the limitation of three years, and a shareholder who has been so obliged to pay a debt of the company may be reimbursed either out of the assets of the company or by contribution from the other shareholders. It is necessary also, that the body of persons who wish to be formed into one of these companies should be provisionally registered within three months after the grant of the charter; and before the company shall begin business a memorial is to be made out, setting forth the title of the company, the names and places of abode of all the members and of every director and manager, or other like officers, and the name or firm of every bank established by the company, and the name of every town or place where the business shall be carried on. This is to be repeated every year as long as they carry on business as bankers, and the memorial is to be delivered to the Inland Revenue Office, where it is to be registered, &c. Also a printed list of the registered names and places of abode is to be made out from time to time, and kept in a conspicuous place in the company's principal place of business. A like memorial is also to be made out and delivered to the above-mentioned Board, containing the same particulars of every new director, manager, or other like officer, and the names of all persons who have become members, either in addition to, or instead of, any former members; and the name of every new town in which the company carry on business, and the names of all who have ceased to be members; and such farther account is to be registered, &c., as before. All these memorials are to be signed by the manager, or one of the directors, and verified by his declaration before a magistrate, &c.; and the persons whose names appear at any time in the then last delivered memorial shall be the existing shareholders, so that a person whose name is in the memorial is liable as a shareholder, although the memorial may not have been framed in all respects in the prescribed form. These companies are also required to make the returns required by the statute 7 & 8 Vict., c. 32, s. 21, to be made by every banker in England on the 1st of January, or within fifteen days after, in every year, under a penalty of 50*l.*

The capital stock of a joint-stock banking company under this statute 7 & 8 Vict. c. 113, is in no case to be less than 100,000*l.*, and the shares are not to be less than 100*l.* each, and every deed of settlement must contain specific provisions for preventing the company from purchasing any of the shares or making advances of money, to any person, on the security of shares. In general, there are no means by which a shareholder can be enabled to withdraw from the concern, except he can find some one who will purchase his share, and it is actually transferred to such person. No share can be transferred until all sums due for calls upon it, and upon every other share which the owner of it holds, shall have been paid. From time to time the directors may make such calls on the shareholders in respect of the amount of capital stock respectively subscribed by them, as the directors shall think fit; and, besides being liable to pay calls by way of action, shareholders are liable to forfeit their shares, by leaving calls unpaid, if the directors, at any time after six calendar months from the day appointed for the payment of such calls, declare them to be so forfeited: the shareholders still remaining liable for the calls due before the forfeiture.

The deed of settlement or partnership must contain specific provisions for the management of the affairs of the Bank and the election and qualification of the directors. Any one of the directors is empowered to sign bills of exchange or promissory notes, made, accepted, or endorsed on behalf of the company, provided it be therein expressed to be so made, &c. by him on behalf of the company.

The deed of settlement ought to contain provisions adapted to prevent any declaration of dividends on the capital by the directors, without due regard to the actual state of the company's affairs. The liability incurred by directors, who declare and divide dividends when the profits made by the company do not authorise their doing so, is very heavy. (See 19 & 20 Vict. c. 47, s. 3, compared with 20 & 21 Vict. c. 49, s. 18. See also Grant's 'Law of Banking,' &c., p. 594; 19 & 20 Vict. c. 47, s. 14; 20 & 21 Vict. c. 49, s. 18.) It is no excuse for directors so declaring dividends when the concern is not in such a state as to admit of it, that they did not act under the influence of a desire to pocket the dividends on their own shares, but with a desire of representing the affairs of the Bank to be in a prosperous condition, so as to attract an increase of custom, and to raise the value of the shares, and stimulate the demand in the market for them.

A manager, or other officer, to perform the duties of manager, must be appointed in all cases.

The deed of settlement must contain provisions for the yearly audit of the accounts by two or more auditors, chosen at a general meeting of the shareholders, and not being directors: also, provisions for the publication, once at least in every month, of the assets and liabilities of the Bank; and for the yearly communication to every shareholder of the auditor's report, of a balance sheet and profit and loss account. As regards the requirement of the law, that these banks should make periodical statements of their affairs, experience has shown these documents to be capable, by dexterous management, of conveying the most fallacious impressions of the real state of things: by the simple expedient, for instance, of not writing off bad debts, and of considering those to be good engagements which, though perhaps not wholly without value, may be utterly unavailing as banking securities, a fair statement of assets may be presented on the balance-sheet, while in truth a company may be in any thing but a prosperous condition. Such a process, it must be remembered, is always available, almost without any risk of immediate detection; indeed, to a certain extent, it may be a question of opinion when to write off a debt as bad or irrecoverably lost; but still the public, who confide in these accounts, have no available means of ascertaining how far the statements in the periodical balance-sheets or states of liabilities and assets have been framed with judgment and honesty, and how far they are designedly put forward with a view of attracting depositors, keeping up the price of the shares in the market, and generally of deceiving and overreaching. The accounts given, it has been alleged, are not sufficiently explicit: to be serviceable, so as to enable persons consulting them to get a practical insight into the nature of the business, they ought to go into details to some extent, not inconsistent with the secrecy in regard to individual transactions, which is indispensable in banking. For instance, it has been urged that a material improvement in the accounts would be, that they should state the amount of over-due bills held by the company at the time of making out the account, together with the sum they were estimated to be likely to realise. Still, in the opinion of experienced bankers no form of account could be framed, with due regard to secrecy, which would enable the shareholders of a bank in which there was anything going wrong to discover where the fault lay, or to put any check on any misconduct or mismanagement of the directors. In the opinion of the best authorities on the subject, you must in the end trust to the honour and integrity and capacity of the directors and manager. But if the periodically published statements are fallacious, what is the case of the audit? How can it be possible to accomplish an effectual audit of the affairs and transactions of bodies of such a magnitude of business as is done by some of the London Joint Stock Banks, some of which hold from 8 to 13 millions sterling of deposits? In general it is probable all that auditors do, indeed all that they can do, is to examine the balance sheet laid before them by the directors, with the help of such vouchers as they can procure: they can merely vouch for the fact of the balance sheet being correct on the data supplied to them. But an effective audit of a bank is something very different from this; it ought to include a full view of the real position of the affairs. Now in taking an account of the assets of a bank, the highest judgment is requisite, founded on acquaintance with the principles of the art of banking. A bill of exchange is either the very best or the worst asset of a bank, and it depends on the judgment of the person examining the asset whether he counts it as good or bad. For an auditor to give a full account of the actual state of a bank, he must value every security; and how is this to be done in cases, for instance, of securities given by persons unknown beyond the district over which the operations of the Bank extend, without a local knowledge of the parties in the auditor? He ought to be in a condition to follow every transaction, especially with reference to bills of exchange, which might be rediscounted at the moment of the audit and so out of the hands of the Bank, and to be able to judge of all the securities, so as to tell whether they would ultimately turn out an asset of the Bank or a claim upon it; in fact, he must acquire a knowledge of all the affairs of the concern as intimate as that possessed by the directors, or the manager himself, before he would be able to report much more with certainty than whether the book-keeping was right, and that the balances were right, on a comparison of the entries with the vouchers. On the whole, there appear to be insuperable objections in the way of obtaining a really effective audit of the affairs of joint-stock banks.

Very material changes have taken place in this country, both with respect to the increased practice of opening accounts with bankers as current accounts on which to draw and pay in, and also in the new practice of deposit accounts on which money is paid into the joint-stock banks, to be retained by them for a short period, after which interest is paid upon it; and on the other hand it can be withdrawn at a short notice, or in some cases at pleasure. The effect of this system of paying interest on deposits has been to attract to these banks an immense aggregate of small sums, often of sums as small as 10*l.* each, which formerly were most probably hoarded. This seems to be a fair and just inference, because from the nature of the case the small sums which are said to form the majority of the deposit accounts of joint-stock banks, could not have formed the subject of accounts in the old banks, and therefore could not have been taken from the private banks in order to be transferred to the joint-stock banks, and the published accounts of the savings' banks show no diminution of the deposits there; so the result seems to be that the joint-stock banks, by the advantages which they hold out, have succeeded in drawing together vast numbers of small sums which previously were hoarded, and which are now placed in the hands of these companies as a kind of investment, where a moderate interest can be enjoyed without the trouble and expense, and sometimes the loss, with which the conversion of other securities is attended. The advantage to the community of this system is stated to be, its tendency to foster habits of prudence and self-denial in the classes of small tradesmen, artisans, mechanics, servants, &c., by furnishing them with the means of obtaining interest for whatever they may save. The disadvantage arises from the result to which the system has been successful; this it is said consists in the peril arising from such enormous masses of money being held at call, or nearly so, and bearing interest, a posture of affairs which compels the joint-stock banks, in order to make a profit, to find instant employment of the money, which necessarily must be effected by discounting bills, of an inferior character to those which they would have dealt with, had the pressure on them to turn their deposits to advantage been less stringent and overpowering. The system is accordingly looked upon with disfavour and apprehension by very high authorities in banking. The following is a statement of the amount of deposits in the London joint-stock banks on the 31st of December, 1857, except in the cases of the Union and the Commercial banks, the accounts in which are made up to the 30th of June.

1857.	
London and Westminster	£13,889,021
London Joint-Stock	10,737,589
Union	10,874,640
Commercial	936,724
London and County	3,533,425
City	1,388,933
Bank of London	1,114,846
Unity	117,380

There is no attempt, however, to deny that it was in fact by means of the large deposits made by the joint-stock banks, in the Bank of England, during the crisis of 1857, that the Bank of England was, in part, enabled to make the advances which it did make for the accommodation of the commercial body. The joint-stock banks, in order to be ready to meet the claims which their depositors might make upon them, instead of employing those deposits by discounting with them, for others than their customers, preferred, for the time, to deposit their reserves, beyond what they kept in their own tills, with the Bank, whence any sums they might want might be withdrawn at pleasure, and so were amply prepared for the crisis. The Bank of England, on the other hand, employed a large portion of these deposits in discounting the bills and advancing upon the securities that were brought to it, by houses requiring accommodation. The joint-stock banks may thus be said to have increased the power of the Bank of England to grant accommodation to trade in times of stagnation and collapse of confidence; first, by drawing within the sphere of banking operations large aggregates of moneys, which formerly never found their way into banks at all, and then by opening accounts with the Bank of England and placing there their reserves, at seasons when they might be turned to the above purpose.

The interest allowed to their depositors by the London joint-stock banks was till lately governed by the Bank rate of the day, being mostly one per cent lower than that rate; now however, they do not observe that rule, but pay more nearly according to the rate of interest which rules in the general money market.

As to the profits of joint-stock banks, it is necessary to distinguish carefully between profits and dividends. The profits are made on the whole funds that the bank employs in making loans, investing in securities, &c.; the dividends are the rateable division at so much per cent. upon the paid-up capital of the shares. Therefore, where the funds employed as above are large, a small per centage of profit on them may supply a large dividend per cent. on the paid-up capital. This distinction, obvious though it be, has frequently been overlooked, and it is asked, when joint-stock banks announce dividends of 18 or 20 per cent., how it is possible to account for such *profits?* An example will show this clearly. A joint-stock bank paying 20 per cent. dividend had paid-up capital of 600,000*l.*, and on 1st January, 1858, its deposits were 10,700,000*l.* Then, supposing its capital to be invested in government securities paying 3 per cent. per annum interest, and an interest of only 1 per cent. per annum to be derived from its deposits, the two sums thus produced make a total which accounts for the dividend.

The practice of rediscounting has been inveighed against with severity, but perhaps without sufficient grounds for that severity of censure with which it is often spoken of. It is in fact one means of transferring the surplus capital of one district to another where it is wanted; thus a bank in Norwich sends up the money for which it can find no profitable employment in its own district, to an agent or a bill-broker in London, with whom it places the money at call and receives interest. Another bank, in a district where there is a demand for money, say Manchester, sends up the bills of exchange that it has discounted, to the same bill-broker in London, who rediscounts the bill with the money he has received from the bank at Norwich, and thus the money is transferred from Norwich to Manchester. In fact, as experience shows, any firm, however prudently conducted, may find it convenient under extraordinary circumstances of pressure, to change, in this way, some of its first-class bills. But, however this may be, the London joint-stock bankers, it seems, never rediscount. (Evidence before Committee on the Bank Act, &c., 1858, Q. 1164, 2245; and see 3 Hansard's 'Debates,' vol. 95, col. 392.) It is true the system may be abused, and instances have occurred where provincial joint-stock banks have discounted paper which they sent up for rediscount in London, and which was so rediscounted solely on the credit of the Bank's endorsement, the other names on it being those of persons of no credit at all. This system of rediscounting is quite distinguishable from lending money upon the security of bills deposited with the lender; a practice to which there seems to be no objection entertained by any one, and which a bank may follow with perfect security. When a banker lends money on the security of bills which the borrower deposits with him, returning to the latter the bills when he recalls the loan, that is no more a rediscount than lending money on the deposit of Consols is.

Joint-Stock Banking Companies (*limited*).—Banking companies on the joint-stock principle, but with liability of the shareholders for the debts incurred by the companies limited to the extent of those shares, are now permitted to be established under the statute 21 & 22 Vict. c. 91.

Banking in Ireland.—In 1783, a national bank, called the Bank of Ireland, was established by charter in Ireland, with similar privileges to those enjoyed by the Bank of England under the Act of 1708. The management is vested in a governor, deputy-governor, and fifteen directors, of whom five go out annually; the election is by a "house list," which is usually adopted by the proprietors.

In 1845 was passed the Act (8 & 9 Vict. c. 37) which now regulates the issue of bank notes of the Bank of Ireland, and the issue of private bankers' notes, &c., by regulations closely analogous to those contained in the statute 7 & 8 Vict. c. 32, relative to the same subjects in England, the great difference being, that the Bank of Ireland note is not made a legal tender in Ireland.

The capital of the Bank of Ireland is 3,000,000*l.* Irish, being about 2,800,000*l.* English, of which 2,630,769*l.* English is lent to the government. The dividend paid in 1857 was 12¼ per cent. The "rest," which is formed from accumulated profits, is 1,040,000*l.* Thus, about 1,200,000*l.* represents the actual trading capital of the corporation. As regards the issue of notes, that privilege was granted to the Bank in consideration of the loan advanced to government, and the issue is 3,738,000*l.*, of which 1,300,000*l.* consists of notes under 5*l.* each. The Bank has invested in government securities to the extent of 2,900,000*l.*; they are expressly prohibited from investing in mortgages. The accounts of the Bank are published in the 'Gazette,' as those of the Bank of England are. The other issuing banks in Ireland are: the Provincial Bank of Ireland (founded in 1825), the National Bank of Ireland, the Belfast Banking Company, the Ulster Banking Company, and the Northern Banking Company. The Bank of Ireland discounts bills of exchange for any person in trade who is known at the office of the secretary of the bank; and they discount at rates varying with those of the Bank of England, so as to avoid making it profitable for persons to send bills to Ireland to be discounted in consequence of the rate being materially lower than that at the Bank of England; and generally, since the removal of the prohibition in the charter from taking more than 5 per cent. interest, and the abolition of the Usury Laws, the rate of interest has been higher than before. The other banks are governed a great deal by the Bank of Ireland in this respect; and when the rate in Ireland is higher than at the Bank of England, bills are sent to England for discount. From one-fourth to one-fifth of the deposits is what the Bank of Ireland usually considers, in ordinary times, to be the proportion to keep in its coffers as a reserve.

The system of clearing in Dublin is the following. An amount of 370,000*l.* of Exchequer bonds is held, in certain proportions, by the different banks; clerks from those banks meet every evening, and where the balance of notes of one bank is above that of the other, Exchequer bonds are given in lieu. If the quantity of Exchequer bonds be thus reduced below two-thirds of the amount which ought to upon the dissolution of an ordinary partnership. The consequences arising upon a transfer of shares must be sought for in the provisions of the deed of settlement, or in some rule of law not repugnant to those provisions. (See the law stated, Grant's 'Law of Banking,' &c.)

Joint-Stock Companies are regulated by an Act of 1844, 7 & 8 Vict., c. 113, according to which the mode of becoming a Joint-Stock Banking Company is the following:—The persons who wish to be formed into such a company are to petition the Queen in council, and on the report of the Board of Trade that the statutory requirements have been complied with, a charter will be granted: then a deed of settlement is to be executed, containing a number of provisions set out in s. 4 of the statute (which still continue to be law, with this exception, that now by a subsequent statute, 19 & 20 Vict., c. 100, the re-election of retiring directors is permitted), which deed must be executed by the holders of at least one-half of the shares into which the capital of the company is divided. But the liability of the shareholders in this class of joint-stock banks is not to be limited (we shall speak presently of the new legislation permitting the establishment of joint-stock banking companies with limited liability of shareholders); and actions may be brought by, or against, the company or shareholders reciprocally, and every judgment against the company being enforcible against it, and under certain restrictions prescribed in the first-mentioned statute, against shareholders and former shareholders, of which the effect is, that a shareholder is not liable to be sued upon the dealings, covenants, and undertakings of the company; he is only liable upon a judgment against the company. If a judgment is obtained against the company, and execution against it proves unproductive, then by certain legal processes execution may be had against any shareholder, and in the event of *that* proving unavailable to realise the sum due, the creditor may proceed to execution against any person who was a shareholder at the time the cause of action arose, with the limitation of three years, and a shareholder who has been so obliged to pay a debt of the company may be reimbursed either out of the assets of the company or by contribution from the other shareholders. It is necessary also, that the body of persons who wish to be formed into one of these companies should be provisionally registered within three months after the grant of the charter; and before the company shall begin business a memorial is to be made out, setting forth the title of the company, the names and places of abode of all the members and of every director and manager, or other like officers, and the name or firm of every bank established by the company, and the name of every town or place where the business shall be carried on. This is to be repeated every year as long as they carry on business as bankers, and the memorial is to be delivered to the Inland Revenue Office, where it is to be registered, &c. Also a printed list of the registered names and places of abode is to be made out from time to time, and kept in a conspicuous place in the company's principal place of business. A like memorial is also to be made out and delivered to the above-mentioned Board, containing the same particulars of every new director, manager, or other like officer, and the names of all persons who have become members, either in addition to, or instead of, any former members; and the name of every new town in which the company carry on business, and the names of all who have ceased to be members; and such farther account is to be registered, &c., as before. All these memorials are to be signed by the manager, or one of the directors, and verified by his declaration before a magistrate, &c.; and the persons whose names appear at any time in the then last delivered memorial shall be the existing shareholders, so that a person whose name is in the memorial is liable as a shareholder, although the memorial may not have been framed in all respects in the prescribed form. These companies are also required to make the returns required by the statute 7 & 8 Vict., c. 32, s. 21, to be made by every banker in England on the 1st of January, or within fifteen days after, in every year, under a penalty of 50*l*.

The capital stock of a joint-stock banking company under this statute 7 & 8 Vict. c. 113, is in no case to be less than 100,000*l*., and the shares are not to be less than 100*l*. each, and every deed of settlement must contain specific provisions for preventing the company from purchasing any of the shares or making advances of money, to any person, on the security of shares. In general, there are no means by which a shareholder can be enabled to withdraw from the concern, except he can find some one who will purchase his share, and it is actually transferred to such person. No share can be transferred until all sums due for calls upon it, and upon every other share which the owner of it holds, shall have been paid. From time to time the directors may make such calls on the shareholders in respect of the amount of capital stock respectively subscribed by them, as the directors shall think fit; and, besides being liable to pay calls by way of action, shareholders are liable to forfeit their shares, by leaving calls unpaid, if the directors, at any time after six calendar months from the day appointed for the payment of such calls, declare them to be so forfeited: the shareholders still remaining liable for the calls due before the forfeiture.

The deed of settlement or partnership must contain specific provisions for the management of the affairs of the Bank and the election and qualification of the directors. Any one of the directors is empowered to sign bills of exchange or promissory notes, made, accepted, or endorsed on behalf of the company, provided it be therein expressed to be so made, &c. by him on behalf of the company.

The deed of settlement ought to contain provisions adapted to prevent any declaration of dividends on the capital by the directors, without due regard to the actual state of the company's affairs. The liability incurred by directors, who declare and divide dividends when the profits made by the company do not authorise their doing so, is very heavy. (See 19 & 20 Vict. c. 47, s. 3, compared with 20 & 21 Vict. c. 49, s. 18. See also Grant's 'Law of Banking,' &c., p. 594; 19 & 20 Vict. c. 47, s. 14; 20 & 21 Vict. c. 49, s. 18.) It is no excuse for directors so declaring dividends when the concern is not in such a state as to admit of it, that they did not act under the influence of a desire to pocket the dividends on their own shares, but with a desire of representing the affairs of the Bank to be in a prosperous condition, so as to attract an increase of custom, and to raise the value of the shares, and stimulate the demand in the market for them.

A manager, or other officer, to perform the duties of manager, must be appointed in all cases.

The deed of settlement must contain provisions for the yearly audit of the accounts by two or more auditors, chosen at a general meeting of the shareholders, and not being directors: also, provisions for the publication, once at least in every month, of the assets and liabilities of the Bank; and for the yearly communication to every shareholder of the auditor's report, of a balance sheet and profit and loss account. As regards the requirement of the law, that these banks should make periodical statements of their affairs, experience has shown these documents to be capable, by dexterous management, of conveying the most fallacious impressions of the real state of things: by the simple expedient, for instance, of not writing off bad debts, and of considering those to be good engagements which, though perhaps not wholly without value, may be utterly unavailing as banking securities, a fair statement of assets may be presented on the balance-sheet, while in truth a company may be in any thing but a prosperous condition. Such a process, it must be remembered, is always available, almost without any risk of immediate detection; indeed, to a certain extent, it may be a question of opinion when to write off a debt as bad or irrecoverably lost; but still the public, who confide in these accounts, have no available means of ascertaining how far the statements in the periodical balance-sheets or states of liabilities and assets have been framed with judgment and honesty, and how far they are designedly put forward with a view of attracting depositors, keeping up the price of the shares in the market, and generally of deceiving and overreaching. The accounts given, it has been alleged, are not sufficiently explicit: to be serviceable, so as to enable persons consulting them to get a practical insight into the nature of the business, they ought to go into details to some extent, not inconsistent with the secrecy in regard to individual transactions, which is indispensable in banking. For instance, it has been urged that a material improvement in the accounts would be, that they should state the amount of over-due bills held by the company at the time of making out the account, together with the sum they were estimated to be likely to realise. Still, in the opinion of experienced bankers no form of account could be framed, with due regard to secrecy, which would enable the shareholders of a bank in which there was anything going wrong to discover where the fault lay, or to put any check on any misconduct or mismanagement of the directors. In the opinion of the best authorities on the subject, you must in the end trust to the honour and integrity and capacity of the directors and manager. But if the periodically published statements are fallacious, what is the case of the audit? How can it be possible to accomplish an effectual audit of the affairs and transactions of bodies of such a magnitude of business as is done by some of the London Joint Stock Banks, some of which hold from 8 to 13 millions sterling of deposits? In general it is probable all that auditors do, indeed all that they can do, is to examine the balance sheet laid before them by the directors, with the help of such vouchers as they can procure: they can merely vouch for the fact of the balance sheet being correct on the data supplied to them. But an effective audit of a bank is something very different from this; it ought to include a full view of the real position of the affairs. Now in taking an account of the assets of a bank, the highest judgment is requisite, founded on acquaintance with the principles of the art of banking. A bill of exchange is either the very best or the worst asset of a bank, and it depends on the judgment of the person examining the asset whether he counts it as good or bad. For an auditor to give a full account of the actual state of a bank, he must value every security; and how is this to be done in cases, for instance, of securities given by persons unknown beyond the district over which the operations of the Bank extend, without a local knowledge of the parties in the auditor? He ought to be in a condition to follow every transaction, especially with reference to bills of exchange, which might be rediscounted at the moment of the audit and so out of the hands of the Bank, and to be able to judge of all the securities, so as to tell whether they would ultimately turn out an asset of the Bank or a claim upon it; in fact, he must acquire a knowledge of all the affairs of the concern as intimate as that possessed by the directors, or the manager himself, before he would be able to report much more with certainty than whether the book-keeping was right, and that the balances were right, on a comparison of the entries with the vouchers. On the whole, there appear to be insuperable objections in the way of obtaining a really effective audit of the affairs of joint-stock banks.

Very material changes have taken place in this country, both with respect to the increased practice of opening accounts with bankers as current accounts on which to draw and pay in, and also in the new practice of deposit accounts on which money is paid into the joint-stock banks, to be retained by them for a short period, after which interest is paid upon it; and on the other hand it can be withdrawn at a short notice, or in some cases at pleasure. The effect of this system of paying interest on deposits has been to attract to these banks an immense aggregate of small sums, often of sums as small as 10*l.* each, which formerly were most probably hoarded. This seems to be a fair and just inference, because from the nature of the case the small sums which are said to form the majority of the deposit accounts of joint-stock banks, could not have formed the subject of accounts in the old banks, and therefore could not have been taken from the private banks in order to be transferred to the joint-stock banks, and the published accounts of the savings' banks show no diminution of the deposits there; so the result seems to be that the joint-stock banks, by the advantages which they hold out, have succeeded in drawing together vast numbers of small sums which previously were hoarded, and which are now placed in the hands of these companies as a kind of investment, where a moderate interest can be enjoyed without the trouble and expense, and sometimes the loss, with which the conversion of other securities is attended. The advantage to the community of this system is stated to be, its tendency to foster habits of prudence and self-denial in the classes of small tradesmen, artisans, mechanics, servants, &c., by furnishing them with the means of obtaining interest for whatever they may save. The disadvantage arises from the result to which the system has been successful; this it is said consists in the peril arising from such enormous masses of money being held at call, or nearly so, and bearing interest, a posture of affairs which compels the joint-stock banks, in order to make a profit, to find instant employment of the money, which necessarily must be effected by discounting bills, of an inferior character to those which they would have dealt with, had the pressure on them to turn their deposits to advantage been less stringent and overpowering. The system is accordingly looked upon with disfavour and apprehension by very high authorities in banking. The following is a statement of the amount of deposits in the London joint-stock banks on the 31st of December, 1857, except in the cases of the Union and the Commercial banks, the accounts in which are made up to the 30th of June.

1857.	
London and Westminster	£13,889,021
London Joint-Stock	10,737,589
Union	10,874,640
Commercial	936,724
London and County	3,533,425
City	1,388,933
Bank of London	1,114,846
Unity	117,380

There is no attempt, however, to deny that it was in fact by means of the large deposits made by the joint-stock banks, in the Bank of England, during the crisis of 1857, that the Bank of England was, in part, enabled to make the advances which it did make for the accommodation of the commercial body. The joint-stock banks, in order to be ready to meet the claims which their depositors might make upon them, instead of employing those deposits by discounting with them, for others than their customers, preferred, for the time, to deposit their reserves, beyond what they kept in their own tills, with the Bank, whence any sums they might want might be withdrawn at pleasure, and so were amply prepared for the crisis. The Bank of England, on the other hand, employed a large portion of these deposits in discounting the bills and advancing upon the securities that were brought to it, by houses requiring accommodation. The joint-stock banks may thus be said to have increased the power of the Bank of England to grant accommodation to trade in times of stagnation and collapse of confidence; first, by drawing within the sphere of banking operations large aggregates of moneys, which formerly never found their way into banks at all, and then by opening accounts with the Bank of England and placing there their reserves, at seasons when they might be turned to the above purpose.

The interest allowed to their depositors by the London joint-stock banks was till lately governed by the Bank rate of the day, being mostly one per cent lower than that rate; now however, they do not observe that rule, but pay more nearly according to the rate of interest which rules in the general money market.

As to the profits of joint-stock banks, it is necessary to distinguish carefully between profits and dividends. The profits are made on the whole funds that the bank employs in making loans, investing in securities, &c.; the dividends are the rateable division at so much per cent. upon the paid-up capital of the shares. Therefore, where the funds employed as above are large, a small per centage of profit on them may supply a large dividend per cent. on the paid-up capital. This distinction, obvious though it be, has frequently been overlooked, and it is asked, when joint-stock banks announce dividends of 18 or 20 per cent., how it is possible to account for such *profits?* An example will show this clearly. A joint-stock bank paying 20 per cent. dividend had paid-up capital of 600,000*l.*, and on 1st January, 1858, its deposits were 10,700,000*l.* Then, supposing its capital to be invested in government securities paying 3 per cent. per annum interest, and an interest of only 1 per cent. per annum to be derived from its deposits, the two sums thus produced make a total which accounts for the dividend.

The practice of rediscounting has been inveighed against with severity, but perhaps without sufficient grounds for that severity of censure with which it is often spoken of. It is in fact one means of transferring the surplus capital of one district to another where it is wanted; thus a bank in Norwich sends up the money for which it can find no profitable employment in its own district, to an agent or a bill-broker in London, with whom it places the money at call and receives interest. Another bank, in a district where there is a demand for money, say Manchester, sends up the bills of exchange that it has discounted, to the same bill-broker in London, who rediscounts the bill with the money he has received from the bank at Norwich, and thus the money is transferred from Norwich to Manchester. In fact, as experience shows, any firm, however prudently conducted, may find it convenient under extraordinary circumstances of pressure, to change, in this way, some of its first-class bills. But, however this may be, the London joint-stock bankers, it seems, never rediscount. (Evidence before Committee on the Bank Act, &c., 1858, Q. 1164, 2245; and see 3 Hansard's 'Debates,' vol. 95, col. 392.) It is true the system may be abused, and instances have occurred where provincial joint-stock banks have discounted paper which they sent up for rediscount in London, and which was so rediscounted solely on the credit of the Bank's endorsement, the other names on it being those of persons of no credit at all. This system of rediscounting is quite distinguishable from lending money upon the security of bills deposited with the lender; a practice to which there seems to be no objection entertained by any one, and which a bank may follow with perfect security. When a banker lends money on the security of bills which the borrower deposits with him, returning to the latter the bills when he recalls the loan, that is no more a rediscount than lending money on the deposit of Consols is.

Joint-Stock Banking Companies (limited).—Banking companies on the joint-stock principle, but with liability of the shareholders for the debts incurred by the companies limited to the extent of those shares, are now permitted to be established under the statute 21 & 22 Vict. c. 91.

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In 1845 was passed the Act (8 & 9 Vict. c. 37) which now regulates the issue of bank notes of the Bank of Ireland, and the issue of private bankers' notes, &c., by regulations closely analogous to those contained in the statute 7 & 8 Vict. c. 32, relative to the same subjects in England, the great difference being, that the Bank of Ireland note is not made a legal tender in Ireland.

The capital of the Bank of Ireland is 3,000,000*l.* Irish, being about 2,800,000*l.* English, of which 2,630,769*l.* English is lent to the government. The dividend paid in 1857 was 12½ per cent. The "rest," which is formed from accumulated profits, is 1,040,000*l.* Thus, about 1,200,000*l.* represents the actual trading capital of the corporation. As regards the issue of notes, that privilege was granted to the Bank in consideration of the loan advanced to government, and the issue is 3,738,000*l.*, of which 1,300,000*l.* consists of notes under 5*l.* each. The Bank has invested in government securities to the extent of 2,900,000*l.*; they are expressly prohibited from investing in mortgages. The accounts of the Bank are published in the 'Gazette,' as those of the Bank of England are. The other issuing banks in Ireland are: the Provincial Bank of Ireland (founded in 1825), the National Bank of Ireland, the Belfast Banking Company, the Ulster Banking Company, and the Northern Banking Company. The Bank of Ireland discounts bills of exchange for any person in trade who is known at the office of the secretary of the bank; and they discount at rates varying with those of the Bank of England, so as to avoid making it profitable for persons to send bills to Ireland to be discounted in consequence of the rate being materially lower than that at the Bank of England; and generally, since the removal of the prohibition in the charter from taking more than 5 per cent. interest, and the abolition of the Usury Laws, the rate of interest has been higher than before. The other banks are governed a great deal by the Bank of Ireland in this respect; and when the rate in Ireland is higher than at the Bank of England, bills are sent to England for discount. From one-fourth to one-fifth of the deposits is what the Bank of Ireland usually considers, in ordinary times, to be the proportion to keep in its coffers as a reserve.

The system of clearing in Dublin is the following. An amount of 370,000*l.* of Exchequer bonds is held, in certain proportions, by the different banks; clerks from those banks meet every evening, and where the balance of notes of one bank is above that of the other, Exchequer bonds are given in lieu. If the quantity of Exchequer bonds be thus reduced below two-thirds of the amount which ought to be held, the party so reducing it is obliged to purchase from some of the others, and to give a draft on London for the amount.

The country circulation of Ireland is regulated in this manner, under the Act of 1845. There is a certain amount limited in the Act, to which each bank of issue may issue notes; all issues of notes beyond that must be made against a corresponding value of bullion. The objection against making the Bank of England note a legal tender in Ireland is that, so far as Ireland is concerned, such portion of the currency as might be constituted of Bank of England notes would be practically inconvertible, unless, at any rate, the Bank of England had some branch in Ireland at which gold should be payable for the notes on demand.

All the banks of issue in Ireland issue notes under 5*l.* each. The Bank of Ireland issues 1*l.* notes and 3*l.* notes; but the circulation of 3*l.* notes is not considerable. Some of the other issuing banks issue 2*l.* notes as well as 1*l.* notes. Previously to the failure of the Tipperary Joint-stock Bank, in 1855, all panics or runs upon banks had been observed to originate with the holders of the small notes; but since that bank, which was a bank of deposit only, stopped payment, runs have commenced with the depositors. The panic of 1857, which extended all over the country, was to the greatest extent among the depositors.

The joint-stock banks are four in Dublin (some of these having branches extending over every part of the country), and three in the country. The Bank of Ireland is the only chartered bank, and has twenty-six branches. The joint-stock banks all allow interest on deposits, there being a general understanding that one shall not allow a higher rate than another, the deposits being partly held on call and in part on notice. The Bank of Ireland allows no interest on deposits. The joint-stock banks of Ireland are not obliged to publish periodical statements, showing the amount of their deposits. Usually the number of shareholders in an Irish joint-stock bank is very considerable, some of them being wealthy persons, but the greater number of them are represented to be widows, clergymen, and persons who have small sums, and are dependent on the incomes arising from them. The same change in the practice of opening accounts with a banker which has been mentioned as having been so widely manifested in England of late years, has also been observed in Ireland, and has caused large accumulations of deposits in the hands of the joint-stock bankers, and banking operations have very much increased accordingly. ('Evidence before Committee,' &c., 1858, pp. 264-287.) The law in Ireland, founded on a statute of the Irish parliament, is understood to prohibit private bankers (that is, bankers other than joint-stock bankers) from paying interest on deposits. (*Ib.* Q. 5805.)

V. *Scotch system of Banking.*—There are three incorporated public banks in Scotland: one of these, called the Bank of Scotland, was established by act of the Scottish parliament in 1695; another, called the Royal Bank of Scotland, received a royal charter in 1727; and the third, the British Linen Company, was incorporated in 1746, for the purpose of undertaking the manufacture of linen, but now operates as a banking company only; its capital is 500,000*l.* None of the Scotch banks have exclusive privileges resembling those of the Bank of England and Bank of Ireland.

The capital of the Bank of Scotland was originally 1,200,000*l.* Scots, or 100,000*l.* sterling money, divided into 1200 shares. This capital has since been augmented at different times, and now amounts to 1,500,000*l.* sterling, but of this sum only one million has been paid up by the subscribers. This bank began to establish branches in 1696, and issued notes for 1*l.* each, in 1704. It also began very early to receive deposits, for which it allowed interest; and in 1729 it introduced the plan of granting credits on cash accounts, which now forms a principal feature of the Scotch banking system.

The nature of these cash accounts consists in the Bank giving credit on loan, to the extent of a sum agreed upon, to any individual or house of business that can procure two or more persons, of undoubted credit and property, to become surety for the repayment, on demand, of the sum credited, with interest. When a person has obtained this credit, he may employ the amount in his business, paying interest only upon the sum which he actually uses, and having interest allowed to him from the day of repaying any part of the loan. These loans are advanced in the notes of the Bank, whose advantage from the system consists in the call which these credits produce for the issue of their paper, and from the opportunity which they afford for the profitable employment of part of their deposits. In order to render this part of their business as advantageous and secure as possible, it is necessary that the credits should be frequently operated upon; and if the managers of the Bank find that they are used as dead loans to produce interest only, or that the operations of the borrower are infrequent, so that the amount of notes called for is inconsiderable during the year, they will speedily put an end to the credit, it being to the interest of the Bank to keep up an active circulation of its notes.

These cash accounts are found to be very advantageous to traders, by supplying an additional capital, for the use of which they pay only in proportion to the amount of it which they employ; but they are not so generally used now as they were some time ago; the majority of them are probably for sums under 1000*l.* each.

The management of the Bank of Scotland is vested in a governor, deputy-governor, twelve ordinary and twelve extraordinary directors. They are chosen every year by the stockholders having 250*l.* of stock or upwards. The management of the various branches, which are opened in all the principal towns in Scotland, is confided to cashiers or agents.

The Royal Bank of Scotland had at first a capital of 150,000*l.*, which has since been increased to 2,000,000*l.* The system of business adopted by this establishment, and by the British Linen Company, is the same as that of the Bank of Scotland, which has already been described. These three banks are incorporated with limited liability.

The statute of 1845 (8 & 9 Vict. c. 38), containing provisions analogous to those of the Bank Charter Act of 1844, which regulated the issues of the note-issuing banks of England, regulates the Scotch paper circulation. The average of the gold circulation for 3 years previous to 1845 was under 400,000*l.*; since then the average gold circulation has been always above 1,000,000*l.* Of the paper circulation, very nearly two-thirds usually consists of notes under 5*l.* The total authorised note circulation is about 3,000,000*l.*; and for all that the banks issue above that sum they are obliged to hold sovereigns. The banks are considered not to be so strongly in favour of a continuance of the 1*l.* note circulation as they were in 1826. There appear to be no banks in Scotland which are not banks of issue.

Besides the system of cash accounts, a principal point in the Scotch banking system is the maintenance at all times of large reserves in government securities, or in cash; and particularly that there should always be a large reserve in London, where, in point of fact, all the large claims upon the Scotch banks are finally liquidated. The older banks regard as a proper reserve, a sum equal to about one-fourth or one-third of their liabilities on their notes and deposits. The Scotch banks allow a moderate rate of interest (2, 3, or 3½ per cent.) upon money deposited with them, whether upon what are called deposit receipts or on current accounts; in 1858, it was 2 per cent. The interest they charge on cash credits, or overdrawn accounts, has been 6½ or 7 per cent., in times of pressure; at present (1859) it is much lower, and is usually about 5 per cent. Since 1845 they have charged in addition one-half per cent. commission. Many of the depositors lodge their money permanently as an investment. When a deposit account is opened, a receipt for the amount is given to the depositor; if he wishes to remove it, on his presenting the receipt, the deposit is returned; or he can pay in again a portion of the sum, if he does not require the whole, when a fresh receipt for such portion is handed to him. The system of deposits removeable at a notice, the interest paid being of course higher, has not succeeded in Scotland.

Banking has for a considerable period been carried on more largely, and the habit of keeping an account with a banker is incomparably more general, in Scotland than in England. In 1847 it was estimated that the total of deposits in the Scotch banks was not less than 30,000,000*l.*; in 1858, several witnesses before the Committee on Banking spoke of the probable amount as not less than 50,000,000*l.* Of late years there has been a great increase in the number of branch banks (no new banks have been erected since 1845); and the aggregate of the banks, including branches, is larger than the aggregate of banks and branches in England. To a considerable extent there prevails a desire amongst Scotch bankers that the Bank of England note should be made a legal tender in Scotland. ('Evid. before Committee,' &c. 1858. Q. 3197-3199.)

(The works consulted in the preparation of the foregoing article were the following: Smith's *Dict. of Greek and Roman Antiquities*; Adam's *Roman Antiquities*; Gilbart's *Logic of Banking*; Porter's *Progress of the Nation*; Lawson's *History of Banking*; *The Bankers' Magazine*; *The Evidence before the Committee on Bank of England Charter Acts, &c.*, 1858; and others.)

BANK NOTE MANUFACTURE. Considerable mechanical ingenuity has been shown in devising the best modes of manufacturing bank notes, to ensure that they shall be light, durable, and not easily imitated by forgers. The making of the paper, the engraving of the steel-plate, and the numbering of the notes, have all called forth this ingenuity.

Many of the banks in the United States have adopted the use of a peculiar kind of paper made expressly for bank notes. There are introduced into the body of the piece of paper for each note as many cotton threads as will show the value of the note in dollars, up to certain limits: or at least, that a definite number of threads shall represent a definite value in the note; so that no chemical or mechanical tampering with the printed part of the note will prevent the paper from revealing the true original value.

In respect to the plates from which bank notes are printed, they used formerly to be formed of copper; but as this material soon wears away, a mode of using steel plates was devised by Messrs. Perkins and Heath, by which a surprising number of copies may be taken. A block or thick plate of steel is softened on the upper side; the device is engraved on this softened surface; the block is hardened by a very careful process after the engraving; the device is transferred, by intense pressure, from the hardened block to the convex surface of a small soft steel roller; the roller is hardened, and the device is transferred from it to any number of softened steel plates; and lastly, these plates are hardened after the transfer, and are then in a state to be printed from. By this beautiful train of operations one originally engraved block is made to suffice for an almost endless number of printings.

The mode in which the writing, the emblems, and the ornaments are combined in a bank note, is so planned as to render forgery difficult. The *numbering* is a remarkable process, as now performed. In 1809, the Bank of England adopted a numbering press invented by Mr. Bramah, by which the expense and uncertainty of finishing annually a large number of bank notes with a pen were materially diminished, and forgery rendered more difficult. The machine was, however, so far incomplete that it produced only units, the tens and hundreds requiring to be brought forward by hand. In 1813 a machine invented by Mr. John Oldham, and used at the Bank of Ireland, had the additional power of effecting numerical progression, from 1 to 100,000, by its own operation; one of these machines was subsequently attached to each press for printing the body of the notes, in order to register and check the number of notes passing through the press.

In 1819 Mr. Bryan Donkin invented a counting machine, applicable to the numbering of notes. Like most others of the kind, its action depended on the relative motions of a series of ratchet wheels with projecting rims, having notches cut in them; so that when the first wheel counted units, the second wheel indicated tens, and so on progressively. When Mr. Thomas Oldham succeeded his father, Mr. John Oldham, as engineer to the Bank of England, he endeavoured to improve on the instruments previously constructed, and devised the following form of apparatus:—Four wheels each divided by ten notches, leaving a facet between each pair, engraved with consecutive numbers from 1 to 0, are placed upon a shaft; a portion of their breadth being turned down about one-half of their depth, having a boss or collar between every two. Upon these bosses, and filling up the spaces, rest latches; and over each wheel is a pall, the width of the first being equal to that of the unit wheel, and the breadth of the others equalling that of the wheel and latch. The palls are driven by a crank; by each revolution of which the first wheel is moved through a space equal to one-tenth of its entire circumference, bringing regularly forward the numbers from 1 to 0. When the figure 0 is reached, the latch of the second wheel is depressed, and the wheel moves forward one division, marking the tens. The same process is repeated with regard to the other wheels; and thus any amount of numbers can be registered, by simply increasing the number of wheels in proportion. Machines of this kind were extensively adopted in the Bank of England; with, of course, an inking apparatus to apply to the types.

A patent was taken out in 1844 for a mode of printing bank notes, intended to obviate the liability to forgery. The surface is covered with two designs, one geometrically regular, and the other very irregular; the two designs are engraved on different plates, and are printed with different inks, the one with visible and the other with invisible ink. Both of the inks are delible or removeable by chemical means; and the usual engraving of a bank note is printed on paper which has already undergone this preparatory or ornamental printing. The rationale of the suggestion is this: that whatever means a forger might take to alter by chemical agency the letters or figures, or to transfer them by lithographic or anastatic processes, the state of the paper would betray him; for he would remove some parts of the design in the one case, and fail to transfer it in the other. The method was patented on individual responsibility, and has not been adopted by the Bank of England.

Notwithstanding all the ingenuity displayed, and novelties introduced, the commercial world has never felt satisfied as to the security of bank notes from forgery. Public bodies have more than once taken up this subject. In 1819 the Society of Arts appointed a committee to inquire into the best modes of engraving and printing bank notes; and many persons are now of opinion that if the report of that committee had been acted on, the forgeries during the last forty years would have been less numerous than they have been. The enquiries were suggested, not merely by the commercial loss consequent on forgeries, but by a repugnance on the part of the public to the terrible punishment inflicted for this crime. Between the years 1797 and 1817, there were 870 prosecutions for forgery of bank notes, followed by the execution of more than 300 persons. In six years, 1812 to 1818, more than a hundred thousand forged notes were stopped at the Bank; sometimes they poured in at the rate of a hundred a day. Not only did the Society of Arts take up the subject, but a Government Committee was also appointed, to which no fewer than 180 projects (mostly relating to intricate designs of note-engraving) were submitted. It is remarkable, however, how little practical benefit resulted from all these enquiries; the suggested inventions were neglected, and almost went out of recollection. Down to the year 1855, all the bank notes were produced by various combinations of the inventions of Perkins and Heath, Bramah, Oldham, and Donkin, already adverted to. The paper was made at one particular paper-mill in Hampshire, by a peculiar and special operation. [PAPER MANUFACTURE.] The engraving was effected by the transfer method above described, sometimes called *siderographic;* the engraving being transferred and re-transferred, from dies to rollers, and from rollers to plates, having various degrees of hardness. The engraving of two notes was upon one plate. The sheets of paper (each for two notes) were damped for printing, by the operation of an ingenious exhausting vessel, which forced moisture into them at the rate of 30,000 sheets per minute. In the printing room of the Bank of England, after the plates had been heated over steam-boxes, they were printed with steam power. The printing was of the "copper-plate" kind, unlike surface or "letter-press" printing; that is, the ink went into the cavities of the device on the plate, and not upon the surfaces. By a very delicate piece of mechanism, the printing presses recorded the amount of their own work on a registering dial; so that any surreptitious printing was impossible. The working power was generally such as to print about 30,000 bank notes per day. The ink, like everything else in the operation, was specially prepared; it was made from the charred husks of Rhenish grapes, combined with boiled and burnt linseed oil; and it was the blackest and most indelible of all inks. The prevention and detection of forgery were attempted by the truly remarkable mode invented by the Oldhams for printing something or other on every note different from every other note. These varying elements were *dates, numbers,* and *denominations.* There might be many notes of the same date, many bearing the same number, many of the same denomination; but never any two notes that agreed in all these three particulars. These results were produced, partly by the mechanism of the register-printing machines, and partly by the use of certain secret numbers and symbols, known only to the Bank authorities.

Such, we have said, was the mode of operation down to the year 1855; and such in many of its features is the plan still adopted; but important changes have been made in other particulars. In 1851, Mr. Smee, surgeon to the Bank of England, suggested to the directors that the time had arrived for the adoption of *surface* printing instead of *plate* printing, in the preparation of the notes, as admitting of greater rapidity, and more complete identity of appearance. Although objecting to any additional change in the form or device of the note, the directors consented to the prosecution of a series of elaborate experiments. In these experiments Mr. Smee was assisted by Mr. Hensman, engineer to the Bank, and by Mr. Coe, superintendent of the note-printing machines. Engravers, press-makers, paper-makers, and ink-makers, all contributed their opinions or inventions towards the preparation of bank notes by surface-printing. At length, in 1854, all the difficulties were surmounted: on the 1st of January, 1855, the first bank note appeared under the new system. The bank note differs very little from its predecessor; the Britannia is, perhaps, somewhat more artistic; but the letters, figures, and flourishes are scarcely altered. Indeed, it was a fixed policy on the part of the directors to render any change in the appearance of their bank notes as little perceptible as possible. The great novelty was in the preparation of the plate for surface-printing. Until the year 1837, the device was engraved on the plate itself from which the impressions were to be printed; from 1837 to 1854, the engraving was managed on the siderographic process; but on the new system, introduced in 1855, the design for the note is made up and engraved on several small pieces of copper, brass, and steel, according to the quality and minuteness of the engraving; the lines of the device being raised instead of sunken. From the model thus made a metallic mould is obtained, by electro-deposition. Mr. Smee's platinised silver voltaic batteries are employed as the source of power. These batteries had already been advantageously used in multiplying the copper-plates for the Ordnance maps. The model is left in the precipitating-trough containing sulphate of copper solution until a layer of copper has been deposited upon it thick enough to bear handling; the device of course appears on this film in intaglio, not in relief, and serves as the mould from which copies of the original model are to be made. Being separated from the original model, and again immersed in the solution, this mould receives a deposit, which, when thick enough, is separated from the mould giving the device. It is this, in relief instead of intaglio, when backed up and strengthened by solder or other metal, which forms the plate from which Bank of England notes are printed. There are about seventy or eighty kinds of Bank of England notes, differing either in their denominations (*5l.*, *10l.*, &c.), or in the town where they are issued (London, Manchester, Birmingham, &c.); each of these has required its own original model; but any one model would suffice for an almost endless number of notes,—seeing that one model will yield an indefinite number of moulds, and one mould an indefinite number of plates; by the electro-metallurgic process, nearly ten million bank notes are printed annually without any necessary renewal of the original models. The paper, supplied by the same establishment in Hampshire which has furnished bank note paper for a long series of years, is manufactured in a manner which exhibits almost as many novelties as the preparation of the plates. Until the year 1855, the 'water-mark' (one of the safeguards against forgery) was produced by forming a device with fine wire in the mould or frame employed in making the paper. Now, however, the device for the water-mark is engraved on steel-faced dies, and transferred by stamping to brass plates; by a delicate process, these brass plates are adjusted to or within the paper-making mould. There is a gradation of light and shade in the present water-mark, very difficult to imitate. The sheets of paper, before they leave the Hampshire mill, undergo a process of dry-glazing by rolling. It has been necessary to make a change in the ink as well as in the paper, in adapting the arrangements for surface-printing; the bank note ink, instead of being prepared from the husks of Rhenish grapes, is made by a combination of a peculiar varnish with the soot resulting from burning coal-tar naphtha in closed chambers. The printing presses, and the mode of printing, differ materially under the present surface-printing system, as compared with the old plate-printing; the mechanism comprises many beautiful novelties.

Excellent as are now the Bank of England notes, there are not wanting experienced men who contend that a more elaborate device, practicable only by the plate-printing method, would be better. Forgery has diminished, but it has not quite died out. The Bank directors opposed any marked change in the simplicity of the device on these grounds:—that forgers can imitate elaborate engraving sufficiently well to deceive the public, if not bank clerks; that parti-coloured notes, invented by Sir William Congreve, were successfully imitated; that the general public, not being judges of artistic effect, and having little discrimination for the different styles of different artists, are apt to be easily deceived by the same *general* appearance in a forged note that they have been familiar with in a real note, and take imperfect imitations of it quite as readily; and that, on the whole, long familiarity with one form of inscription, and one style of ornament, is the best preventive against forgery. These opinions were contested by Mr. Henry Bradbury, in a Lecture delivered at the Royal Institution, on the 9th of May, 1856; the lecture was afterwards printed as a quarto pamphlet, with engravings of three specimen bank notes, from designs by Mr. John Leighton. Mr. Bradbury contends that the object to be aimed at should be to impart to each bank note an individuality, thereby expressing qualities which are not within the province of mechanical imitation. This is to be done by employing a design of a high artistic character; seeing that the work which has the genius of an artist imprinted on it, is not to be imitated by an inferior mind. The vignette is the part of a note on which the most artistic skill is displayed; and Mr. Bradbury urges that this skill should be still further exercised. Early in the present century the Plymouth Dock Bank, to lessen the forgery of its notes, caused a vignette to be engraved; the forgeries at once ceased. When a really skilful artist can engrave a vignette of high character, his social position and prospects are such as to take him out of the influence and temptation of forgers. The higher the class of the engraving, the less the likelihood of forgery; seeing that the work of every real artist has an individuality about it which others could not imitate. Admitting that the Bank of England note exhibits simplicity of design, Mr. Bradbury remarks, "The objection I have to submit is that its simplicity is *too* simple,—not having upon the face of it those features which characterise the true art-point. The vignette is a specimen the reverse of what I have been advocating; it is alike deficient in conception and execution. Surface-printing having been chosen as the medium, the Bank authorities were restricted in the application of their art. In consequence of this, the Bank of England note in its present form is unworthy of the bank and the nation." Assuming that high art should be employed to give character to the simplest parts of the note, Mr. Bradbury would employ machine-engraving—such as medallion work, and guilloche or rose-engine work—to produce ornamental details of any desired degree of complexity; straight lines, waved lines, circles, ellipses, &c., may be combined in ways almost illimitable. To produce these results—the combination of high art, simplicity with mechanical intricacy, as a double check to the forger—Mr. Bradbury believes that plate-printing would be necessary. Mr. Grubb, engineer to the Bank of Ireland, has expressed opinions very similar to those of Mr. Bradbury.

The electrotype is resorted to as the most perfect and practical mode for multiplying the number of plates. The objection formerly raised to the use of copper is entirely removed; if a copper-plate be covered by electro-deposition with a thin coating of iron or zinc, an unlimited number of impressions may be printed from it: and as the coating can be removed and renewed at pleasure, and *ad libitum*, without the slightest injury to the plate, copper-plates by this treatment will entirely supersede the use of steel-plate engraving and siderography for bank notes.

It may be remarked, that while the current coin of the realm is made at the Government Mint on Tower Hill, the Bank of England notes, which are the property of that corporation, and not of the state, are prepared within the walls of the Bank in Threadneedle Street.

BANKRUPT (*banque-routier*, a bankrupt, and *banque-route*, bankruptcy—from *bancus*, the table or counter of a tradesman, and *ruptus*, broken) is a merchant or trader whose property and effects, on his becoming insolvent, are administered and distributed for the benefit of all his creditors, under that peculiar system of statutory regulations called the Bankrupt Laws. These laws, which originated in England with the statute 34 & 35 Henry VIII. c. 4, were first mainly directed against the criminal frauds of traders, who acquired the merchandise and goods of others, and then fled to foreign countries, or lived in extravagance, and eluded and defrauded their creditors. The bankrupt was consequently treated as a criminal offender; and formerly, the not duly surrendering his property under a commission of bankruptcy, when summoned, was a capital felony. The bankrupt laws are now, and have for some time past, been regarded as a connected system of civil legislation, having the double object of enforcing a complete discovery and equitable distribution of the property and effects of an insolvent trader, and of conferring on the trader the reciprocal advantage of security of person and a discharge from all claims of his creditors. These laws were till lately spread over a voluminous accumulation of statutes, referring to and depending on each other, and often creating confusion and inconvenience from their diffuse and contradictory provisions. These were, under the auspices of Lord Eldon, repealed, and their provisions altered and consolidated by the general Bankrupt Act (6 Geo. IV. c. 16), which also introduced many important alterations and simplifications. A subsequent statute, 1 & 2 Will. IV. c. 56, constituted 'the Court of Bankruptcy,' and materially altered the mode of administration of this law: it entirely removed the jurisdiction in the first instance in cases of bankruptcy from the Court of Chancery to a Court of Bankruptcy, reserving only an appeal from the judges of that court to the Lord Chancellor, as to matters of law and equity and questions of evidence. Instead of the commission under the Great Seal, which formerly issued to a certain number of barristers-at-law who were permanent Commissioners of Bankruptcy, the above Act substituted a *fiat* of bankruptcy, and introduced other important alterations. This statute was followed by the 5 & 6 Will. IV. c. 29, which reduced the number of judges of the Court of Review, established by the previous act, from four to three; and by the 5 & 6 Vict. c. 122, which introduced some alterations into the law of bankruptcy, further modified the constitution of the Court of Review, and established country courts of bankruptcy in the place of the local commissioners of bankrupt, to whom fiats in bankruptcy were previously directed.

The numerous statutes relating to bankruptcy have again been consolidated by the Bankrupt Law Consolidation Act, 1849, and this has been amended in a few particulars by the 15 & 16 Vict. c. 77, and by the Bankruptcy Act, 1854. These three acts embody the actual law applicable directly to bankrupts and to their estates.

In considering the provisions of the Bankrupt Law, we must explain—

1. Who may be made a bankrupt.
2. By what acts a trader becomes liable to be made a bankrupt.
3. The proceedings by which a trader is made a bankrupt.
4. The assignees, their powers and duties; and the vesting of the bankrupt's property and effects in them.
5. The examination and certificate of the bankrupt.
6. The proof of debts by the creditors.
7. The effect of the bankruptcy on the rights of third parties.
8. Arrangements between bankrupts and their creditors under the control of the court, or by deed; and composition of bankruptcy.
9. The constitution of the Court of Bankruptcy.

1. *Who may be made a Bankrupt.*—The Bankrupt Law Consolidation Act, 1849, s. 65, enacts, that "all alum makers, apothecaries, auctioneers, bankers, bleachers, brokers, brickmakers, builders, callenderers, carpenters, carriers, cattle or sheep salesmen, coach proprietors, cow-keepers, dyers, fullers, keepers of inns, taverns, hotels, or coffee-houses, lime-burners, livery-stable keepers, market gardeners, millers, packers, printers, ship-owners, shipwrights, victuallers, warehousemen, wharfingers, persons using the trade or profession of a scrivener receiving other men's moneys or estates into their trust or custody, persons insuring ships or their freight or other matters against the perils of the sea, and all persons using the trade of merchandise by way of bargaining, exchange, bartering, commission, consignment, or otherwise, in gross or by retail, and all persons who, either for themselves or as agents or factors for others, seek their living by buying and selling, or by buying and letting for hire, or by the workmanship of goods or commodities, shall be deemed traders liable to become bankrupt; provided that no farmer, grazier, common labourer, or workman for hire, receiver-general of the taxes, or member of or subscriber to any incorporated commercial or trading company, established by charter or act of Parliament, shall be deemed as such a trader liable to become bankrupt."

The above enumeration has given rise to a variety of decisions in the courts of law. It is not every single act, or even every series of acts, of buying and selling which constitutes a man a trader within the law: there must be an intention of dealing generally, and of gaining a livelihood by trading. Thus a schoolmaster who sells books to his scholars; a colonel of militia, who occasionally sells regimental horses; a master of hounds, who buys dead horses, and sells off the skin and bones; a farmer who sells the milk of his cows to a retail dealer, or who buys and sells articles not with a view of making profit, but merely as auxiliary to the carrying on his farm;—these and many similar persons have been held not within the bankrupt laws as traders. And the same has been determined with respect to an owner of coal-mines, who digs and sells his coals; a person having a freehold interest or a term of years in a brick-ground, who sells the bricks made from his brick-earth, though if he purchased the materials for making bricks it would be otherwise. If a trader retires from trade, still while his trading debts remain unpaid he may be made a bankrupt in respect of them, but not in respect of debts contracted after his retirement.

2. *The acts by which a Trader becomes liable to be made a Bankrupt.*—These acts are of two sorts: first, those which are only acts of bankruptcy when done with *intent* to defeat or delay his creditors; secondly, certain acts which have that effect, without reference to any intention. The first class are enumerated in section 67 of the Bankrupt Law Consolidation Act, 1849, which enacts, "that if any trader liable to become bankrupt shall depart this realm, or being out of this realm shall remain abroad, or shall depart from his dwelling-house, or otherwise absent himself, or begin to keep his house, or suffer himself to be arrested or taken in execution for any debt not due, or yield himself to prison, or suffer himself to be outlawed, or procure himself to be arrested or taken in execution, or his goods, money, or chattels to be

attached, sequestered, or taken in execution, or make or cause to be made either within this realm or elsewhere any fraudulent grant or conveyance of any of his lands, tenements, goods, or chattels, or make or cause to be made any fraudulent surrender of any of his copyhold lands or tenements, or make or cause to be made any fraudulent gift, delivery, or transfer of any of his goods or chattels; every such trader doing, suffering, procuring, executing, permitting, making, or causing to be made, any of the acts, deeds, or matters aforesaid, with intent to defeat or delay his creditors, shall be deemed to have thereby committed an act of bankruptcy." A few observations will elucidate the several acts of bankruptcy mentioned in the above clause.

Departing the realm.—This must be done with a view to defeat or delay creditors, or it will not constitute an act of bankruptcy; but if it is done with such intention it is an act of bankruptcy, though no creditor may, *in fact*, be delayed by it. The intention is, in general, a question of fact to be decided by a jury. If a man leave the realm in such circumstances that a delay of his creditors will be the almost necessary consequence of his departure, he will be considered to have intended that they should be delayed within the meaning of the law. The word *realm* means the jurisdiction of the courts of England, and therefore departing to Ireland or Scotland, or a British colony, which are out of such jurisdiction, may constitute an act of bankruptcy.

Trader departing from his dwelling house.—If this is done with the intent to delay creditors, it is an act of bankruptcy, though none are actually delayed. And if the trader departs without making the necessary arrangements for carrying on his business, it will be presumed that he had the intention specified in the act. The absence must be voluntary, in order to constitute an act of bankruptcy. And the trader's own declarations of his bad circumstances, of his fears of arrest, &c., are evidence of his intentions, if they accompany corresponding *acts*, such as removing his goods, books, &c.

Or otherwise absent himself.—A trader's absenting himself from his abode, if voluntarily done, and not by means of an arrest, is primâ facie evidence of his intention to delay his creditors. And the absenting himself from the Royal Exchange, if he habitually frequents it, or from any temporary place of resort, may have the same effect. The proprietor of a theatre retiring behind the scenes and giving orders to be denied, was held to commit an act of bankruptcy. But a mere breach of an appointment with an individual creditor will not be so considered, though the breach of an appointment to meet creditors generally may be an act of bankruptcy.

Or begin to keep house.—These words having been adopted in the early statutes respecting bankrupts, have acquired a well-known technical meaning, signifying the trader's retiring or concealing himself in his house or place of business in order to avoid creditors, or the giving orders to be denied in case they should call. A general order of denial is not an act of bankruptcy, unless followed up by actual denial, or by some other act which is evidence of a beginning to keep house. The denial may be at a friend's house, as well as at the house of the trader himself. Closing the doors and shutters of a banking-house has been held a "beginning to keep house," although the trader did not reside at the banking-house.

Or suffer himself to be arrested or taken in execution for any debt not due, or yield himself to prison.—This must be a voluntary yielding to prison by a trader who either is not bonâ fide indebted to the person on whose behalf he is arrested, or who, on his arrest, has funds to pay the debt, but prefers going to prison with a view to defeat his general creditors. A compulsory going to prison under a bonâ fide arrest is only an act of bankruptcy when the imprisonment endures twenty-one days.

Or suffer himself to be outlawed.—That is, if a man keep out of the way with intent to defraud his creditors, in consequence of which he is outlawed for want of due appearance to legal process.

Or fraudulently procure his goods to be attached, &c.—This extends both to fraudulent attachments of the trader's goods under the custom of foreign attachment in London and other cities [ATTACHMENT], and to fraudulent judgments, executions, and attachments (Common Law Procedure Act, 1854), out of the superior courts.

Or make, either within the realm or elsewhere, any fraudulent grant or conveyance of his lands, tenements, goods or chattels.—A conveyance of the trader's property, if executed abroad, is now held an act of bankruptcy.

An assignment of *all* a trader's effects to trustees for the benefit of creditors is a clear act of bankruptcy, since it deprives him of the power of carrying on his trade, goes to defeat the distribution under the Bankrupt Law, and to vest the property in persons of his own choice, instead of those provided by the law. But if *all* the creditors (as often happens) assent to, and sign such an instrument, it becomes valid, since they are then *estopped*, by their assent, from treating it as an act of bankruptcy. And by the 68th section of the Bankrupt Law Consolidation Act, 1849, such an assignment is not to be deemed an act of bankruptcy, unless a petition for adjudication be filed against the trader within three calendar months from the execution; provided the assignment be executed by every trustee within fifteen days from the date of the execution by the trader, and the execution be attested and publicly notified in the manner pointed out by the statute.

An assignment of *part* of a trader's effects is, in many instances, perfectly good and valid; but if he assign the whole with only some colourable exception, it is an act of bankruptcy; and, in general, if he assign over so considerable a proportion of his stock-in-trade and effects as must disable him from carrying on his trade, it is an act of bankruptcy; and if the assignment be made voluntarily, that is without the pressure of the creditor, and with a view to prefer a particular creditor, or creditors, it will, though not made in immediate contemplation of bankruptcy, constitute in itself an act of bankruptcy; and, *à fortiori*, it will have that effect if made under such circumstances as show that the trader must, at the time of executing it, have contemplated bankruptcy. A bonâ fide sale, even if under value, is clearly not an act of bankruptcy.

Or make any fraudulent gift, delivery, or transfer of any of his goods or chattels.—The transfer or delivery must in general, be *voluntary*, and not brought about by terror of legal process, or even by the importunity of a creditor; and, in some cases, even the circumstance of the proposal to make the delivery coming from the creditor and not from the bankrupt, has been held to negative the inference of voluntariness, and to render the transaction valid. But whether of his voluntary motion, or under pressure of a creditor, if a trader transfer over, otherwise than by bonâ fide sale, the whole of his effects, or such a portion of them as must necessarily lead to insolvency and the stoppage of his trade, it now constitutes an act of bankruptcy.

The acts of bankruptcy above enumerated depend upon the trader's presumable intention in doing the act. The following are the acts which constitute acts of bankruptcy, whether done with or without an intention to delay or defraud creditors.

Lying in prison or escaping out of prison.—By the 69th section of the Bankrupt Law Consolidation Act, 1849, "if any such trader, having been arrested or committed to prison for debt, or on any attachment for non-payment of money, shall upon such or any other arrest or commitment for debt, or non-payment of money, or upon any detention for debt, lie in prison for twenty-one days, or having been arrested or committed to prison for any other cause, shall lie in prison for twenty-one days after any detainer for debt lodged against him and not discharged, every such trader shall thereby be deemed to have committed an act of bankruptcy; or if any such trader having been arrested, committed, or detained for debt, shall escape out of prison or custody, every such trader shall be deemed to have thereby committed an act of bankruptcy from the time of such arrest, commitment, or detention."

The bankrupt law does not now, and never did, make the mere circumstance of being arrested an act of bankruptcy. The most substantial trader is liable, under unforeseen emergencies, to be arrested; the presumption of insolvency arises from the fact of lying in prison twenty-one days without being able to satisfy the debt, or of escaping out of prison to avoid its payment.

Filing a declaration of insolvency.—Under the old law no effectual provision was made for enabling an honest debtor, who believed himself insolvent, voluntarily to subject himself to the bankrupt law, and thereby to produce an equal distribution of his property among his creditors. It is now provided that if a trader file, in the court within the district whereof he shall have resided or carried on business for the preceding six months, a declaration of his insolvency, signed by himself, and attested by an attorney, such trader shall be deemed thereby to have committed an act of bankruptcy at the time of filing such declaration, provided a petition for adjudication of bankruptcy shall be filed by or against such trader within three months from the filing of such declaration.

Compounding with petitioning creditor.—By the 71st section of the Bankrupt Law Consolidation Act, 1849, it is provided that if any trader, after the filing of any petition for adjudication against him, shall pay money to the petitioning creditor, or give or deliver to such petitioning creditor any satisfaction or security for his debt, or for any part thereof, whereby such petitioning creditor may receive more in the pound in respect of his debt than the other creditors, such payment, gift, delivery, satisfaction or security shall be an act of bankruptcy; and if adjudication of bankruptcy shall have been made under such petition, the court may either declare such adjudication to be valid, and direct the same to be proceeded in, or may order it to be annulled, and a petition or new petition for adjudication may be filed, and such petition or new petition may be supported either by proof of such last-mentioned, or any other act of bankruptcy.

Trader not paying, securing, or compounding for a judgment debt within seven days after notice requiring payment.—By the Bankrupt Law Consolidation Act, 1849, s. 72, it is provided that if a trader, against whom a judgment has been recovered in an action personal for the recovery of a debt or money demand, shall, after seven days notice in writing, personally served upon him, requiring immediate payment of such judgment debt, fail to pay, secure, or compound for the same, he shall be deemed to have committed an act of bankruptcy upon the eighth day after service of such notice. To give or proceed upon such a notice the judgment creditor must be in a condition to issue execution upon his judgment.

Trader disobeying order of Court of Equity, &c.—By the Bankrupt Law Consolidation Act, 1849, sec. 73, it is provided that if a trader disobey any decree or order for the payment of money made by a court of equity, or in any matter of bankruptcy or lunacy, and duly served upon him, the court by which such decree or order was made may, by its further order, fix a peremptory day for such payment, and if such trader having been personally served with such last-mentioned order seven days before such peremptory day, fail to pay the money as ordered, he shall be deemed to have committed an act of bankruptcy on the eighth day after service of the order.

Filing petition in Insolvent Debtors' Court in England.—By the Bankrupt Law Consolidation Act, s. 74, it is provided that the filing by any trader of a petition in the Court for the Relief of Insolvent Debtors, for discharge from custody, shall be deemed an act of bankruptcy, from the time of filing such petition, if such trader be adjudicated a bankrupt before the time appointed for his being brought up to be dealt with according to the laws for relief of insolvent debtors, or within two months from the making of any vesting order by such insolvent court. The property of such trader by such subsequent adjudication becomes divested out of the provisional assignee of the Insolvent Court.

Insolvency in India.—Analogous provision to the above is made by s. 75, for the case of traders filing petitions in India under the "Act to consolidate and amend the Laws relating to Insolvent Debtors in India."

Arrangement between trader debtor and his creditors.—Section 76 of the Bankrupt Law Consolidation Act, 1849, provides that filing a petition for arrangement by a trader under a subsequent section (211), shall constitute an act of bankruptcy if a petition for adjudication be filed against him within two months from the dismissal of such petition for arrangement.

Acts of bankruptcy by traders who have privilege of Parliament.—As traders being members of parliament are not liable to personal arrest for debt during the time of privilege, some special provisions are requisite as to acts of bankruptcy committed by such persons. Accordingly, it is provided by the Bankrupt Law Consolidation Act, 1849, s. 77, that if any creditor of such trader in an amount sufficient to support an adjudication of bankruptcy, shall file an affidavit of such debt and of the trading in one of the superior courts, and shall sue out of the same court a writ of summons in the special form provided by the Act, and personally serve the same; and if such trader shall not within one month after such service, pay, secure, or compound, for such debt; or give sufficient security for debt and costs in the action, and within the month cause an appearance to be entered in the action, such trader shall be deemed to have committed an act of bankruptcy from the time of the service of the summons.

Non-payment of debt after trader debtor summons.—The Bankrupt Law Consolidation Act, 1849, lastly provides, s. 78, et seq., that a trader upon whom an account of the particulars of a creditor's demand, together with a notice in writing in the form provided by the Act, requiring immediate payment has been served in the manner also by the Act provided, may, upon formal affidavit filed in the Court of Bankruptcy for the district in which the trader resides, and upon summons issued out of such court, be required to appear in such court, and to state whether he admits the debt or not. If he admits it, he is required to sign a formal admission, to be filed in the court, and if he fails to pay the sum admitted within seven days after filing the admission, he is deemed to have committed an act of bankruptcy on the eighth day from the filing the admission. But if he fails to appear or refuse to admit the debt, and do not make a formal deposition upon oath that he believes he has a good defence upon the merits, and do not, if required by the court, enter into a bond with sureties, as provided by the Act, he is deemed to have committed an act of bankruptcy upon the eighth day after service of the summons to appear. But in either case the petition for adjudication must be filed within two months from the filing of the affidavit.

This process by trader debtor summons, as it is called, is found very effective for the recovery of debts, and is much resorted to for that purpose notwithstanding the penalty imposed upon exaggerated claims by s. 86, and the discretion as to costs vested in the court by s. 85. The advantages presented to creditors are expedition and economy in recovering the debt if admitted by a solvent trader, while if denied the trader is put to his affidavit, and may be required to find security for the debt and for the creditor's costs of suit. Traders who are really indebted are thus compelled either to pay their debts summarily or to submit to an otherwise immediate bankruptcy. Great care, however, should be taken in employing this process, and if collateral with an action it should rarely be resorted to until after the defendant has pleaded.

The above are the various and the only acts which, according to the present law, render a trader liable to an adjudication of bankruptcy. No other acts, however strongly they may indicate insolvency or fraudulent intention in the trader, are sufficient to render him a *bankrupt*. The act of bankruptcy may be committed after a trader has ceased trading; for so long as his *trading* debts remain unpaid, he is amenable to the law of bankruptcy. The debt, however, on which the adjudication is grounded must, as before stated, be one which existed during the period of his trading. An act of bankruptcy, in order to support an adjudication, must have been committed within twelve months before filing the petition.

3. *Of the proceedings by which a Trader is made a Bankrupt*—Having considered what persons may be rendered bankrupts, and the several acts and circumstances by which they may become so, we will now shortly explain the peculiar mode of proceeding by which creditors render their debtor a bankrupt.

The adjudication of bankruptcy is made upon a petition of one or more creditors to the Court of Bankruptcy.

If on the single petition of one creditor, his debt must amount to 50*l.*; if of two creditors, not being partners, to 70*l.*; if of three or more such creditors, to 100*l.* This debt must have been contracted while the bankrupt was in trade, or must at least have been at that time subsisting; and it must have been actually due at the time of the act of bankruptcy. If the debt of the petitioning creditor appears on any ground insufficient, the adjudication may be supported on any other debt of another creditor which is legally adequate to sustain it, sec. 103. The petitioner files and prosecutes his petition at his own costs until the choice of assignees by the creditors, and is entitled to have them paid back to him out of the estate when realised. See 'Bankrupt Law Consolidation Act,' 1849, s. 114, and 'Rules and Orders in Bankruptcy,' 114 & 115. If it appear that the debt alleged in the affidavit is not due to the petitioning creditor, or no proof be given that the person petitioned against is or was a trader, and that he committed an act of bankruptcy, and that the petition was filed fraudulently and maliciously, the court may order satisfaction to be made. If the petitioning creditor compound with the bankrupt after adjudication, so as to receive more in the pound than the other creditors, he is liable to forfeit his whole debt, and to repay and deliver up all money or securities received, to the assignees for the benefit of the creditors. In the case of a firm of traders, any creditor whose debt is of sufficient amount may petition either against the firm collectively, or against one or more partners in it. The petition must, unless otherwise specially ordered, be addressed to, and filed, and prosecuted in the court for the district within which the trader shall have resided or carried on his business for six months next preceding the filing the petition. The form of petition is provided by the statute, and its truth must be verified by the affidavit of the petitioner. Upon proof of the petitioning creditor's debt, of the trading, and of the act of bankruptcy, the court adjudges the trader a bankrupt. A trader may petition for an adjudication of his own bankruptcy, and upon his application and proof of his trading, and of the filing and declaration of insolvency, and of his available estate being sufficient to produce at least 150*l.*, the court similarly adjudges him a bankrupt. Immediately after adjudication, an official assignee is appointed by the court, whose duty it is at once to take possession of all the bankrupt's property.

Notice of the adjudication is given to the bankrupt, that he may, if so advised, show cause against it; this he is at liberty to do within seven days, giving two days' notice in writing thereof, and of the grounds of objection to the petitioning creditor or his solicitor, and to the registrar of the court. The necessary proofs must be again given, and the adjudication is thereupon either annulled or sustained. There is an appeal from the Commissioner to the Lords Justices of Appeal in Chancery, and from their judgment to the House of Lords. If the adjudication is submitted to, or sustained, the commissioner causes notice thereof to be given in the 'London Gazette,' and at the same time appoints two public sittings of the court for the bankrupt to surrender and conform, and for the election of creditors' assignees. This advertisement becomes conclusive evidence as against the bankrupt of the date of the petition being filed, and of his bankruptcy before such date, unless he shall within two calendar months thereafter (if within the United Kingdom, and if elsewhere, within an extended period), have commenced, and shall duly prosecute an action or other proceeding to dispute or annul the adjudication. The bankrupt is at liberty, however, to surrender at any time before the time limited, by appearing in court and signing a memorandum to that effect, on which he obtains an order of protection from arrest at the suit of any creditor, until the next sitting of the court.

4. *The Assignees, their powers and duties, and the vesting of the Bankrupt's property and effects in them.*—At the first of these sittings an election must be made of assignees, or persons to whom the bankrupt's estate shall be assigned, and in whom it shall be vested for the benefit of the creditors; which assignees are to be chosen by the major part in value of the creditors who shall then have proved their debts; but no creditor shall be admitted to vote in the choice of assignees, whose debt, on the balance of accounts, does not amount to 10*l.*

In the mean time, however, and immediately on the adjudication being made, the official assignee becomes the depository of all the bankrupt's property, and if the court so order, he may, before the creditor's assignees are chosen, sell or dispose of goods of a perishable nature, or other property, the holding of which until the choice of assignees would prejudice the bankrupt's estate. The official assignee receives all rents, interest, proceeds of sale, or other monies which may accrue from the bankrupt's estate, and places them in the Bank of England. All books, papers, and accounts relating to the estate must be delivered up to him, on oath, if required, and the bankrupt must attend him at all reasonable times, to assist in getting in and protecting the estate, for which attendance he is paid at the rate of five shillings a day. The election of creditors' assignees being made, and the selection being ratified by the court, such appointment has the effect of vesting in these assignees, conjointly with the official assignee, all the bankrupt's estate and effects, to be by them held for the benefit of the creditors at large.

By the Act for the Abolition of Fines and Recoveries, 3 & 4 Wm. IV. c. 74, the Court of Bankruptcy may dispose for a valuable consideration of all lands of which the bankrupt is tenant in tail, and thereby create as large an estate as the bankrupt himself might have done had he not become bankrupt. The copyhold estate of the bankrupt does not pass to the assignees by virtue of their mere appointment, but the court is authorised to convey such property to any person who purchases it. The purchaser is to agree and compound with the lord of the manor wherein it is situate for the fines and services, and the lord shall at the next court grant the property to the vendee. Contingent estates and interests in real property which belong to the bankrupt pass to the assignees; but the expectancy of an heir-at-law (or possibility, as it is technically called) is not such an interest as vests in the assignees. Offices of an inheritable nature, or such as are held for a term of years, are in general saleable, and therefore pass to the assignees, provided they do not concern the administration of public justice; and as an officer on half-pay cannot sell his half-pay, so on principles of public policy, he cannot be called on to discover or surrender it in case of his becoming a bankrupt. All the debts and choses in action due to the bankrupt vest in his assignees, who have a right to sue upon all beneficial contracts entered into with the bankrupt before his bankruptcy, and also for all torts and injuries affecting his *property;* but not for mere personal wrongs, such as assaults, slanders, libels, and the like. The right to bring a real action passes to the assignees, even though the estate may be the bankrupt's in right of his wife. The bankrupt's interest in a patent, and his right to publish a newspaper, constitute property which vests in his assignees. As the right of the bankrupt to sue at law on contracts passes to his assignees, so also does his right of suing in equity to enforce their specific performance; but in order to protect vendors who have agreed to sell real property to a trader who becomes bankrupt, the assignees are compelled (on being required) to execute the agreement or to abandon it, or if they fail to do so, the vendor may apply to the Court of Bankruptcy, and the court will order the assignees to deliver up the agreement, or make such other order as it shall think fit. The bankrupt's personal property situated in a foreign country will pass to the assignees, unless the law of the foreign country prevent it. With respect to leases, the assignees are not bound to accept a leasehold interest belonging to the bankrupt unless they think proper; for in some cases such a property is burdened with rent and covenants beyond its value, and would prove a loss to the creditors. Such property, therefore, remains vested in the bankrupt till the assignees have done some act amounting to an acceptance, such as taking possession of it, or intermeddling with it in the capacity of owner; but a mere experiment, by putting it up to sale to ascertain its value, will not constitute an acceptance of it. If the assignees accept the lease, they become liable to the landlord for the rent and covenants, and the bankrupt is discharged from both from the date of the filing of the petition for adjudication. If the assignees decline the lease, the bankrupt is also discharged by the Bankrupt Acts from the rent and covenants, provided he deliver up the lease to the landlord within fourteen days from his having notice that the assignees have declined it; and if the assignees, on being required, fail to elect whether they will accept or decline the lease, the landlord may apply to the Court of Bankruptcy, and the court will order them so to elect, and to deliver up the lease in case they decline it. Property which the bankrupt holds as trustee for others does not pass to his assignees, being in no way beneficial to his creditors. If the bankrupt has stock standing in his name, the court may order it to be transferred into the names of the assignees. Whatever beneficial interest the bankrupt may have in property of his wife passes to his assignees; but property which she enjoys as a *sole trader* in the city of London, or which is settled to her separate use, does not fall within the operation of the bankruptcy. If the assignees are able to recover possession of the wife's property in a court of law, equity will not interfere with their legal title; but if the property is of such a nature that they are compelled to sue in a court of equity to recover it, that court will require a provision to be made for the wife out of the fund. All property which might be redeemed by the bankrupt, may be redeemed by his assignees for the benefit of the creditors. The assignees not only take all the bankrupt's present property, but also property which may accrue to him previously to his obtaining his certificate; but they have no right to seize the profits of his personal and daily labour, for that would be to deprive him of his means of existence. In a case where the bankrupt, a furniture broker, was engaged to remove goods, and he employed, for that purpose, vans, packing-cases, and five or six men, it was held that his demand for this employment passed to his assignees, since it did not consist solely of a remuneration for his personal labour. The right to nominate to a vacant ecclesiastical benefice does not pass to the assignees. To the assignees also pertains the duty of calling meetings, collecting debts, and acting generally for the benefit of the estate under the orders of the court; the official assignee, until assignees are chosen by the creditors, having been, as we have already seen, to all intents and purposes the sole assignee of the bankrupt's estate and effects.

5. *The Examination and Certificate of the Bankrupt.*—At the second of these sittings, at farthest, which must be on a day not less than thirty and not exceeding sixty days from the advertisement in the 'Gazette' (unless the time be enlarged by the court), the bankrupt, upon notice personally served upon him, or left at his usual place of abode, must surrender himself personally to the commissioners; which surrender (if voluntary) protects him from all arrest, unless he has been guilty of certain offences enumerated by the statute, which involve a refusal of protection: and he must thenceforth in all respects conform to the directions of the statutes of bankruptcy; or, in default of either surrender or conformity, shall be guilty of felony, and may be transported for life, or imprisoned for seven years. When the bankrupt appears, the commissioner is to examine him touching all matters relating to his trade and effects. He may also summon before him, and examine, the bankrupt's wife, and any other person supposed to have any of the bankrupt's property in his hands, or to be capable of giving information touching his affairs. And in case any of them shall refuse to answer, or shall not answer fully, to any lawful question, or shall refuse to subscribe such their examination, the commissioner may commit them to prison without bail till they submit themselves, and make and sign a full answer; the commissioner specifying in his warrant of commitment the question so refused to be answered. And any gaoler permitting such person to escape or go out of prison shall forfeit 500*l.* to the creditors.

The bankrupt upon his examination, which may be adjourned from time to time, or *sine die*, is bound upon pain of transportation for life (formerly the penalty was death) to make a full discovery of all his estate and effects, as well in expectancy as in possession, and how he has disposed of the same, together with all books and writings relating thereto: and is to deliver up all in his own power to the commissioners, except the necessary apparel of himself, his wife, and his children; household furniture, tools, and such like necessaries, which, to the amount in value of 20*l.*, are to be allowed to him; and in case he conceals or embezzles any effects to the amount of 10*l.*, or withholds any books or writings, with intent to defraud his creditors, he shall be guilty of felony, and be liable to transportation for life or not less than seven years, or imprisonment for any term not exceeding seven years. Under the rigorous enactment of the statute 21 Jac. I. c. 19, which was not repealed until the year 1816, unless it appeared that his inability to pay his debts arose from some casual loss, he might, upon conviction by indictment of such misconduct and negligence, be set upon the pillory for two hours, and have one of his ears nailed to the same and cut off.

After forty-two days from the filing of the petition have elapsed, any person voluntarily discovering any part of the bankrupt's estate, before unknown to the assignees, is entitled to five per cent. out of the effects so discovered, and such farther reward as the assignees with the consent of the court shall think proper. But any person wilfully concealing the estate of the bankrupt, after the expiration of the two and forty days, shall forfeit 100*l.*, and double the value of the estate concealed.

Hitherto, everything is in favour of the creditors, and the law seems to be pretty rigid and severe against the bankrupt; but, in case he proves honest, it makes him full amends for all this rigour and severity. For, if the bankrupt has made an ingenuous discovery, and has conformed in all points to the directions of the law, the court proceeds to appoint a public sitting for the allowance of the certificate of conformity. And unless there appears cause to the contrary, the court certifies that the bankrupt has made a full discovery, and conformed in all respects. This certificate may in certain cases be suspended for a time, but if the bankrupt be proved to have destroyed or falsified his books or entries, or to have been guilty of any manner of fraud in contracting debts, or to have given a fraudulent preference to any of his creditors, or concealed or made away with any of his property, or given fictitious accounts of his losses and expenses, or put his creditors to unnecessary expense by frivolous defences, or wilfully withheld the production of any book relating to his dealings, or have wilfully omitted to keep proper accounts of his trading, then the court may refuse or suspend the certificate, or annex such conditions to it as the justice of the case may require. And if the bankrupt is shown to have lost 20*l.* in one day by gaming, or 200*l.* within the year next preceding the filing of the petition, or if within the same time he has lost 200*l.* by a time bargain for the purchase or sale of stock, he is not entitled to a certificate, or if he obtains one it is void.

Three classes of certificates are given; the first where the bankruptcy is found to have arisen from unavoidable losses and misfortunes; the second when it has not wholly arisen from such causes; and the third when it has not arisen from such causes at all; and this finding is in every case specified in the certificate. Notice of the allowance of the certificate, the time of suspension (if any), and the conditions of allowance (if any), is given by advertisement in the 'London Gazette,' ten days or more before the time allowed by the statute for appealing against the granting of the certificate; and if no appeal be lodged, the Court at the expiration of the time, on production of the 'Gazette' containing the advertisement, delivers to the bankrupt the certificate of conformity, unless the delivery of the certificate have been suspended. When the certificate has been allowed, the bankrupt is entitled to a decent and reasonable allowance out of his effects, for his future support and maintenance, and to put him in a way of honest industry. This allowance is rendered proportionate to his former good behaviour, in the early discovery of the decline of his affairs, tested by the amount of dividend secured to his creditors. For if his effects will not pay one-half of his debts, or 10*s.* in the pound, he is left to the discretion of the court and assignees, to have a competent sum allowed him, not exceeding three per cent. upon the nett produce of his estate; but if they pay 10*s.* in the pound, he is to be allowed five per cent.; if 12*s.* 6*d.*, then seven-and-a-half per cent.; and if 15*s.* in the pound, then the bankrupt is allowed ten per cent.; provided that such allowance do not in the first case exceed 300*l.*, in the second 400*l.*, in the third 500*l.*, and in the fourth 600*l.* Besides this allowance, he has also an indemnity granted him, of being free and discharged for ever from all debts owing by him at the time he became a bankrupt, and from all claims and demands provable under the bankruptcy, even though judgment shall have been obtained against him, and he lies in prison upon execution for such debts; and for that, among other purposes, all proceedings in bankruptcy are entered of record, as a perpetual bar against actions to be commenced on this account; though, in general, the production of the certificate, properly allowed, is sufficient evidence of all previous proceedings. Thus the bankrupt becomes a clear man again. Thus much for the proceedings in a bankruptcy, so far as they affect the bankrupt personally.

6. *The Proof of Debts by the Creditors, and the effect of Bankruptcy on the rights of third parties.*—Having thus shown the mode in which the trader is declared a bankrupt, and his property and effects are brought under the control of the court for distribution among his creditors, the verification of the creditors' debts is the next step to be considered. The commissioner, we have seen, is bound to appoint two meetings immediately upon the adjudication of bankruptcy, and at these and every other meeting (with ten days' notice in the 'London Gazette') appointed for that purpose, the creditors may prove their debts on oath. Corporate bodies may make proof by an authorised agent, creditors living at a distance by affidavit, and creditors out of England by affidavit duly verified; and by a special provision, the person effecting a policy of assurance on ships or goods may, though not himself beneficially interested, make proof in case of loss when the person interested is not within the united realm. All debts legally due from the bankrupt at the time of the act of bankruptcy are provable, and also all debts contracted before the filing of the petition for adjudication, though subsequent to the act of bankruptcy; provided the creditor, at the time of the debt being contracted, had *no knowledge* of any act of bankruptcy. Obligees on bottomry and respondentia bonds, and the assured in policies of assurance, are entitled to *make claim*, and when the loss or contingency happens on which the debt depends, they may then prove the debt and receive dividends with the other creditors, as if the contingency or loss had happened before the filing of the petition; and all creditors having claims upon the bankrupt which depend on any contingency may, on application to the court, have a value set upon the contingent claim, and be admitted to prove for the debt thus ascertained. In cases where parties have become bail or sureties for the bankrupt, and have paid the debt or a part thereof (though after the filing of the petition), if the principal creditor has proved the debt under the bankruptcy, such sureties are entitled to stand in the place of the creditor as to the dividends and all rights under the bankruptcy; or where the creditor has not proved his debt, such surety may prove his demand in respect of the payment he has made, so as not to disturb former dividends of the bankrupt's estate; and this, although such surety may have become surety for the bankrupt subsequent to the act of bankruptcy, provided he had no notice of any act of bankruptcy when he became surety. With respect to creditors to whom the bankrupt owes annuity debts, all such creditors may prove for the value of the annuity, which the court is to ascertain, having regard to the original price given, and to the diminution of value from lapse of time between the granting of the annuity and the date of the petition for adjudication. With respect to interest on debts, the general rule is, that no interest is provable unless interest was reserved by contract, either express, or arising by implication from the usage of trade, or other circumstances attending the origination of the debt; but interest is provable if the debt was made payable at a certain time by virtue of some written instrument, or if payable otherwise then from the time of a written demand of payment notifying to the debtor that interest will be thenceforth claimed. Where interest is allowed it is calculated to the date of the petition.

With respect to proof of debts against the partners in a firm, the general rules are, 1st, that as a creditor of the whole firm may, if he please, petition for adjudication against any single partner or any number of partners, he may prove his debt in the same manner; 2nd, a joint creditor of the whole firm may prove against the separate estate of any one partner who is bankrupt, provided there is no partner who is solvent; but if there is a partner who is solvent, then the joint creditors cannot come into competition with the separate creditors of the partner who is bankrupt; 3rd, where there are no separate debts, the joint creditors may of course prove against the estate of the partner who is bankrupt. But for the mere purpose of voting for assignees, joint creditors may prove upon the separate estate, although separate creditors cannot upon the joint estate.

If the whole firm become bankrupt, being indebted to an individual partner, such partner cannot prove against the joint estate in competition with the joint creditors; for as they are his own creditors also, he has no right to withdraw any part of the funds available for the payment of their debts; nor can those partners of a firm who remain solvent prove against the separate estate of a member of that firm in competition with his separate creditors, unless the joint creditors be first paid 20*s.* in the pound and interest.

There are certain classes of creditors which the legislature has peculiarly privileged. The court is authorised to order that the clerks and servants of the bankrupt (which includes travellers) shall receive their wages and salary, not exceeding 30*l.*, and for not exceeding three months, out of the estate of the bankrupt; and they are at liberty to prove for the excess. In certain instances the creditor has a remedy for his debt without proof. Thus, if the creditor of the bankrupt, at the time of the bankruptcy, owes him money, or if there is *mutual credit* between the creditor and the bankrupt (as, for instance, on bills or securities not yet fallen due at the time of the bankruptcy), the creditor is not bound to pay his debt to the estate and prove his counter-debt and take a dividend only with the general creditors, but one debt must be *set off* against the other, and the balance only can be claimed on either side. But in order to be entitled to the benefit of this set-off, the creditor must not have had any notice of the bankrupt's act of bankruptcy at the time when he gave him credit.

In certain cases, also, where the creditor has obtained a security or lien upon the bankrupt's estate, he is allowed to satisfy himself out of it, instead of being compelled to accept a mere dividend. An extent for a debt due to the crown is still more favourably regarded; for as that writ binds the goods of the bankrupt from its *teste* (that is, from the date of its issuing), and as the property in the goods does not pass from the bankrupt till the appointment of the assignees, at which time it vests in them, if the crown extent issues before the appointment of assignees, the crown obtains the property in the goods in preference to the assignees. Other crown process, such as a warrant to levy for land-tax money, obtains a preference for the crown from the time of the *seizure*, in case the assignees have not then been appointed.

A legal mortgage gives the mortgagee a right to retain the property mortgaged until his debt is satisfied, and the assignee of the bankrupt can only redeem it by paying the principal mortgage money, and all interest up to the date of the redemption; and an equitable mortgage, by mere deposit of title deeds, is in general entitled to the same preference. A bonâ fide pledge of personal property stands on the same footing as a mortgage of land, and can only be redeemed by the assignees on payment of the sum advanced. In order however to give such effect to the securities above mentioned, it is necessary that the creditor should have obtained them either before the act of bankruptcy, or, if obtained subsequently, that they should have been obtained without knowledge of any prior act of bankruptcy. The situation of the landlord of a bankrupt tenant is peculiar. He has a right to distrain all goods on the premises for his rent, even though the demise itself be not made till after the act of bankruptcy. If he neglects his right of distress he must then prove, and come in with the common creditors; and the distress, if made subsequent to the act of bankruptcy, is only available for one year's rent up to the filing of the petition, and the landlord must prove the residue of his demand like another creditor.

Assessed taxes, up to the 5th day of April next after the bankruptcy, not exceeding one year's assessment, are to be paid out of the estate; and the bankrupt is relieved from further assessment in respect of articles previously kept for trade purposes and duly surrendered and sold under the bankruptcy and not subsequently used.

When an officer of a friendly society becomes bankrupt, monies of the society in his hands are to be paid over to the society out of his estate in preference to other claims.

7. *Of the Effect of the Bankruptcy on the Rights of Third Parties.*—The general rule is, that all the property of a bankrupt vests in his assignees for the benefit of the creditors *from the time of the act of bankruptcy;* from which it follows that all dispositions made by the bankrupt of his property after that time are void—a doctrine which occasioned much hardship in many instances to persons who had dealt with the bankrupt in ignorance of his having committed an act of bankruptcy, and which has therefore been materially mitigated and qualified by legislative provisions. It is accordingly provided, that all bonâ fide payments by or to, and all bonâ fide conveyances by, and all contracts, dealings, and transactions by and with the bankrupt, made before the filing of the petition for adjudication, and that all executions against the bankrupt's land bonâ fide executed by seizure, and all executions against the goods of a bankrupt bonâ fide executed and levied by seizure and sale before the filing of such petition, shall be deemed to be valid, notwithstanding any prior act of bankruptcy, provided the person so paying to or dealing with the bankrupt, or at whose suit such execution issued, had not at the time of so paying or dealing, or at the time of sale under such execution, notice of any prior act of bankruptcy, and also provided that there be no fraudulent preference of any such creditor. This protection is afforded on condition that the party protected has no notice of an *act of bankruptcy* at the time of the payment or dealing, &c., and consequently no transaction that is itself an act of bankruptcy is thus protected. In order however to deprive the party of the benefit of the act, he must have notice strictly of some act of bankruptcy having been committed. Mere knowledge that the bankrupt is in *embarrassed circumstances* at the time of the payment will not take the case out of the protection of the statute; and unless a petition

for adjudication be filed within twelve months, all bonâ fide purchases for value are protected.

When none of the above statutory exceptions and qualifications take effect, the general rule applies, with all its consequences, that the assignees are invested with the property of the bankrupt, by relation, back to the act of bankruptcy. The doctrine that the adjudication when made, has relation back to the act of bankruptcy, has no application against the crown; and therefore intermediate seizures by the crown of the bankrupt's goods are valid. And as a party who is sued at law by a bankrupt cannot defend himself, by showing that the bankrupt, before the action, has committed an act of bankruptcy, it follows that all payments actually enforced at law by the bankrupt, before the adjudication, are good payments, since it would be a glaring injustice to allow the assignees to recover them a second time.

Not only is all the property to which the bankrupt himself has a right applicable towards the payment of his creditors, but there are instances in which *effects of other parties* in his custody, which could not have been retained by the bankrupt had he not become bankrupt, will vest in his assignees under the *fiat*. The present enactment on this subject, the Bankrupt Law Consolidation Act, 1849, § 125, is levelled at the mischief occasioned by allowing the use of other persons' property to be granted with impunity to a failing trader, who is thereby enabled to assume a deceitful appearance of wealth, and obtain factitious credit with the world. Accordingly, if any bankrupt, by the permission and consent of the owner, shall have in his possession, order, or disposition, any goods or chattels whereof he was reputed owner, or whereof he had taken on himself the sale, alteration, or disposition as owner at the time of his bankruptcy, the court may sell the same for the benefit of the creditors. This provision applies only to goods and chattels, such as furniture, utensils in trade, stock, bills of exchange, &c. Ships are specially provided for by the Merchant Shipping Act, 1854, § 72, which enacts that no registered mortgagee of any ship, or of any share therein, shall be affected by any act of bankruptcy by the mortgagor subsequent to the date of the record of such mortgage. Interests in property of a real nature, including fixtures, are not affected by it. The main difficulty, which has occasioned much litigation as to the cases within this clause, is in deciding whether the bankrupt was or was not the *reputed owner* of the property at the time of his bankruptcy, which is a question of fact determinable by a jury, according to the circumstances of each particular case. Where the bankrupt has once been the real owner, but has sold or disposed of the goods, the circumstance of his still remaining in possession of them raises generally a presumption that he possesses them as reputed owner; but where the bankrupt has the possession of the goods without ever having been the real owner, it will require stronger evidence to show his reputed ownership at the time of the bankruptcy. The distinctions upon the subject are some of the nicest which occur in the decisions of the courts. Where the purchaser of wines transferred them to a particular bin in the vendor's cellar, had each bottle sealed with his own seal, and had an entry made in the vendor's books, it was held that these precautions prevented the wines from falling within the operation of the clause. But in a case, where the purchaser simply marked certain casks in chalk with his initials, and gave no notice to the warehouseman, the decision was to the contrary. If a bond is assigned over by the obligee, it must be delivered to the party to whom it is assigned, and notice must be given to the debtor, otherwise it will pass to the assignees of the obligee in case of his bankruptcy. And it is the same as to the assignment of a policy of insurance or other chose in action. Bills discounted by a banker are in effect purchased by him, and they therefore pass with the rest of his property to his assignees in the event of his bankruptcy; but bills which are not due, and are entrusted by a customer to his banker for collection (entered short), though indorsed, remain the property of the customer, since the banker is a mere agent for the purpose of receiving the amount when they become due. But it is otherwise if the bills, though not due, are paid in by the customer, and treated absolutely as *cash*. Property which the bankrupt holds merely as trustee, or as executor or administrator, or as a factor, or which is placed in his hands merely for some particular purpose, will not pass to his assignees as being in his reputed ownership. Goods which a bankrupt receives on the terms of sale or return are held to be in his reputed ownership, and to pass to the assignees; but where the bankrupt had received goods the evening before his bankruptcy, and in fact never unpacked them, it was held the owner might reclaim them. If a trader have mortgaged his goods, but remain in possession of them, they will pass to the assignees; and this used to be the law with respect to the mortgage of a ship.

8. *Arrangements between Bankrupts and their Creditors under the control of the Court, or by deed; and composition of bankruptcy.*

a. Under the control of the Court.—A trader unable to meet his engagements may, by petition to the Court of Bankruptcy within the district of which he has resided or carried on business for the previous six months, set forth the reasons of such inability, and pray that his person and property may be protected from process until further order. This petition must be in the form provided by the Bankrupt Law Consolidation Act, 1849, Schedule Aa, and be supported by affidavit. Thereupon the court may make such protecting order, and if he be already in custody for debt may, except in certain specified cases (Bankrupt Law Consolidation Act, 1849, § 211), order his release. The court then appoints a private sitting and an official assignee; and if sufficient cause be shown, may direct the petitioner's estate and effects to be seized by the messenger of the court, or to be held and received by such official assignee. Fourteen days' notice in writing of this private sitting must be given to every creditor; and ten days before it is held the petitioner must file a full account and statement of his affairs, and therein set forth such proposal as he is able to make for the payment or compromise of his debts and liabilities. At the sitting the creditors are to prove their debts, and the petitioner is to attend and be sworn to his account and statement, and may be examined thereon. If three-fifths in number and value of the creditors, who have proved for amounts exceeding 10*l.*, assent to the proposal or to any modification of it, the court appoints another sitting for its confirmation, to be held not earlier than fourteen days from the first sitting. Of this second sitting seven clear days' notice in writing must be served upon every creditor not present in person or by agent at the first sitting; and if at such second sitting the proposal assented to at the first sitting be accepted by three-fifths in number and value of those creditors who have debts to the amount of 10*l.*, the terms of the proposal are reduced into writing, and the creditors are to sign the same. The court after hearing any opposing creditor who desires so to be heard, may, if the resolution or agreement appear to the court to be reasonable and proper, approve and confirm it. It is then filed and entered of record, and a certificate is issued by the court to the petitioner; whereupon is endorsed from time to time a protection from arrest binding upon all creditors who had notice of the sittings. Upon this approval and confirmation the petitioner's estate vests in the official assignee as fully as in bankruptcy, either solely or conjointly with any persons that may be named for that purpose in the resolution. When the terms of the resolution or agreement have been fully carried out, the court gives to the petitioner a certificate thereof, that has the same effect as a certificate of conformity under a bankruptcy, except as to debts contracted wholly or in part by reason of any manner of fraud or breach of trust, or without reasonable probability at the time of contract of being able to pay the same, or by reason of any judgment in any prosecution for breach of the revenue laws, or in any action for breach of promise of marriage, seduction, criminal conversation, libel, slander, assault, battery, malicious arrest, malicious trespass, maliciously suing out a fiat in bankruptcy, or maliciously filing or prosecuting a petition for adjudication of bankruptcy. If the petitioner does not attend the sittings of the court, or if he fails duly to file a true and complete account, or if neither his proposal nor any modification thereof be assented to at the first sitting, or any adjournment thereof, or if it appear that any debts have been contracted under such circumstances as would exclude the operation of the certificate as above-mentioned, or that the petitioner's affidavit was wilfully untrue, or that his proposal was unreasonable, or that his petition was unduly delayed, or if within three months of its presentment he wrongfully assigned or made away with any portion of his estate and effects, or voluntarily allowed his goods to be taken in execution, the court may adjudge him thenceforth a bankrupt and proceed accordingly.

b. By Deed.—Any deed or memorandum of arrangement between a trader and his creditors, signed by or on behalf of six-sevenths in number and value of those creditors whose debts amount to 10*l.*, touching such trader's liabilities and his release therefrom, and the distribution of all his estate among all his creditors rateably, is obligatory upon those creditors who have not signed it, and is not liable to be disturbed by any prior or subsequent act of bankruptcy. But such deed or memorandum does not thus bind a creditor until the expiration of three months from his receiving from the trader notice of his suspension of payment, and of the deed or memorandum, unless the court for the district in which the trader has resided or carried on business for six months next preceding his suspension, shall in the meantime certify that the deed or memorandum has been duly signed, and the creditors had fourteen days' notice of the trader's intention to apply for such certificate. When the trustees or inspectors under the deed or memorandum (if any be appointed thereby), or in the absence of such appointment, when any two creditors are satisfied that the deed or memorandum has been duly signed, and certify the same to the court in writing, their certificate is filed with the registrar, and becomes primâ facie evidence of such due signature. This certificate is to have appended to it a full and particular statement of the trader's debts and of his creditors, verified by the trader's affidavit; and if there be in it, through fraud or culpable negligence, any false statement or omission, the trader will be deprived of all benefit to be derived by him under the arrangement. The rights of the creditors are adjusted as in bankruptcy.

c. Composition of Bankruptcy.—If any bankrupt, after passing his last examination, call a meeting of his creditors, giving twenty-one days' notice thereof in the 'London Gazette,' and then make an offer of composition that nine-tenths in number and value of his there present creditors agree to accept, and if such proposal be again so accepted at a second meeting similarly convened, the court, upon such acceptance being notified to it in writing, and upon payment of such sum as it may direct, annuls the adjudication and dismisses the petition, and every creditor is bound by the composition. Special regulations as to voting in respect of compositions, are prescribed by the Bankrupt Law Consolidation Act, 1849, sec. 231.

9. *The Constitution of the Court of Bankruptcy.*—The court of bankruptcy is a court of record, and for all purposes of bankruptcy administers both law and equity. Its ordinary judges are commissioners appointed under the great seal. The court of appeal is composed of the lords justices of appeal in Chancery. The commissioners have separate jurisdiction limited by their respective districts. The London district comprises the Metropolitan counties, and Sussex, Hampshire, and part of Wiltshire. Its court is presided over by one chief commissioner at a salary of 2500*l.* per annum, and by four commissioners at salaries of 2000*l.* per annum. The country districts are seven in number, and their courts are held respectively at Manchester, Leeds, Liverpool, Birmingham, Bristol, Exeter, and Newcastle-upon-Tyne. To each of the first two above-mentioned districts are attached two commissioners; to the last five one commissioner only is attached. Each country commissioner has a salary of 1800*l.* per annum. To each court is also attached one registrar in respect of each commissioner. The London court has one chief registrar who enjoys a salary of 1200*l.* per annum, and four registrars at 1000*l.* per annum each; besides a registrar who attends the court of appeal. Country registrars receive salaries of 800*l.* per annum. To each court are also attached certain official assignees who are appointed by the Lord Chancellor, and must be selected from the class of merchants, brokers, accountants, or traders. Ten such assignees are attached to the London court, and eighteen are attached to the country courts. Their remuneration chiefly consists of a per-centage upon the assets collected. The emoluments of the London assignees average from 1000*l.* to 1200*l.* exclusive of office expenses. In the country their emoluments are less and the variations greater.

Messengers and brokers are also attached to the various courts. The expenses of the official staff and machinery employed in bankruptcy is very great, and in the smaller cases very much out of proportion to the assets actually distributed among the creditors. In the course of the years 1853, 1854, and 1855, the London and country commissioners adjudicated on 2138 petitions. In 583 of these cases no dividend had been paid, but of these only 40 were above 500*l.* Of the others the amount of assets collected had been 1,978,325*l.*, of which 1,073,386*l.* had been distributed in dividends. The solicitors' charges had been 235,513*l.*; the commissions, &c., of the official assignees were 85,586*l.*; the charges for stationery, postage, &c., were 12,622*l.*; other charges, including fees to brokers, messengers, travelling expenses, &c., amounted to 294,501*l.*, and the balance in hand was 278,455*l.* Thirty per cent. or rather more of the assets are consumed by costs.

The number of certificates granted by the London Court of Bankruptcy during the five years ending July 5, 1858, was as follows, viz.: first class certificates, 307; second class certificates, 1176; third class certificates, 467; certificates suspended, 693; certificates refused, 37; adjournment of bankrupts' examinations *sine die*, 404.

A valuable report was presented to parliament in 1854, whence much information as to the working of the present system of bankruptcy may be obtained.

A steady and gradual diminution of the business of the court has been for some years progressing, and the better class of estates are now almost universally wound up and distributed out of bankruptcy. To remedy the evils observed, and to render the constituted court thoroughly effective, a bill has been (February 7, 1859) introduced into the House of Lords by the Lord Chancellor for amendment of the law of debtor and creditor, and the procedure for administering bankrupt and insolvent estates. It is thereby proposed to amalgamate the present bankruptcy and insolvency jurisdictions, and to extend to the non-trader the liabilities and benefits hitherto confined to traders. Imprisonment for debt by way of ordinary remedy for its recovery is to be abolished. Lord John Russell also (February 15, 1859) introduced to the House of Commons a somewhat similar measure, and there can be now little doubt of great alteration and improvement being effected in this important branch of administration.

The subject of the bankruptcy and winding-up of joint-stock companies under the numerous statutes relating to them, will be more conveniently discussed under the title COMPANIES, JOINT STOCK, WINDING-UP.

Proceedings under the act for facilitating arrangements between debtors (*not being traders*) and their creditors, 7 & 8 Vict. c. 70, though within the exclusive jurisdiction of the court of bankruptcy, will be more fitly considered under the title INSOLVENCY.

The Irish law of bankruptcy was gradually assimilated to the English law by several acts, 6 & 7 Will. IV. c. 14; amended by 1 Vict. c. 48, and 2 & 3 Vict. c. 86; and recently by the 20 & 21 Vict. c. 60, the various laws relating to bankrupts and insolvents in that part of the kingdom have been consolidated, and the administration thereof committed to a new court called 'The Court of Bankruptcy and Insolvency' (20 & 21 Vict. c. 60).

See upon the subject of bankruptcy, Blackstone's 'Commentaries' edited by Dr. Kerr, vol. ii. p. 484, et seq.

In 1841 an act was passed by Congress to establish a uniform system of bankruptcy throughout the United States of North America. The act came into operation in 1842.

In June, 1838, the French law of 1807 on bankruptcy and insolvency was abrogated, and an entirely new law was promulgated, which now forms Book III. of the Code de Commerce (Des Faillites et Banqueroutes).

BANKRUPT LAWS OF SCOTLAND. In the earliest records of the law of Scotland we find that debtors were entitled to a discharge on a judicial cession of their goods to their creditors. This proceeding, which still subsists in Scotland, we shall consider in detail under the head of CESSIO BONORUM; and only remark here, firstly, that it has always been a general remedy, and not confined to traders or any other class; and secondly, that it is essentially an insolvent's remedy, and, although it relieves the *person* from liability, it leaves the liability still subsisting as to the *property* of the debtor.*

The first statute which introduced the principle of a total discharge to the debtor was passed in 1772. All persons might be brought under it, and the funds were held and distributed by an assignee, under direction of the Court of Session. In 1783, the management of the estate was removed from this judicial control, and placed, as it has continued ever since, entirely in the hands of the creditors themselves, and subject to review by the court only on points of law. At the same time, however, the remedy was restricted to *traders*; a restriction which continued in force till 1856. The law of bankruptcy, which had in the meanwhile undergone a variety of successive improvements, in that year was expanded in several most important particulars, and a consolidation act was passed (19 & 20 Vict. c. 79), which with a short amending act of the following year (20 & 21 Vict. c. 19), now comprises the whole of the statute law on the subject of *Sequestration for Debt*, as bankruptcy is styled in Scottish legal language.

The law of bankruptcy in Scotland is, however, by no means limited to the proceedings connected with a sequestration. The commission of an act of bankruptcy constitutes what is called *notour* (that is, notorious) bankruptcy; a status which has a retrospective as well as prospective effect, and which subsists until insolvency ceases. It has always been the law, that any person might be rendered notour bankrupt, although traders only could obtain as a consequence the subsequent benefit of sequestration. The general operation of an act of bankruptcy, constituting notour bankruptcy, consists, 1. In its annulling all preferences granted to particular creditors (except in the shape of payment in cash) within sixty days prior to its commission. 2. In its establishing a "*pari passu* ranking of diligence;" that is, an equality of sharing in the proceeds of all forms of execution against the property of the debtor, amongst all persons who sue out such executions within the period of sixty days before, and four months after, the commission of the act of bankruptcy.

The acts of bankruptcy which constitute this status of notour bankruptcy are, except one, all of a judicial nature. The first is sequestration itself, or an adjudication of bankruptcy in England or Ireland. These are sufficient, although the party be not really insolvent; all the other acts must be conjoined with actual insolvency to have effect. Notour bankruptcy then may be constituted by actual insolvency concurring with imprisonment, or at least arrest on a judgment debt, or the absconding of the debtor to avoid arrest after receiving notice to pay such a debt, or by a sale of his goods under a *poinding* (*fi. fa.*), or *sequestration for rent* (distress), or by his application for the benefit of *cessio bonorum*. Where he is protected from imprisonment by privilege, or it is otherwise impossible, execution against the goods or real estate after notice to pay will suffice before the stage at which they are actually sold. The sole case in which a merely private proceeding on the part of the debtor will amount to an act of bankruptcy is where, being insolvent, he takes refuge for twenty-four hours in the *Sanctuary*—a space of ground round Holyrood Palace, which still retains its royal privilege of protecting against arrest for debt. In the case of a company or partnership, any of the above-mentioned forms which are applicable will render it notour bankrupt, and the same effect will be produced by any of the partners being rendered notour bankrupt in respect of a company debt.

We proceed now to the consideration of a sequestration for debt, or adjudication of bankruptcy. This remedy is now of the widest possible application; being available to every one who is subject to the jurisdiction of the supreme courts of Scotland. It includes companies and partnerships, and even extends to the property of persons deceased. It may be applied for by the debtor himself, and it is not necessary that he should be notour bankrupt, but he must obtain the consent of creditors to the same amount as would entitle them to petition of themselves. This amount is, 50*l.* for one creditor, 70*l.* for two, and 100*l.* for three or more. It is not necessary that these debts should be liquidated, but they must not be contingent. If creditors petition for sequestration without the consent of the debtor, it is requisite that he should have been made notour bankrupt within four months prior to the petition. The estate of a deceased debtor may be brought into bankruptcy if he had given written authority for its being done, or if

* Fraud was not reckoned in Scotland an essential element in the description of a bankrupt. The Scottish name was *Dyvour*, a term the etymology of which lawyers have not hitherto been very successful in tracing; but it seems to be derived from *devorer*, French, to consume one's substance, and if so it is synonymous with the former appellation in English law, *decoctor* or spendthrift. The most ancient Scottish appellation was *Bare-man*, and the cessio bonorum was called "the bare-man's process." This term, indeed, conveys the generic idea without any adventitious quality.

creditors to the requisite value petition, although he was not notour bankrupt. But if he was not, or unless his representatives consent, six months must elapse after his death before the award of sequestration (the adjudication) can take place.

It is not necessary to show that the debtor has assets to any particular amount. But if in the course of the proceedings it appears that the assets fall short of 100*l.*, the court has power, on application of a majority of the creditors, to order that the discharge (certificate) shall be equivalent only to a discharge in a cessio, which, as already mentioned, leaves the debtor's after-acquired property still liable.

One of the most valuable improvements made in the recent act, lies in the authority given to the sheriffs of counties (judges of county courts) to award sequestration in the case of debtors who have resided or carried on business for a year within their jurisdiction. Formerly it could be awarded only in the Court of Session. In all cases, indeed, it still *may*, and where the debtor has not spent the requisite time in one county it still *must* be applied for in that Court. Yet it appears from the returns for the first year after the change was introduced (1856-7), that seventy-five per cent. of all the sequestrations awarded were applied for to sheriffs of counties; and it is understood that the proportion is still increasing. But in whatever court the sequestration is awarded, the whole of the subsequent judicial procedure takes place in the county in which the debtor resided or carried on business, or which may be most convenient for the creditors. This is determined by the Court of Session, when the preliminary proceedings have taken place before it.

If the petition is by the debtor, or with his consent, no service is requisite, and sequestration is at once awarded; but if by creditors without the debtor's consent, it must be served upon him with notice to appear on a day fixed, not less than six nor more than fourteen days after service. In the event of his being out of Scotland, service is effected by publication in a register for that purpose kept in Edinburgh, and twenty-one days are allowed for appearance; in either case, notice is also given by advertisement in the 'Edinburgh Gazette.' On the day appointed, the debtor may oppose the petition on legal grounds, or may pay the petitioning creditors' debts, together with the debts of any other creditors who have appeared. But if he do not, or if his opposition be not well founded, sequestration is awarded. No appeal lies against this order, and the procedure consequent on it cannot be delayed; but any creditor, or the debtor himself (if he had not consented), may, within forty days, apply to the Court of Session to recall the sequestration. In considering this application the Court exercises a large discretion; not only in respect to the strict legality of the proceedings, but in respect to their fitness. Even after the forty days, nine-tenths of the creditors have the power, at any time, of applying for recall.

The award of sequestration vests the estate in the creditors; but it must be instantly advertised in both the London and Edinburgh 'Gazettes,' and a notice of it must be inserted in a register of rights affecting land kept in Edinburgh. This last operates as notice to all persons dealing with the debtor's real estate. The personal property may, if it is thought necessary, be taken possession of by an officer appointed by the court, and held by him till the first meeting of creditors.

This meeting is fixed in the judge's order awarding sequestration, and must take place not less than six nor more than twelve days after the appearing of the advertisement of sequestration in the Gazettes; the place and time for holding it are notified in the same advertisements. At this meeting the creditors may resolve (by a majority of four-fifths in amount of the claims) to wind up the estate under a deed of arrangement; if they do so, they apply to the sheriff for an order to stay proceedings for a period not exceeding two months. Within this period they must present to the sheriff a deed of arrangement, signed by four-fifths in number and value of the creditors; and the sheriff after ordering such intimation as he may think requisite, and hearing any parties who oppose, may approve or disapprove of it. If he approves, the deed is rendered binding on all the creditors, and the sequestration is at an end; if he disapproves, the sequestration proceeds.

But if the creditors do not resort to this course, the first business of the meeting is to elect a trustee (assignee); this is done by a majority (in value of debts) of those present, or represented by proxies. The trustee may be a creditor, provided he has no special interest opposed to that of the general body of creditors; in the larger bankruptcies an accountant is generally selected. The debts of the creditors voting are proved in the presence of the meeting itself, by being stated in writing in the statutory form, and accompanied with proper vouchers and with an affidavit of their truth. Primâ facie proof is all that is at this stage required. The decision of the meeting is liable to review by the sheriff, either on the ground of objection to the candidate elected, or on the ground of votes in his favour having been wrongly admitted. Frequently the sheriff's decision is obtained on the spot, for it is in the power of any two creditors by previous requisition to obtain his attendance at the meeting; but if the question be of difficulty, or he is not present at the meeting, his judgment may be obtained within a few days after. No appeal lies from his judgment. No costs come out of the estate; they are paid by the unsuccessful parties.

In like manner the creditors next proceed to elect a sort of council of the trustee, consisting of three persons, necessarily creditors, who are designated commissioners. They may next, if they think fit, decide (by a majority in number and value) on granting or renewing a protection from arrest to the bankrupt. Up to this period, the bankrupt may have enjoyed such protection granted by the sheriff, on cause shown; but from the date of the first meeting of creditors, the question of continuing it rests wholly with them. Lastly, the meeting may (by a majority of four-fifths in value) vote an allowance to the bankrupt till the time for payment of the second dividend, not exceeding the rate of three guineas per week.

When the trustee's election has been duly declared, he must give a bond of security to such amount as shall have been previously fixed by the meeting of creditors, and with sureties approved by them. When this is done, he obtains from the sheriff a formal appointment to his office, which serves for his title in all suits and other proceedings. He may be removed at any time by a majority in number and value of the creditors, or by the Court of Session, on application of one-fourth in value of the creditors, and on sufficient cause shown. The commissioners may, in like manner, be removed by the creditors. On such an event occurring, a new trustee or commissioner is elected in the same manner as at the first election.

The trustee's first duty is to take possession of the whole of the bankrupt's estate, and to make out an inventory, list of creditors, &c. In this he has the assistance of a statement by the bankrupt of his affairs, which he is bound to submit to the first meeting of creditors. But neither the trustee nor the bankrupt are entitled to professional assistance in performing this duty, at least at the cost of the estate. The trustee must also apply to the sheriff to name an early day for the bankrupt's examination. The day and place are advertised, and the examination is conducted in presence of the creditors, any of whom may put questions; but it does not, except on special application, take place in public. The bankrupt may correct his statement of affairs, and must then swear to its truth. Any of his family, clerks, shopmen, or other persons who may be supposed able to give information as to the estate, may likewise at any time be examined. The examination is before the sheriff, and on oath.

The trustee then proceeds to realise the bankrupt's estate; in this he is bound to follow any directions the creditors may think fit to give, and he is aided by the advice of the commissioners. At the same time he takes preparatory steps for the payment of the dividends. These are made at fixed periods, without any order of court. The first is made six months after the sequestration, the second ten months, and each succeeding dividend three months after that preceding. Claims must be given in to the trustee two months before the time for payment of the first dividend, a period of which ample notice is given by advertisements and circular letters. They must be accompanied with an affidavit, and sufficient legal proof of the debt; but personal attendance of the creditor is not necessary, unless his proof be so defective as to make it necessary that the trustee should examine him. The trustee considers the proofs of each debt, admits or rejects them, or calls for further evidence, as he may think proper, and notifies the result to each creditor. A creditor may appeal either against his own rejection, or against the admission of another; such appeal is taken either to the sheriff or Court of Session. The commissioners audit the trustee's accounts, and fix the sum applicable to dividend. This is paid, on the day appointed, to those whom the trustee has admitted; a proportion being retained to meet the claims which he has rejected, and on which appeal has been brought.

A similar procedure is followed in making each succeeding dividend. A creditor whose claim has been once admitted does not, however, need to renew it; he receives the subsequent dividends as matter of course. Creditors who have not claimed in time for the first dividend, receive an equalising dividend on the occasion of the next, if there are funds to pay it. The commissioners have power to postpone making a dividend till the arrival of the next statutory period for so doing; and the creditors may, on the other hand, shorten the statutory intervals between each. Twelve months after the sequestration they may, by a majority of three-fourths, sell their remaining interest in the estate by auction.

At any time after his examination, the bankrupt may apply to the sheriff for his *discharge* (certificate); but he must in all cases produce a report by the trustee on his conduct, and this report the trustee is not bound to give till five months after the sequestration. Further, till six months after the sequestration, the bankrupt must produce the consent of every creditor; and, until the completion of two years from the sequestration, he must produce the consent of a gradually diminishing majority in number and value of his creditors. The petition for discharge is advertised in the 'Gazette,' and intimated to each creditor; and the court, after hearing any opposition that may be made, grants or refuses it. There is no division of discharges into classes. The bankrupt receives the surplus, if any, of his property, but no sum for re-establishing him in business.

Instead of the ordinary course of dividing the estate, the bankrupt may offer a composition; it must be accompanied with security for its payment. Ample notice must be given to the creditors, and the trustee must send to each an estimate of the amount the estate is likely to produce. A meeting is specially called to consider the proposal, and four-fifths in value are required to authorise its acceptance. If accepted, the sheriff, or Court of Session, may hear any objectors, and unless the offer is found reasonable by the court the acceptance is void. If found reasonable, the bankrupt obtains his discharge.

When the whole estate has been divided, or a composition accepted, the trustee applies for his discharge. He lays his books and accounts before a meeting of creditors called for the purpose, who may express their opinion upon them. This opinion is laid before the sheriff; and he, after hearing any objection, may grant the trustee his discharge, and order his bond of security to be returned to him. The unclaimed dividends are placed in a bank; the books and papers are transferred to a registry kept by the accountant in bankruptcy. The trustee is paid by a commission on the assets collected, the rate of which is fixed by the commissioners at each audit prior to making a dividend, and he receives authority to take credit for the amount. He may, if dissatisfied, appeal to the sheriff. The commission averages about four per cent. It may be mentioned that the whole of the legal and miscellaneous expenses chargeable on the estate average about six per cent. more. The commissioners act gratuitously, and no solicitor can be employed at the cost of the estate, except to conduct law-suits sanctioned by the creditors.

The accountant in bankruptcy is a public officer, whose duty it is to obtain and file all returns which trustees on bankrupt estates are bound to make at regular periods. No money passes through his hands, but any irregularity which he may detect, either in the accounts or in the general proceedings, may be brought by him under the notice of a meeting of creditors, and, if necessary, of the Court of Session. He annually makes out a return, showing what has been done in each sequestration, and including a general report on the working of the act.

It has been seen that the proceedings in a Scottish bankruptcy are wholly extra-judicial, except where the creditors require the interposition of the *power* of a court of justice, or where an appeal is taken from their determination, or where authority is required to enable a part to bind the whole. In such cases the application may generally be to the local judge: in some cases either to him or to the Court of Session. In some cases of importance also, an appeal is given from the local judge to the Court of Session. Most of the functions of the Court of Session in matters of bankruptcy are performed by a single judge, called the Lord Ordinary on the Bills, who sits as well in vacation as during the sittings of the court, and in vacation *all* proceedings may be taken before him. No appeal has the effect of staying the regular proceedings in the bankruptcy.

[*Treatise on the Law of Bankruptcy in Scotland*, by John Boyd Kinnear, Advocate and Barrister-at-Law, 1857, and Supplement, 1858.]

BANKS FOR SAVINGS. [SAVINGS BANKS.]

BANNER. Dr. Johnson, instead of a definition of this word, or a description of the thing signified by it, has given only an imperfect catalogue of its synonyms: *flag, standard, military ensign, streamer*, and derives it from the Welsh *banair*. The etymology is uncertain, but it is probably derived from the old German *ban* or *fan*, to lead on, whence the Germans themselves have derived *fhan*, a standard, or banner. It is not improbable that it may come at once to us from the Anglo-Saxon *banegn*, an ensign, that is, the sign or rallying-point of the band or troop which bears it. A *banner* we conceive to be essentially a piece of drapery attached to the upper part of a pole or staff. This generally hangs loose, but is sometimes fixed in a slight framework of wood. Before, however, the idea of *banner* is complete, we must regard this simple piece of workmanship as being in some way indicative of dignity, rank, or command, or as being carried on some occasion with which ideas of dignity are connected, as in processions in time of peace, or in the field in time of war.

The size and form are but accidents. In fact, it has been made to assume all the varieties of which so simple an instrument is susceptible. When banners are displayed at the same time by persons of different ranks, the size has often borne relation to the respective rank of the parties.

The drapery of a banner is usually made of the most costly stuffs—velvet or silk—but the material most commonly used is a kind of soft silk called taffeta. Sometimes it is quite plain, and of one uniform colour. A white banner was anciently borne in the English army. One of the knights at the siege of Carlaverock, a castle in Scotland, in the wars of Edward I., carried a plain red banner; but they were often richly ornamented with tassels and fringes, and generally there is wrought upon them some figure or device which has reference to the person, the community, or the nation by whom the banner is raised, or to the purpose or occasion of its being displayed.

Other terms by which a banner is called, are—

Standard, by which is meant the most considerable banner of an army, or the national banner when displayed in the field, or a banner set up by some prince, or other chief, as a rallying-point for his friends.

Colours, the banners now borne by particular regiments.

Flag, a banner on board a ship, generally employed as a signal.

Pendant is a narrow flag with a long streaming tail, and has been adopted by all modern nations to denote the vessel which carries it to be a national vessel, or man-of-war.

Streamer is a poetic word, which seems to be used for any species of floating banners.

Ensign is a word formed on the idea of the banner displaying *insignia* which belonged to a particular person, or collection of persons. It was formerly used where we now say *colours*; and the officer called an *ensign* was originally the *ensign-bearer*. It is also applied to the national colours worn by vessels over their stern.

Pennon, another mode of writing pendant.

Pensil, or *Pennoncille*, a small pennon.

Bannière-quarrée, where the drapery was square.

Guidon is now used for the little banner of a regiment.

Gonfannon is properly appropriate to the banner of the pope or of the church.

Oriflamme, was the name of the great national standard of France, only unfurled on important occasions.

Of all these, however, the word *banner* is used by most writers and speakers as a synonym, or as a generic term, of which the other words indicate particular species. We shall therefore bring together in this article much of the information we have been able to collect on a subject to which little attention has hitherto been paid, but which is connected with all our chivalry and much of our poetry, and is not without its share of historical importance and national interest.

The earliest mention of standards is in Numbers ii. "every man . . . shall pitch by his own standard, with the ensign of their father's house," and Egyptian paintings and Assyrian sculpture show us what those ensigns probably were, namely, representations of some object, beast or bird, or some arbitrary symbol, fixed on the top of a pole; and these show also that there were at least three kinds of them, those of the monarch, those of houses or families, those of tribes, and the great standards which served as rallying-points for the whole host, as well as for marking the line of march or the places of encampment. The military standards of the Greeks and Romans were of a similar character, the standard of the Athenians was an owl, which they also impressed on their coins, that of the Thebans a sphinx. The standards of the Romans were carvings in metal or wood; the eagle, or some other figure, elevated at the end of a tall lance or pole. The forms of them are known to us by the representations of them on medals, or the common coinage of that people. The Persian standard described by Xenophon ('Anab.' i. 10) was a golden or gilded eagle, raised on a spear or pole. We have few such representations of the military ensigns of other nations of antiquity, and nothing, it seems, which can authorise us to suppose that banners, in the sense in which the term has been here defined, were in use among them.

But we find them in use among the modern nations of Europe from a very early period. The first notice of them in English affairs is by Bede, who, when he relates the first interview which Augustine and his followers had with Ethelbert, king of Kent, says that they approached the king bearing banners on which were displayed silver crosses, and the picture of Jesus Christ, and chanting, as they went along, prayers for his welfare, and that of his people. They were then living in the Isle of Thanet; and when the king had assigned them habitations in Canterbury, they entered the city in procession, carrying their little banners chanting halleluiahs, and praying for the blessing of God on the city which received them.

Thus early were banners used in religious affairs, to the pomp and splendour of which they have lent their aid in all later times, as in Catholic countries they still continue to do.

All the monasteries in England had banners laid up in their wardrobes, to be produced on the great anniversaries, or on the anniversary of the particular saint in whose honour the church was founded. These were sometimes, as we shall see, allowed to be carried out of the monastery, and displayed in the field. At Ripon, for instance, there was the banner of St. Wilfrid; at Beverley, the banner of St. John of that town. Both these were displayed in the field at Northallerton in the reign of Stephen. We find, also, Edward I. paying 8½*d*. a day to one of the priests of the college of Beverley for carrying in his army the banner of St. John, and 1*d*. a day while taking it back to his monastery.

Sometimes the banners of the religious not only displayed a representation or symbol of a particular saint whom they held in especial honour, but some relic of the saint composed a part of the banner. This was the case with the banner of St. Cuthbert at Durham. Of this banner there is a particular and authentic description in a very curious little volume, entitled 'The Ancient Rights and Monuments of the Monastical and Cathedral Church of Durham,' 1672, which we shall here transcribe:—"The prior caused a goodly and sumptuous banner to be made, with pipes of silver to be put on a staff, being five yards long, with a device to take off and on the pipes at pleasure, and to be kept in a chest in the feretory, when they were taken down, which banner was showed and carried in the said abbey on festival and principal days. On the height of the overmost pipes was a fair pretty cross of silver, and a wand of silver, having a fine wrought knot of silver at either end, that went underneath the banner-cloth, whereunto the banner-cloth was fastened and tied; which wand was of the thickness of a man's finger, and at either end of the said wand there was a fine silver bell. The wand was fastened by the middle to the banner-staff hard under the cross. The banner-cloth was a yard broad and five quarters deep; and the nether part of it was indented in five parts and fringed, and made fast all about with red silk and gold; and, also, the said banner-cloth was made of red velvet, on both sides most sumptuously embroidered and wrought with flowers of green silk and gold; and in the midst of the said banner-cloth was the said holy relique and corporax cloth [this was the corporax cloth with which St. Cuthbert in his lifetime had been used to cover the chalice when he said mass] inclosed and placed therein: which corporax cloth was covered over with white velvet, half a yard square every way, having a red cross of red velvet on both sides over the same holy relique, most artificially and cunningly compiled and framed, being finely fringed about the skirts and edges with fringe of red silk and gold, and three little fine silver bells fastened to the skirts of the said banner-cloth, like unto sacring bells; and being so sumptuously finished and absolutely perfected was dedicated to holy St. Cuthbert, to the intent and purpose that the same should be presented and carried always after to any battle, as occasion should serve; and which was never carried or showed at any battle, but, by the especial grace of God Almighty, and the mediation of holy St. Cuthbert, it brought home the victory."—pp. 42-44. This banner was made in the year 1346, but there had been a banner of St. Cuthbert before; for in the wardrobe accompts of Edward I. (1299-1300) there is an entry of *5l.*, paid to William de Gretham, a monk of Durham, for his expenses in carrying it from the 3rd of July to the 24th of August, and for replacing it in the church of Durham. The fame of the banner of St. Cuthbert in securing the victory was so great, that when Wilfrid Holme, an early English writer of verse, who has left a metrical account of the insurrection in the reign of Henry VIII., called the 'Pilgrimage of Grace,' speaks of various religious works or relics to which particular virtues were ascribed, he says of St. Cuthbert's banner that it "caused the foes to flee." When the Earl of Surrey commanded an expedition into Scotland early in the reign of Henry VIII., he stopped at Durham, and when he had attended mass he agreed with the prior for St. Cuthbert's banner. This is mentioned by Hall the chronicler; Skelton the poet also alludes to the fact, and names also the banner of St. William, another northern saint, as being carried in the same army.

This banner of St. Cuthbert, after the Reformation, fell into the hands of Whittingham, who was made dean of Durham, one of the zealots of the Reformation. His wife, who was a French woman, is reported to have burnt it. ('Rites and Monuments,' &c. p. 44.)

It is not our intention to introduce in this article much respecting the use of banners in other countries; but we must remark that the *oriflamme*, of which there is frequent notice in the romances of chivalry and the authentic chronicles of the middle ages, was no other than the banner of St. Denis, which, like this of St. Cuthbert, was borrowed from the abbey of St. Denis near Paris, and carried in the French armies for the encouragement of the soldiery. The oriflamme was flame-coloured, without any embroidery; below, it was divided into three parts, and it was fastened to the lance by loops of green silk. When Louis le Gros had to defend France against the Emperor Henry V., he received this banner at the altar of St. Denis with much ceremony. It was carried in the armies of St. Louis and Philip le Bel. Charles VII. had it not, the abbey of St. Denis being then in possession of the English.

Among the Saxon kings of England there were two who were reputed saints, Edmund the Martyr and Edward the Confessor. The banners of these saints accompanied the English army, and waved over the fields where our Edwards and Henries gained their victories. The device on the banner of St. Edmund was two-fold: it had a representation of Eve in the garden, and the serpent tempting her; it had also the three crowns, which were interpreted of Royalty, of Continence, and of Martyrdom. This we learn from Lydgate, a monk of Bury, where was the monastery especially founded in honour of Edmund, king and saint. The device upon the banner of St. Edward the Confessor was, no doubt, the cross and martlets as they appear carved in stone in the abbey of Westminster, where he is buried. Henry V. had also with him a banner of the Trinity, and another of the Virgin.

We probably should not err widely if we were to assert of the banners in the Middle Ages, that they formed a link between the military and the ecclesiastics, between the affairs of war and the sentiments and feelings of religion. Their influence would be felt on many occasions, but more particularly when Christians were engaged in war with the Saracens and other enemies of the faith: it was then the cross or the crescent. We may trace, even to these times, a connection between military affairs and the religious sentiment, through the medium of the banners carried in the army. Even in Protestant countries they are frequently blessed by a minister of religion. The Pope still sends consecrated banners where he wishes success. The banners of Knights of the Garter are suspended in the Chapel of St. George at Windsor, and those of Knights of the Bath in Henry VII.'s Chapel at Westminster. The churches are still the depositories of banners taken from the enemy, and banners hang over the tombs of military or naval men of distinction.

That which is peculiarly the national banner of England is a religious one. It was the practice of Christian nations, as well as of private persons, to place themselves under the peculiar tutelage of some one saint. England's patron saint was St. George, for what reason the antiquaries are puzzled to determine. But 'St. George for England' was a usual war-cry, and his banner was, above all, the banner of Englishmen. The device was a plain red cross on a white ground. Whatever other banners were carried, this was always foremost in the field; and to this day the red cross forms the most conspicuous feature in the figure which the banner of England presents.

The other parts of the figure on the national banner are composed out of the crosses of St. Andrew and St. Patrick, the patrons of Scotland and of Ireland. Both these are what the heralds call saltier-crosses, that is, crosses with the limbs extended towards the corners instead of the sides of the shield. St. Andrew's cross was white upon a blue ground. Soon after King James VI. became king of England, he directed that this cross should be united with the cross of Saint George in the national ensign. This formed what was called the Union-Flag. To this, on the union with Ireland in 1800, the cross of Saint Patrick was added. This was red upon a white ground. This did not unite with the other two so well as the cross of Saint Andrew had united with that of St. George.

The Lions of England are the personal achievement of our kings. There is reason to believe that from the time of Richard I., beyond whose reign they can hardly be traced, there was a banner, bearing the lions, always carried near the person of the king when he was engaged in war. It seems, also, that other devices which were favourite cognisances of kings of England were depicted in banners as well as carved upon the buildings erected by them, or placed in the windows. Thus, Edward IV. had a banner with the white rose of the House of York. Henry VII., after the battle of Bosworth, offered in the church of Saint Paul, at London, three banners, one of Saint George, one which had a dun cow for its device, and the third exhibiting a red fiery dragon, an ensign which had reference to his descent from the princes of Wales.

In thus carrying their own personal banners into the field, the king was imitated by the earls and other persons of distinction who were in the English armies. In the feudal times, the armies were composed for the most part of bodies of men brought up by the great tenants-in-chief of the crown, and led by that chief himself, who was bound to personal service, as well as to furnish a certain quota of men. [Army.] These persons brought banners of their own, on which were depicted the heraldic insignia of their houses. This was no doubt an affair gratifying to the passion for distinction; but it was a matter of prudence, if not of necessity, also. Heraldry was in those days, far more than at present, a necessary art,—a dumb language. When the figure was so completely cased in steel, and the face covered by the face-plate, there was scarcely the possibility of distinguishing one knight from another of the same height and general appearance. But the escallop-shells showed who were Dacres; the water-budgets, Rooses; the chevrons, Clares; and the white lion on the red field, Mowbrays, with as much certainty as if the very names themselves were painted on the shields, embroidered on the surcoats, or displayed upon the banners. The young Earl of Gloucester, grandson of King Edward I., was slain in Scotland by persons who would gladly have saved his life had they known who he was; but, as the chronicler who relates the fact observes, he had not his armorial insignia with him.

The consequence of all this was, that besides the national banner, the banner of the king, and the banners brought by men of religion, there were in the English army, in the times of chivalry, a great number of lesser banners, by which particular portions of the army were distinguished, and which served to show, as we should now say, the position in the field of the company to which each soldier belonged. This must have added greatly to the picturesque appearance of an army, which has not escaped painters and poets. References to this custom are numerous in the writers who in any way touch upon the military transactions of the Middle Ages. When, in the reign of King Richard II., there was a question in the court of chivalry, contested very tenaciously and at an immense expense, between Sir Richard Scrope and Sir Robert Grosvenor, respecting the right to the heraldic figure of a golden bend upon an azure field, the depositions in which suit have been published from the original roll in the Tower, the evidence on both sides consisted very much of the testimony of persons who said that they had seen the ancestors of one or other of the claimants exhibiting in fields of war on their shields or banners the figure in question, or had heard of it from their fathers. In the present day there is reference to the practice, when a family asserts a right to coat-armour, independently of any grant from any Earl Marshal of England. The plea is, that an ancestor bore it in a field of war, which is held to be a good and sufficient plea; and it only remains to prove a male descent from such ancestor. But the most complete exhibition of this interesting custom of our ancestors is presented in a French poem of the reign of King Edward I., relating to the siege of the castle of Carlaverock in the wars of that prince. Besides the particulars of the siege, there is given a catalogue of the chiefs who were present, which may rival in extent and minuteness the catalogue of the chiefs who went to the siege of Troy. The author touches slightly on the character of each; but he gives in good technical terms a description of the heraldic device which each displayed on his banner. A short extract will show the way in which he proceeds:—

"He had for a companion a jollie and smart bachelor, well versed in love and arms, named John Paignel, who bore on a green banner a maunch painted, of fine gold.

"The good Edmund Deincourt not being able to attend himself, sent his two brave sons in his stead, with his banner of arms billetted of gold and surcharged with a dancette.

"John le Fitz Marmaduc, esteemed by princes and dukes, and all other persons acquainted with him: on his banner was the resemblance of a fess and three popinjays, distinguished by white and red.

"And Maurice de Berkelee, who was present at this expedition, had a banner red as blood, with crosslets and a white chevron, with a label of azure, because his father was living.

"But Alexander de Bailleol, ever attentive to do good, had a white banner and shield, with a red shield voided."

Thus the poet and herald goes through the entire host, presenting us with a view, nearly complete, of the whole chivalry of England as it stood in the reign of King Edward I.

When the English army ceased to be made up of contributions from the feudal tenants, the private banner would disappear, and only the national, the regal, or the religious banner be unfurled. But in the army of the Parliament the private banner again made its appearance. Sometimes it was decorated, as in earlier periods, with the armorial insignia of the captain who displayed it; but in general the devices partook more of the character of the impresses which had come into fashion in the reign of Elizabeth, by which some moral sentiment was sought to be expressed. Thus Captain Thomas Saint Nicholas, of Kent, had a scroll on which was written, 'Dabitur victoria Sanctis.' Captain Copley displayed a banner, on which was wrought the figure of an armed knight on a bay charger, with the words, 'Nay! but as a Captain of the Lord of Hosts am I come!' A contemporary has left an account of these banners: it is a curious picture of the spirit of the times. It is printed in the work known by the title of 'Sir John Prestwich's Res Publica.'

Banners with inscriptions, or intelligible devices, afford so ready a means of diffusing a sentiment or feeling among a multitude, that they have been used in all popular insurrections. The five wounds, the crucifix, and other devices of the same class, were exhibited on banners in the insurrections in favour of the Old Religion. And in indictments for treasons in the Middle Ages, there is scarcely one which does not enumerate among the overt acts, that the party had marched with banners displayed.

The early sovereigns of England are represented on their seals, the most authentic representations which we have of them, as knights on horseback bearing little banners. But it appears, by the illuminations of early manuscripts, that distinguished persons were attended by one who carried his banner; and this was, no doubt, from the beginning the usual practice. In later times it was certainly so. In 1361, King Edward III. granted two hundred marks annual fee to Sir Guy de Bryan, as a reward for having borne his banner discreetly at the siege of Calais. Lord Boteler, of Sudeley, in the reign of Henry VI., had a grant of one hundred pounds annual fee, as due to his office of bannerer. This was probable the same office with that which was called the Standard-Bearer of England, which was held in the reign of King Henry VIII. by Sir Anthony Browne, Knight of the Garter and Master of the Horse. Inferior persons who were allowed to bear a banner in the field had also their banner-bearers.

The standard which was in use in the 11th and 12th centuries was too large to be wielded by any one hand. The French antiquaries have traced it to Italy, and describe it thus:—The drapery floated from near the top of a mast or tall tree, which was fixed in a scaffold resting on a car drawn by oxen. The oxen were covered with housings of skin, adorned with devices and cyphers of the reigning prince. At the foot of the tree a priest celebrated mass every day; while ten knights, attended by as many trumpets, kept watch upon the scaffold night and day. Such an inconvenient machine was in use in the English armies; and at the battle in the reign of Stephen, called the Battle of the Standard, one of this kind was in the field. The pole was the mast of a vessel, and it was decorated with various religious symbols, and with the banners of Saint Peter, Saint John of Beverley, and Saint Wilfred.

The chief use of the standard and of other banners in military affairs must in all times have been to serve as a rallying point to soldiers of whatever class who composed the army. But they constituted, in the middle ages, as now, the telegraphic language of war. A banner hung out from a besieged fortress was as much a sign that a parley was desired in the reign of King Edward I. as now. When a fortress was taken, the banners of England were placed in some conspicuous part of it. Vessels at sea displayed then, as now, the national or royal banner, and sometimes the banner of its commander. A herald, when sent on an embassy, carried a banner of the prince whom he served; and the drapery of a trumpet was in early times, as now, the pennon-quarrée of a banner.

In all pageants, banners have aided the splendour of the scene: at tournaments, at coronations, or funerals, banners were exhibited in great profusion.

Corporations also had their banners, and the several trading companies, who still keep them. The author of 'The Rites and Ceremonies of the Church at Durham' says that, on Corpus Christi Day, "the bailiff of the town did stand in the tolbooth, and did call all the occupations that were inhabitant within the town, every occupation in its degree, to bring forth their banners, with all their lights appertaining to their several banners, and to repair to the Abbey Church door. Every banner did stand a-row in its degree from the Abbey Church door to Windisholl-gate; on the west side of the way did all the banners stand, and on the east side of the way all the torches stood pertaining to the said banners" (p. 162). The further use of them on that day is described by Naogeorgus:

> "In villages, the husbandmen about their corn do ride,
> With many crosses, banners, and Sir John, their priest, beside;
> Who, in a bag about his neck doth bear the blessed bread,
> And often times he down alights, and Gospel loud doth read.
> This surely keeps the corn from wind and rain, and from the blast,
> Such faith the Pope hath taught, and yet the Papists hold it fast."

When the drapery of the banner was allowed to float in the air, it was usually either square or extended out to a considerable length, and divided at the extremity, so as to form what is called the swallow-tailed banner. The banner of William Rufus was of this form; that of his father has the appearance of being three shreds, each attached singly to the pole.

We refer, for other particulars, to Sir Samuel Meyrick's work on 'Ancient Armour;' and to the 'Roll of Carlaverock,' translated and published with many useful notes by Sir Harris Nicolas, which, better than any other single piece, illustrates this subject of banners.

BANNERET, a name of dignity, now nearly if not entirely extinct. It denoted a degree which was above that expressed by the word *miles* or *knight*, and below that expressed by the word *baro* or *baron*. Milles, speaking of English dignities, says that the banneret was the last among the greatest, and the first of the second rank. Edmondson ('Body of Heraldry') says the order was instituted in 736, but gives no authority; it is more generally believed to have been first created in England by Edward I. Many writs of the early kings of England run to the earls, barons, bannerets, and knights. When the order of baronet was instituted, an order with which we must be careful not to confound the banneret, precedence was given to the baronet above all bannerets, except those who were made in the field, under the banner, the king being present.

This clause in the baronet's patent brings before us one mode in which the banneret was created. He was a knight so created in the field, and it is believed that this honour was conferred usually as a reward for some particular service. Thus, in the fifteenth of King Edward III., John de Copeland was made a banneret for his service in taking David Bruce, King of Scotland, at the battle of Durham. John Chandos, a name which continually occurs in the history of the wars of the Black Prince, and who performed many signal acts of valour, was created a banneret by the Black Prince and Don Pedro of Castile. It is in the reign of Edward III. that we hear most of the dignity of banneret. Reginald de Cobham and William de la Pole were by him created bannerets. In this last instance the creation was not in the field, nor for military services, for De la Pole was a merchant of Hull, and his services consisted in supplying the king with money for his continental expeditions. We have therefore here an instance of a second mode by which a banneret might be created, that is, by patent-grant from the king. Milles mentions a third mode, which prevailed also on the continent. When the king intended to create a banneret, the person about to receive the dignity presented the sovereign with a swallow-tailed banner rolled round the staff; the king unrolled it, and, cutting off the ends, delivered it a *bannière quarrée* to the new banneret, who was thenceforth entitled to use the banner of higher dignity. Sometimes the grant of the dignity was followed by the grant of means by which to support it. This was the case with some of those above-mentioned. De la Pole received a munificent gift; the manor of Burstwick, in Holderness, and 500 marks, annual fee, issuing out of the port of Hull. (Dugdale's 'Baronage,' vol. ii.)

The rank of the banneret is well understood, but what particular privilege he enjoyed above other knights is not now known, beyond being allowed to bear arms with supporters. It was a personal honour in England, though in France it was hereditary; and yet in De la Pole's patent it is expressed that the grant was made to him to enable him and his heirs the better to support his dignity. But the patent was perhaps irregular, as it seems to have been surrendered. No catalogue has been formed of persons admitted into this order, and it is presumed that they were few. The institution of the order of baronets probably contributed greatly to the abolition of the banneret. The knights of the Order of the Bath in modern times approach nearest to the bannerets of former days. In the civil wars, Captain John Smith, who rescued the king's standard at the battle of Edgehill, was created a banneret, and he was the last; he was killed in the skirmish at Alresford, in Hampshire.

It remains to be observed that the French antiquaries since Pasquier have represented the banneret as having been so called as being a knight entitled to bear a banner in the field; or, in other words, a knight whose quota of men to be furnished to the king's army for the lands he held of him were of that number (it is uncertain what) which constituted of itself a body of men sufficient to have their own leader. In England it is believed there were few tenants bringing any considerable number of men who were not of the rank of the *barones*.

BANQUETTE is a term applied in fortification to the step or small terrace of earth, made on the rampart, and against the parapet of a work, to enable the defenders to fire over its crest. The upper surface or *tread* of the banquette, which is generally about 4 feet wide, should be within 4 feet 3 inches of the crest of the parapet, in order that the men may conveniently use their muskets over it. The tread is reached from the terreplin of the rampart, or from the ground, if it is only a field work, by steps; or by the earth being sloped to the rear with a slope of 1 in 2, which men can easily run up, and having discharged their pieces, retire down again under cover. In the defence of houses, barricades, &c., the banquette is made up of tables, chairs, or anything which will raise the defenders to a sufficient height to fire through the loop-holes.

BANS. [BAN; MARRIAGE.]

BAPTISM (the English form of the Greek word βαπτισμὸς, *baptismos*), a well known rite or ordinance of Christianity; one of the two sacraments of the English Reformed Church.

When baptism, as a religious rite, was first practised, is a question on which the opinions of the learned have been divided. It is pretty generally admitted, that if any trace of it is to be discovered in the religious usages of any people before the time of our Saviour, and his forerunner John, it is among the Jews; and some early Jewish writers, whose testimony on such a subject is worthy of some regard, speak of it as a custom of their nation from very ancient times, and as having been always an accompaniment of circumcision, whether of infants or when a proselyte was made. To this it is replied, that the Hebrew writings which are called the Old Testament, by far the most ancient and authoritative monuments which we possess of the early religious usages of that nation, contain no trace whatever of any rite which resembles the baptism of John and of the founder of Christianity. In their religious code ablutions are undoubtedly prescribed in certain cases, but there is no analogy between those cases and the cases in which the Christian rite of baptism is performed; yet it is by no means improbable that those ablutions, which were supposed to wash away impurities, might suggest the idea of baptism, with which has always been connected, in some degree, the notion of the washing away of moral impurity.

We possess, however, the most authentic and satisfactory information, that in the reign of Tiberius there appeared in the wild country, on the banks of the river Jordan, a prophet whose name was John, who called upon the people of Judæa to adopt stricter rules of life, to expect the immediate coming of the kingdom of heaven, and to repent. Great multitudes attended the preaching of John. Most of those who heard him received him as a prophet sent of God. He required of those who became his disciples that they should be *baptised*. This was done in the river, and the meaning of the rite seems, in this case, to have been two-fold: 1. Repentance, or renouncing former opinions and practices; and, 2. Proselytism, or the taking John to be their general spiritual or religious guide and authority. On account of his requiring his proselytes to submit to this rite, the name of the Baptist was given him.

The part which John sustains in the history of Christianity is subordinate to that of a more sacred character, and we hear little afterwards of any sect, or community, or church, held together by a common reverence for the name of John, and the individuals of it baptised into that name. Among those who acknowledged John as a divine prophet, and received baptism at his hand, was Jesus of Nazareth, the long-expected Messiah, at whose baptism there was a supernatural appearance in the air, and a voice heard, which declared him to be the "beloved Son of God, in whom he was well pleased." John also bore his testimony that Jesus was the Messiah. Jesus founded that great church or community in which so large a portion of the human race are now comprehended, and appointed that admission into this church should be accompanied by the rite of baptism.

It is remarkable that he did not himself baptise. But while he was himself employed in diffusing that new and sacred truth which he came to communicate, and in the performance of those miracles by which his claim to be a divine teacher was established, his apostles and others of his more eminent disciples did baptise, and many flocked to their baptism. (John iv. 1, 2.) This was done under the eye and with the concurrence of their master, but after his resurrection he gave a more direct sanction to the practice, and in fact established the rite as a perpetual ordinance in his religion, saying to his apostles—"Go ye therefore and teach all nations, baptising them in the name of the Father, and of the Son, and of the Holy Ghost, teaching them to observe all things whatsoever I have commanded you." (Matt. xxviii. 19, 20.)

The apostles acted according to this injunction. The language of Peter on the day of Pentecost to the Jews at Jerusalem was this:—"Repent and be baptised every one of you in the name of Jesus Christ for the remission of sins:" when they that gladly received his word were baptised, to the number of three thousand. (Acts ii. 38, 41.) In the eighth chapter of the Acts we have an account of two remarkable baptisms by Philip; and in the same book are so many accounts of the performance of this rite when there was a profession made of belief in Christ, and there are at the same time so many allusions to the practice in the apostolic epistles, that there is no room for doubt that it was regarded by the apostles and first Christians as an instituted ordinance of the Christian church. The meaning of Christian baptism differed little, if at all, from the baptism of John. It implied repentance and faith in Christ.

The washing was no inapt symbol of this change. When formally administered by some officer of the Christian Church, and in the presence of a Christian assembly, it was an outward and visible sign that the convert took upon himself the profession of Christianity. It was an intelligible act about which there could afterwards be no dispute. The convert might relapse; but if he had once been baptised, there was once a time when he had professed himself a Christian, and when he had given a solemn pledge that he put away his Heathen or Jewish opinions and practices, and adopted the principles of the Christian faith. On the other hand, the performance of the rite by an apostle, or by a person commissioned by the apostles, or by any other person who was himself a Christian, and who professed that he was performing the rite as a Christian ordinance, and in obedience to the command of Christ, was an assurance to the person baptised that he was received into the Christian Church, that he was henceforth to be acknowledged by the whole Christian community as one of themselves, and was become entitled to all the blessings and advantages which attend those who are disciples of Jesus Christ. Our parish registers are not of births but of baptisms, and they are the authoritative records of the admission, by this rite, of persons into the Christian Church; the registry by the registrar is altogether independent of the baptism.

Different opinions are entertained of the amount of the advantages which ensue on the performance of this rite. Some regard it as not of itself bringing with it any advantages, but as being merely initiatory, and consider that the advantages of a profession of Christianity spring from other sources within the profession itself. Some regard it as in itself an actual washing away of all former sins, and, in the case of infants, of their participation in the guilt of Adam; and under this impression, we find that, in the early ages of the Church, there were those who deferred submitting to the rite till near the close of their lives, that the guilt of a whole life might thus be washed away. Others have taken their stand on the declaration of the apostle (Acts ii. 38), that those who were baptised should receive the gift of the Holy Ghost, and imagine that there is now some effusion of the Spirit on the person baptised. Some attribute to this rite what is called an immortalising efficacy, so that by baptism alone a person becomes entitled to that immortality which Jesus of Nazareth revealed; and others, again, regard baptism and regeneration as correlative. These opinions have all given occasion to controversies in the Church.

The manner in which it was performed appears to have been at first by complete immersion, "as a sign of total baptism into the Holy Spirit, being entirely penetrated by his grace," says Neander; who adds, that it was only in cases of sickness that sprinkling was allowed. ('Hist. of the Christ. Rel.,' sect. ix.) John baptised in the Jordan; and in another place (John iii. 23) it is said that he baptised "in Ænon, near to Salim, because there was much water there." The Ethiopian eunuch went down into the water to receive baptism from Philip. The words *baptism*, and to *baptise*, are Greek terms, which imply, in their ordinary acceptation, *washing*, or *dipping*. The question, however, is not whether entire immersion were the practice in the primitive church, but whether it was regarded as so essentially a part of the ordinance that there could be no baptism without it; and against that opinion it is argued, that this is nowhere declared in the Christian Scriptures; that a partial washing is, as a symbol, or an initiatory rite, as efficient as an entire immersion; that there is no evidence that entire immersion was in all cases demanded by the apostles; that we can hardly conceive that the three thousand converts who were baptised on the day of Pentecost received the rite at Jerusalem by immersion; that in one of the most remarkable cases of baptism recorded in the New Testament (Acts xvi. 33), the jailer and his family were baptised by St. Paul in the night immediately after they had made the profession of their faith, when it is improbable that the means were at hand for entire immersion; and that it is not to be supposed that the apostles would have declined to communicate the advantages of Christianity where they perceived faith and repentance, though the party were in circumstances in which it was impossible, or at least extremely inconvenient, to perform the rite in the usual manner; whence it is inferred that entire immersion is not *essential* to the ordinance.

The words which are to be used in the performance of this rite are thought, by most persons, to be prescribed by Jesus Christ himself;—"Baptising them in the name of the Father, and of the Son, and of the Holy Ghost." These words have been adopted as the formula by, it is believed, every church; yet it is remarkable that we do not find these words to have been used as a baptismal formula in any of the baptisms of which we have an account in the book of Acts; and in the account of some of them it is expressly said that the parties were baptised in the name of Jesus. (Acts ii. 38, and xix. 5.) It would seem, from the manner in which St. Paul writes to the Corinthians (1 Ep. i. 11-17), as if there were at that time some danger lest eminent Christians should be ambitious of having baptisms in their own names.

The opinions of the Christian world have been much divided with respect to the time of life at which it is proper to administer the ordinance. At first it was administered only to adults; it marked the reception of a new faith. When Christianity addresses herself to the unconverted, the proper time evidently is whenever the faith and repentance necessary are perceived to be complete; but the question relates to the case of nations which are already Christianised, and it properly assumes this form:—Shall the performance of the rite be delayed till the offspring of Christian parents are sufficiently advanced in religious knowledge to have the faith, and, if need be, the repentance of the convert? or shall those who are born in Christian households, and for whom there is the serious intention entertained by those who are their natural protectors to bring them up in the faith and knowledge of the Christian, be devoted early by their protectors to the faith of Christ, and admitted, in their still unconscious state, to whatever advantages may be supposed to attend the performance of this rite? Without entering at large into the controversy which was raised on this point, as early as the close of the 2nd century, by Tertullian, we may observe that, on the one hand, any profession of faith or repentance can only be made by persons of some maturity of judgment, and that therefore the ordinance seems better adapted to the case of persons who have attained to those years in which it may be expected that there is some acquaintance with the evidence by which the divine commission of our Saviour is proved, some knowledge of the nature of the doctrine taught by him, and some real sense of the advantages which attend the true believers in Christ. On the other hand, it is alleged that there is nothing in the New Testament which relates to the baptism of the offspring of parents themselves Christian, but only to the baptism of converted persons, leaving us without an authoritative direction in the case; that it was natural for the first converts, who were Jews, to infer an analogy between this rite and the initiatory rite of Judaism, which, by the divine command, was to be performed in infancy, and which brought the person who received it within the scope of the promises to Abraham and his seed, as baptism did within the scope of the promises to believers in Christ; that we read in the Scriptures of whole households being baptised at once (Acts xvi. 15, 33); that infant baptism certainly did prevail in the Church at a very early period; that it has been received by the authorities in the Roman Church, and in the Churches of England and of Scotland, and other Protestant Churches; and, lastly, that among those who attribute a saving efficacy in any form to the ordinance, it is to be supposed that a parent would think himself criminal if he neglected to obtain this blessing for his child at the earliest period possible, as St. Paul, in 1 Cor. vii. 14, says, "else were your children unclean, but now are they holy;" and even among those who regard it as but initiatory, that there is a propriety in Christian parents presenting their offspring newly-born in a Christian temple, and pledging themselves to a Christian minister, and in the presence of a Christian congregation, that they will bring it up in the knowledge and fear of God through faith in Jesus Christ.

The Quakers and some other Christians contend against the perpetuity of the ordinance. They say that it was intended only for the apostolic age, or, at most, only for persons of mature age who have been converted from heathenism or Judaism. Against this opinion there is the constant practice of the Church. We find, at the very close of the Scripture history, the apostles and other Christians proceeding with their baptisms; and at the very beginning of that history of the affairs of the Church which is to be collected from writers whose works are not in the New Testament, we find the ordinance in use among believers. The inference drawn from this is, that the words of our Lord, by which he instituted the ordinance, were understood by his apostles to mean, that all persons should be admitted into his Church by this rite, and that they transmitted this sense of them to those who afterwards were the teachers in the Church.

When baptism was received as a permanent ordinance of the Christian Church, suitable places were provided, called baptisteries, which, in some instances, preceded churches, and were, in fact, the point about which other edifices arose, forming an entire church. [BAPTISTERY.] In many of the larger churches of England, a portion of the building is set apart for the performance of this rite, and contains the *font*, so called from *fons*, a fountain, perhaps in reference to the original baptisteries, the springs or running streams of the East, or as the Spring of that water which was supposed to be life-giving. The maintenance of a font in the church for baptism is enjoined on every parish. Many of the old fonts of England have capacious basins, large enough to receive the entire body of the infant. It was the practice of the English Church, from the beginning, to immerse the whole body. (See Fuller's 'Church History,' p. 109.) Tyndale, writing at the eve of the Reformation, speaks of it as the general practice, and says that the exceptions were in cases of sickness, when the water was only poured on the head of the infant. Dr. John Jones writing in 1579 on the early culture of children, incidentally notices the fact that some of the old priests of that time were accustomed to dip the child very zealously to the bottom of the font. A few years later the practice was giving way, and the custom of sprinkling only becoming general; for Chappell, Bishop of Cork, in the account which he has left of himself, says that he was dipped, as was the custom of the parish in which he was born. He was born in Nottinghamshire, in the reign of Elizabeth. Since then the baptism of infants by immersion has been almost entirely disused in England. [FONT.]

At the Reformation it was intended to continue an ancient practice in the baptism of infants—the trine immersion; and there was an ordinance for the purpose in the reign of Edward VI. This has reference to the three persons in the Godhead named in administering the rite; and when performed according to what is supposed to be the genuine ancient usage, at the first immersion the right side must be downward, at the second the left, and at the third the face. Instances do sometimes occur in which the baptism of infants in the English Church is thus performed.

It has always been an object with the authorities in the Church of England to enforce the attendance at the public font in the Church. Private baptism is rather connived at than allowed, except in cases in which there is sickness or hazard of life; nor is the clergyman in these cases to perform the full service, but only so much as may be needful, in the estimation of himself and the parents, for satisfaction that the child, if it dies, die not unbaptised. The friends of the infant must still repair to the church for the completion of the ceremony. Among Dissenters, the baptism of infants has been, for the most part, peformed at home.

It is not absolutely necessary that the rite should be performed by a clergyman. The Church of England allows, in certain cases, of lay baptism; and it was on this allowance, in a great measure, that Sir John Nicholl rested the case in his judgment pronounced on the 11th of December 1809, in the case of Kemp and Wickes, clerk. Articles were offered against the clergyman for refusing to inter the child of two of his parishioners on the ground that it had not been baptised. It was proved that it had been baptised by a Dissenting minister. Sir John Nicholl's judgment was, that the baptism was so far sufficient, and that the clergyman had acted contrary to the law.

The Church requires that at baptism there shall be *sponsors*, from *spondeo*, to promise, or, in our own Saxon tongue, *godfathers* and *godmothers*, who pledge themselves that the infant shall be brought up in a Christian way. They are to be not less than three: for a male child, two men and one woman; for a female child, two women and one man. This practice is of great antiquity in the Church. It probably was adopted correlatively with infant baptism, as the infant could not of itself make the necessary profession of faith, and which was therefore promised for him; and Tertullian uses this as an argument against infant baptism, because the obligation undertaken by the sponsors was one that many circumstances might prevent their fulfilling. The practice however remains, and its effect is to introduce one other social tie among private families and friends. Persons who voluntarily undertake the office cannot hold themselves absolutely excused from some attention to the religious education of the infant, especially in the case of the death, or the criminal negligence, of its natural protectors.

Another incident to baptism, as administered in the English Church, is the giving a name to the child. If the child is registered before baptism, a name must be given, and this name must be retained, but additional names may be bestowed at the time of baptism. In this Christians seem to have followed the example of the Jews, who assigned a name when the rite of circumcision was performed. The name thus given during the performance of one of the sacraments is appropriately called the Christian name. The surname, or name of addition, is not on this occasion mentioned; and it is observable, that though there are frequent instances of the change of the surname in after life, the instances are extremely rare of any change in the Christian name. In the Roman Catholic Church indeed this name is not unfrequently changed by persons who enter holy orders, or into any religious society; but the English Protestant Church seems not to have pointed out the way in which the change can be legally effected, though some have maintained that it may be changed by the authority of the bishop, if solicited by the party at the time when presenting himself for confirmation.

The Church of England retains the signing the infant with the sign of the cross, as a token that it is hoped it will become a good soldier of Jesus Christ. This is one of the ceremonies which the English reformers thought it expedient to retain from many ceremonies with which this ordinance had been loaded in the earlier times of the Church. These additions to the simplicity of the ordinance began at a very early period. Tertullian, a Christian writer, who flourished from about A.D. 194 to 216, says that it was then the custom to give the baptised person milk and honey, and that he abstained from washing for the remainder of the day. The giving of salt, the touching the mouth and ears with saliva, anointing, the imposition of hands, and, lastly, formal exorcism, were by degrees introduced into the ordinance; and most, if not all, of them were the practice of the English unreformed Church. The sign of the cross was alone retained; but this gave great offence to the party of reformers called Puritans, who would have brought back everything in respect of religion to what they conceived to be the precedent, or the express directions of Scripture.

The most important treatises on the subject of baptism are: 'The History of Infant Baptism,' by William Wall, D.D., 1705; 'Reflections on Mr. Wall's History of Infant Baptism,' by John Gale, D.D., 1711; 'History of Baptism,' by Robert Robinson, 1790; 'The Nature and Design of Christian Baptism,' by R. A. Lancaster, 1855.

BAPTISTERY, a building in which the early Christians performed the ceremony of baptism. The word is derived from the Greek *βαπτιστήριον*, a large vase, labrum, or piscina of the frigidarium used to wash in. [BATH.] (Plin. lib. 2, ep. 17; lib. 5, ep. 6.) It was called by the Romans *baptisterium*, from whence is derived the word baptistery, a place in which the ceremony of Christian baptism was performed. It is most probable that the early Christians baptised for a long time after the primitive manner which was practised by St. John (Mat. iii.

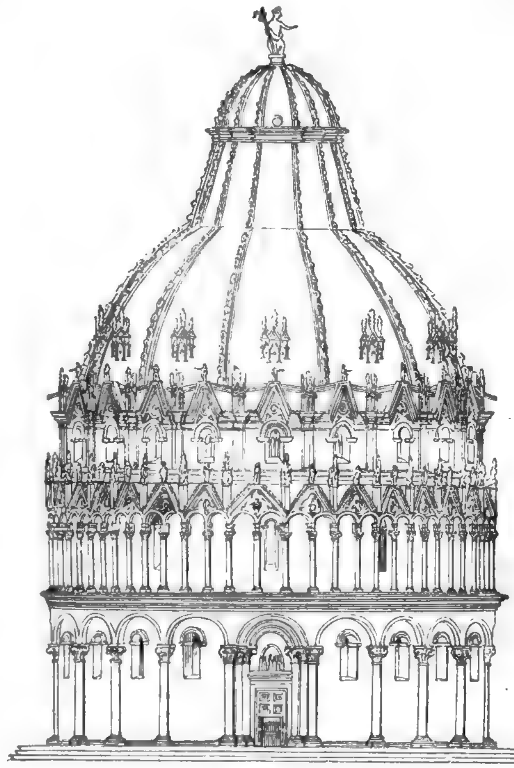
6, 16). Baptisteries were afterwards erected on a large scale, for the purpose of receiving a great number of individuals.

These baptisteries were originally in most cases placed at the west end of the basilicas to which they belonged; but afterwards were attached to or included in the churches. The form is, for the most part, hexagonal or circular; and it is very probable that the form of these buildings was imitated from some apartment in a Roman bath. [See BATH; and the plan of a Roman bath discovered at Bologna, cap. vi. of Cameron's 'Roman Baths;' and the Church of Santa Maria Maggiore, near Nocera, formerly a Roman bath; and especially the vignette at the commencement of the same work.]

The most celebrated existing baptisteries are those of Rome, Florence, and Pisa; the most ancient is the baptistery of S. Giovanni in Fonte, near the church of S. Giovanni Laterano, at Rome, commonly said to have been erected by Constantine the Great. The plan of this building is an octagon, with a small portico at the entrance; the interior is decorated with eight beautiful porphyry columns, the finest of the kind in Rome. These columns, unequal in diameter, support an architrave, over which eight small white marble columns are placed; above this second order there is an attic decorated with pilasters, and this is crowned with a dome. The walls are adorned with frescos, consisting of subjects from the Gospel and the principal events of the reign of Constantine. In the centre of the building is an octangular basin, three feet deep, lined and paved with marble. A modern font now stands in the centre of this basin, raised on steps of marble. The internal diameter of this structure is about sixty-five feet; and it appears to have been constructed with the materials of other buildings. Eustace calls this structure a chapel, and informs us that in it "only, and upon the eves of Easter and Pentecost, was public baptism administered in Rome; many magnificent ceremonies, which occupied the whole night, accompanied this solemnity." (Eustace's 'Class. Tour,' vol. i. p. 337.)

The Baptistery of Florence, which is also octangular, with a diameter of about one hundred feet, according to the plan in the 'Metropolitana Fiorentina,' stands opposite to the principal entrance of the cathedral. The date of its first construction is unknown; the Florentines pretend that it was originally a temple to Mars. In the internal arrangement, sixteen large granite columns are employed to support a gallery, which is carried nearly all round the interior; the vaulting is decorated with mosaics, by Andrea Tafi, the scholar of Cimabue; on the pavement is a large circle of copper, with numerical figures and signs of the zodiac upon it; and in the centre of this was originally a very fine octagonal basin. The external façades are built of black and white marble, and designed in that peculiar style of Florentine architecture of which Giotto was the father. Possibly this edifice may have been erected after his designs. The three great bronze doors are celebrated for the beauty of their bas-reliefs, and for the marble and bronze figures above them. The valves of the doors are divided into panels, on which are represented the principal events of the life of St. John—"the cardinal and theological virtues," and subjects from the Old and New Testament; and so important was the subject considered, that Nicolo da Uzzano and Lionardo d'Arezzo were engaged to select subjects for the sculptor. The most celebrated of these doors was made by Lorenzo Ghiberti, in 1330, and in after times eulogised by Michael Angelo in the highest style of panegyric. (See thirty-four engravings of 'La Terza Porta di San Giovanni di Firenze,' Firenze, 1773, in small folio, in the British Museum.) Another was made under Ghiberti's direction, assisted by many other artificers. Fifty years were employed in making and completing them. (See the work quoted above, in which are also published the contracts for their execution.) The most ancient was made by Andrea of Pisa.

The Baptistery of Pisa, erected between the years 1152 and 1160, by Diotisalvi, is of a singular design. The plan is circular, with a diameter of 116 feet; the walls are eight feet thick; the building is raised on three steps, and surmounted with a dome in the shape of a pear. The external elevation is divided into three stories: in the basement the columns, twenty in number, are engaged, and have arches springing from column to column, with a bold cornice above; in the first story the columns are smaller, stand out in relief, and are placed closer together; and the order is surmounted with pinnacles and high pediments, placed at equal distances: the terminations of these parts are crowned with statues. Above this is an attic story, decorated with other high pediments, pinnacles, and statues. The dome, which is covered with lead, is intersected by long lines of very prominent fretwork: all the lines meet in a little cornice near the top, and terminate in another dome, above which is a statue of St. John. The interior is much admired for its proportions: eight granite columns, placed between four piers decorated with pilasters, are arranged round the basement story; above this is a second order of piers, arranged in a similar manner, on which the dome rests, which is famous for its echo, as the sides produce the well-known effect of whispering-galleries. In the plan drawn by J. and F. de Milanis, preserved in the British Museum, columns are not shown in the interior. In the middle of the baptistery is a large octagonal basin of marble, raised on three steps. Within the basin there are four circular places hollowed out for water, and round the centre of the basin, which is occupied by a pedestal, is a place likewise hollowed out for the priest, who was thus enabled to turn from one basin to the other. By this means confusion was prevented, which would otherwise have occurred from the crowd pressing to one side of the font only. The city of



Geometrical elevation of the Baptistery of Pisa, from an elevation by J. and F. Milanis.

Scale 0 50 100 feet.

Ravenna and the episcopal cities of Tuscany have also their baptisteries. There are some interesting baptisteries in Germany; in France and England remains of baptisteries are rare and seldom of much importance.

The largest known baptistery ever erected was that belonging to the church of Santa Sophia at Constantinople, which is said to have been so spacious as to have once served for the habitation of the Emperor Basilicus; and in it also a very numerous body of persons once assembled in council.

The multangular edifices placed at the sides of cathedrals, which are called chapter-houses, are very similar in plan to the ancient baptistery. It is possible that they were originally used for that purpose. Bede mentions a wooden *oratory* built in haste at York for the express purpose of baptising Edwin, king of Northumberland, on Easter-day, A.D. 627. (Bentham's 'History and Antiquities of the Conventual Church and Cathedral at Ely.') The baptismal font [FONT] is not synonymous with baptistery; but should be applied only to the large stone vessel placed in the centre of the baptistery. At the close of the 6th century, the baptismal fonts belonging to baptisteries began to be placed in churches. At a font placed in a church the French King Clovis received baptism at the hands of St. Remis, archbishop of Rheims.

The baths in the English Baptist meeting-houses which are used for baptism are called baptisteries. They are not invariably *in* the places of worship.

(Montfaucon's *Monumens François*, vol. i.; Eustace's *Classical Tour; Ristretto delle Cose le più notabili di Firenze, &c.;* Cameron's *Roman Baths; La Metropolitana Fiorentina; La Terza Porta di S. Giovanni di Firenze,* small folio; Nolli's *Plan of Rome;* and the *Plan and Elevation of the Baptistery at Pisa,* by J. and F. de Milanis: the two last are in the King's Library in the British Museum. Plans, sections, and elevations of this building are given in Messrs. Taylor and Cressy's *Architecture of the Middle Ages in Italy.*)

BAPTISTS, a religious sect, and, in England, one part of the body known by the general name of the Three Denominations of Protestant Dissenters. As the name implies, they hold peculiar views on the subject of baptism, maintaining that this Christian rite ought to be administered by immersion, and not by sprinkling, at such an age that the ordinance can be regarded as the profession of the baptised person's own faith, and not in infancy. Such, they believe, was the practice of the apostolic times. In vindication of their mode of performing the ordinance, they lay great stress on the original word βαπτίζω which signifies, as they contend, nothing but immersion.

They defend the postponement of the rite from the words of the baptismal commission, in which the Apostles are commanded to teach before they baptise: "Go ye and teach all nations, baptising them in the name of the Father, and of the Son, and of the Holy Spirit." The reception of the Gospel being thus assumed as an indispensable qualification for baptism, the Baptists require that all to whom they administer it should repent of their sins, believe in Christ, and joyfully receive the word; a profession to this effect is made by most persons who are baptised in their communion.

An outline of the characteristic opinions of this sect has been promulgated in the four following heads:—1. That baptism commenced with the Christian dispensation, and was peculiar to it, bearing no analogy to any previous institution, such as circumcision; nor in any sense derived from previous enactments, but revealed as a positive law of the kingdom of Christ. 2. That baptism is only scriptural as administered by the immersion of the whole body in water. 3. That it cannot scripturally be administered to any but as a profession of faith in Christ Jesus, and therefore not to infants. 4. That as a command of the New Testament, it is obligatory on all who profess faith in Christ, and is intended to form a great line of separation between Christ and the world.

The question of baptism was brought before different councils in the 5th century, whose decisions were given in favour of infant baptism. The opposite opinions were therefore anathematised, and those who held them incurred the penalties attached to heresy. The baptismal controversy is alluded to in the writings of several of the fathers, some of whom did not scruple, in spite of edicts and decrees, to condemn the practice of baptising infants, as a deviation from Scripture and the early custom of the Church. The same view of the subject was very prevalent in the eastern provinces of the Roman empire, where it became so popular that, in the 9th century, when that powerful schism arose which led to the formation of the Greek Church, this was one of the articles in which an irreconcileable difference of opinion prevailed between the new communion and the old; the Western Church adhering to its established custom of sprinkling infants in baptism, while the Greek Church performed the ceremony by trine immersion.

The schism which had occasioned such a defection from the Church of Rome did not remove the cause of controversy concerning baptism; but, on the contrary, increased it by the intolerant proceedings which were taken against those who refused to be silenced. Driven from the bosom of their own communion, they took refuge in the churches of the Waldenses, in the vallies of Piedmont, and, at a later period, joined the disaffected sects in Germany and Flanders, amongst whom they sowed the seeds of their own doctrines. The zeal with which they laboured to spread their opinions only made them a more conspicuous mark for persecution. Imprisonment, exile, or death, was the fate of those who persisted in their adherence to this heresy. All the terrors of the Church were invoked to extinguish the offensive tenet; but so rapid was its growth under persecution, that the numbers of those who professed it in the beginning of the 12th century are said by Mosheim to have amounted to 800,000.

From this time to the commencement of the Reformation, Germany was the chief seat of the Baptist reformers; from whence, following the course of the Rhine, they spread over Holland. Being thus scattered over that part of the continent in which the doctrines of the Reformation were agitated, they availed themselves of the opportunity of gaining attention to their own views. From this great epoch in the history of religious opinions may be dated a new era in the history of baptism. Up to this time the doctrine, though so long and tenaciously maintained, appears not to have bestowed any particular designation upon those who held it. Their existence, as a distinct sect, commenced in Germany in the days of Luther, under the name of Anabaptists. Unhappily for the success of the doctrine, it was blended with principles so fanatical and lawless, that none who had a respect for the morals and order of society dared to avow it. So disreputable did the very name of this disorderly sect become, that it has made the advocates for baptismal immersion averse to the name of Anabaptists. The term Baptist has the advantage of being more etymologically correct than the earlier designation of Anabaptist, as *ana*baptism is only an accident, and not an essential circumstance. It is only necessary for us to remember, in order to preserve the thread of their history, that those persons who first insisted upon the necessity of baptismal immersion were, and are still, frequently known on the continent by the name of Anabaptists (in German Wiedertäufer), although the opinions now held by them bear a close, if not a complete, resemblance to those of their English brethren who are called Baptists. But the term Wiedertäufer is considered by the continental Baptists as a word of reproach; and in Germany they prefer to call themselves *Taufgesinnte*, and in Holland *Doopsgezinde*. The Mennonites, so called from Menno Simonis, always disclaimed all connection with the Anabaptists of Münster; they now form a numerous body in Holland, and are found in various parts of Germany; in Prussia they are said to amount to 15,000.

Little is known of the Baptists in England before the 16th century. Their name then appears among the various sects who were struggling for civil and religious freedom. Their opinions, at this early period, were sufficiently popular to attract the notice of the national establishment, as is evident from the fact that, at a convocation held in 1536, they were denounced as "detestible heresies utterly to be condemned." Proclamations followed to banish the Baptists from the kingdom; their books were burnt, and several individuals suffered at the stake. The last person who was burnt in England for his religious opinions was a Baptist, of the name of Edward Wightman, of Burton-upon-Trent: he was not, however, burnt as a Baptist, but for blasphemy and heresy.

We do not hear of any congregation of Baptists in this country before 1607. At that time one was formed by Mr. Smyth, a clergyman of the Church of England, who, having embraced the leading tenet of this denomination, resigned his living, and opened a place for public worship on the principles of the Baptists in the metropolis. This step encouraged others to follow his example who had hitherto concealed or privately professed their opinions. The forms of worship adopted by these congregations, that sprung up in various parts of England and Wales, did not materially vary from the practice of the Puritans. The reformed churches on the continent furnished a model for all the sects which then contended for the right of nonconformity, and have flourished since under the name of the Three Denominations of Protestant Dissenters. Among these, the Baptists were not the least distinguished for the consistency of their conduct in maintaining the right of private judgment, and in advocating the principle of universal toleration in matters pertaining to religion.

The Baptists subsist under two denominations, namely, General and Particular Baptists. The latter designation is given to those who hold Calvinistic views, and who are in every respect but their distinctive doctrine the same as the Independents. The General Baptists maintain the doctrine of universal redemption; but they are divided into the Old Connexion (Unitarian), and the New Connexion (Trinitarian), the latter by far the most numerous. Among both the Particular and General Baptists there is another ground of separation, relating to the terms of communion at the Lord's Supper. Some churches (each society or congregation is a church) do not allow persons who have not received baptism according to their views of it, to join with them in the celebration of this rite. Of this number are some of the Particular Baptists, and all the New Connection of General Baptists. Others, however, do not scruple to meet, on that occasion, not only those of the Baptist persuasion who hold other opinions widely different from their own, but even persons who do not embrace the Baptist tenet, provided their religious faith is, in other respects, as they conceive, orthodox, and their lives conformable to their profession. This is called Free Communion. The tolerant spirit which it cultivates, advocated as it has been by those eloquent defenders of liberty, Robert Robinson and Robert Hall, has made considerable progress through the whole denomination.

In Ireland and Scotland the Baptists have many congregations; but neither there nor in this country do their opinions spread so fast as in the United States of North America. The number of registered members in 1854, was 1,078,754. In Great Britain the census returns of 1851 gave the number of places of worship of the Particular Baptists as 1947, of the General Baptists as 93, of the New Connexion General, as 182, and 567 as those of Seventh Day, Scotch, and Baptists not otherwise designated. Sittings are provided in these places for 705,663 persons, of which 550,749 were in those of the Particulars. The total of attendants on Sunday, March 30, 1851, was 337,614, of whom 267,205 were Particular Baptists. These returns, are, however, acknowledged not to be precisely accurate, as there were 181 places which did not make returns of the number of attendants. In the United States, the "church accommodation" of the Baptists at the census of 1850 was 3,248,580, being much larger than that of any other denomination except Methodists: the number of church members was estimated at nearly a million (982,693); but these numbers include all the several descriptions of Baptists, which are more numerous in America than in England. Their church property was estimated at the sum of 10,931,382 dollars, and they then had eleven theological schools.

The Particular Baptists support colleges at Bristol, Bradford, Pontypool, Haverfordwest, and in Regent's Park, London; and the General Baptists of the New Connexion have a college at Nottingham, for the education of young men for the Baptist ministry. They have funds and associations for aged ministers, for widows, and for the education of the children of their ministers. Besides these, their pecuniary exertions for the support of home and foreign missions are very considerable. The English Baptists are among the foremost who sent Missionaries abroad to teach the doctrines of Christianity. For the advancement of this object, they have numerous agents in distant countries; in addition to which, they employ a great number in visiting the rural districts at home.

(*An Historical Sketch of the Baptist Denomination*; Mosheim's *Ecclesiastical History*, vol. iv.)

BAR is a term applied, in a court of justice, to an inclosure made with a partition of timber, three or four feet high, with the view of preventing the persons engaged in the business of the court from being incommoded by the crowd. It has been supposed to be from the circumstances of the counsel standing there to plead, that those lawyers who have been called to the bar, or admitted to plead, are termed *barristers*, and that the body collectively is denominated *the bar*; but these terms are more probably to be traced to the arrangements in the inns of court. [Barrister and Inns of Court.] Prisoners are also brought for trial to the same place; and hence the practice of speaking of them as the 'prisoners at the bar.' The term bar is similarly applied in the houses of parliament to the partition which divides from the body of the respective houses a space near the door, beyond which none but the members and clerks are admitted. To these bars witnesses and persons who have been ordered into custody for breaches of privileges are brought; and counsel stand there when pleading before the respective houses. The Commons go to the bar of the House of Lords to hear the speech of the sovereign at the opening and close of a session.

BAR, in music, a perpendicular line drawn through the staff [STAFF], dividing a piece of music into certain equal portions or measures, in order to render its execution more easy. The term *bar* is also applied to the quantity contained in any such portion: thus we say, a bar of two minims, of six quavers, &c.; and a bar in common time, in three-eight time, &c. Sir John Hawkins remarks, that the use of bars is not to be traced higher than the year 1574, and that it was considerably later before their use became general. He conjectures that we are indebted for their common use to Henry Lawes, who published his 'Dialogues,' &c., in 1653. That laborious historian may be right as relates to this country; though, with a work lying before us, 'Madrigali e Canzonette, posti in Musica dal R. P. Severo Bonini,' dated Firenze, 1607, in which the bars appear throughout, we cannot bring ourselves to think that nearly half a century elapsed before so obvious an improvement was adopted in England.

Double Bars mark a conclusion. They are likewise placed at the end of each strain; and if accompanied by dots, as in the example, they

indicate that the part next the side on which the dots appear is to be repeated.

BAR IRON. The relations which bar-iron bears to other forms of the manufactured metal will be described under IRON MANUFACTURE; but it may be useful in this place to notice the vast extent to which these products of industry are now exported. In the Board of Trade returns, bar, bolt, and rod iron are included in one return. The most important of these items is that of railway bars, with which England supplies a large portion of the world. In the three years ending with 1858, the average quantity of bar, bolt, and rod iron exported amounted to no less than 5,900,000 tons annually; of which 1,600,000 tons went to the United States, and 1,100,000 tons to the East Indies.

BARALIPTON. [SYLLOGISM.]

BA'RBACAN, or BARBICAN (*Barbacâne*, Italian; *Barbacane*, French), in ancient fortification, was usually a small round tower for the station of an advanced guard, placed just before the outward gate

Walmgate Bar and Barbacan, York. From "The History and Antiquities of the Fortifications to the City of York," by Messrs. Lockwood and Cates, architects. Lond. 1834.

of the castle-yard or ballium. (King's 'Sequel to his Obs. on Ancient Castles,' Archæol., vol. vi. p. 308.) Whence Spenser, in the 'Fairy Queen,' b. ii.,

> "Within the *barbacan* a porter sate,
> Day and night duly keeping watch and ward."

Grose ('Antiq. of England and Wales,' vol. i. pref. p. 5) calls it the first member of an ancient castle. He says it seems to have had no positive place, except that it was always an outwork. The term is still preserved in the ruins of different castles, as at Framlingham and Canterbury castles; and a small stone-work covering the gate of Bodiham Castle, in Sussex, is still called the barbacan; and barbacans also remain in tolerable preservation at Carlisle Castle, where the general arrangements of a barbacan may perhaps be better studied than anywhere else, and at Scarborough Castle. The two round towers at the angles of the barbacan of York were probably connected by a low breastwork over the gateway. Messrs. Lockwood and Cates consider the whole of the building which projects 56 feet from the gate called Walmgate to be the barbacan.

In cities or towns the barbacan was a watch-tower or outwork, placed at some important point of the circumvallation; thus, Lydgate, in his Bŏke of Troy, speaks of

> "Barbicans and also bulwerkes huge
> Afore the town made for high refuge."

It had sometimes a ditch and drawbridge of its own. (Grose, 'Milit. Antiq.,' vol. ii., p. 2.) The street of London called Barbican received its appellation from its vicinity to a tower of this sort attached to the city-wall: it had been removed when Stow wrote, but some remains of it were visible till the close of the last century. It is in this sense that Ben Jonson uses the term in his Epithalamion ('Works,' vol. vii. p. 5):

> "That far all-seeing eye
> Could soon espy
> What kind of waking man
> He had so highly set, and in what *barbican*."

Spelman ('Gloss.' in v.) says barbacan was a term likewise used for a hole in the wall of a city or castle, through which arrows and darts were cast out. It also signified a long narrow opening left in the walls, to drain off the water from a terrace or platform. In process of time it seems to have been applied to any projecting out-work of a building; at least Florio, in his 'Italian Dictionary' (1598), has "*Barbacane*, an out-work, or corner standing out of a house, a jettie."

The etymology of this word is uncertain. Spelman derives it from the Anglo-Saxon *burgh-kening* (*espiall* from the town); Junius from *burh-beacon* (as if it meant the signal-tower); while Manning, in the Supplement to Lye's 'Dictionary,' expressly says that the word barbican is not Saxon, but derived from the Arabic; first adopted in Italy, and brought to us by the Normans. He says, "Vox ista minime *Saxonica*: scilicet ab Arabibus primo accersitam, et ab *Italis* acceptam, ad nos deduxerunt *Normanni*." Whatever may have been its derivation, there can be little doubt it was received by us from the Normans or French. Its supposed Arabic origin is noticed by Dufresne, 'Gloss.' edit. Francof. 1681, tom. i. col. 473.

BARBACANAGIUM, or BARBICANAGE, was money paid to the maintenance of a barbacan or watch-tower, Cart. 17 Edw. III. m. 6, n. 14; or a tax levied for the same purpose on certain lands. (Grose, 'Antiq. of Eng. and Wales,' pref. p. 9.)

BARBARIAN. The Greek term Βάρβαρος (barbaros) appears originally to have been applied to language, signifying a mode of speech which was unintelligible to the Greeks; and it was perhaps an imitative word intended to represent a confused and indistinct sound. In the 'Iliad,' ii. 867, *καρὶς Βαρβαρόφωνοι*, &c., is rendered by Chapman—

> "The rude unlettered Caribæ that barbarous were of tongue."

Barbaros, it will be observed, is formed by a repetition of the same syllable, *bar-bar-os*. Afterwards, however, when all the races and states of Greek origin obtained a common name, it obtained a general negative sense, and expressed all persons who were not Greeks. (Thucyd. i. 3.) At the same time, as the Greeks made much greater advances in civilisation, and were much superior in natural capacity to their neighbours, the word in question obtained an accessary sense of inferiority both in cultivation and in native faculty, and thus implied something more than the term *ξενός*, or foreigner. At first the Romans were included among the barbarians; and in the time of Plautus the Romans themselves admitted the appellation (Pompeius Festus, lib. ii.), and called themselves barbarians. By degrees they excepted Italy, and at length *barbari* signified all who were not Romans or Greeks. In the middle ages, after the fall of the Western empire, it was applied to the Teutonic races who overran the countries of western Europe, who did not consider it as a term of reproach, since they adopted it themselves, and used it in their own codes of law as an appellation of the Germans as opposed to the Romans. At a later period it was applied to the Moors, and thus an extensive tract on the north of Africa obtained the name of Barbary. [BARBARY, IN GEOG. DIV.]

Barbarian, in modern languages, means a person in a low state of civilisation, without any reference to the place of his birth, so that the native of any country might be said to be in a state of barbarism. The word has thus entirely lost its primitive and proper meaning of *non-Grecian*, or *non-Roman*, and is used exclusively in that which was once its accessary and subordinate sense of *rude* and *uncivilised*.

BARBER-SURGEONS. In former times, both in this and other countries, the art of surgery and the art of shaving went hand in hand. As to the barbiers-chirurgiens in France, see the 'Diction. des Origines,' tom. i. p. 189. They were separated from the barbiers-perruquiers in the time of Louis XIV., and made a distinct corporation.

The barbers of London were first incorporated by King Edward IV. in 1461, Richard duke of Gloucester being one of the founders. At that time the barbers were the only persons who exercised surgery; but afterwards others, assuming the practice of that art, formed themselves into a voluntary association, which they called the Company of Surgeons of London. These two companies were, by an act of parliament passed in the 32 Hen. VIII. cap. xli., united and made one body corporate, by the name of the Barbers and Surgeons of London. This act however at once united and separated the two crafts. The barbers were not to practise surgery further than drawing of teeth; and the surgeons were strictly prohibited from exercising "the feat or craft of barbery or shaving." The surgeons were allowed yearly to take, at their discretion, the bodies of four persons after execution for felony, "for their further and better knowledge, instruction, insight, learning, and experience in the said science or faculty of surgery;" and they were moreover ordered to have "an open sign on the street-side where they should fortune to dwell, that all the king's liege people there passing might know at all times whither to resort for remedies in time of their necessity." Four governors or masters, two of them surgeons, the other two barbers, were to be elected from the body, who were to see that the respective members of the two crafts exercised their callings in the city agreeably to the spirit of the act. There was a surgical museum in their hall when Maitland wrote his 'History of London,' of which he thought very highly.

Holbein commemorated the granting of the charter to the barber-surgeons, in a picture which is still preserved at their hall in Monkwell-street.

The privileges of this company were confirmed in various subsequent charters, the last bearing date the 15th of April, 5 Charles I.

By the year 1745, it was discovered that the two arts which the company professed were foreign to and independent of each other. The barbers and the surgeons were accordingly separated by act of parliament, 18 Geo. II., and made two distinct corporations.

(Pennant's *London*, p. 255; *Stat. of the Realm*, vol. i. p. 794; Edmondson's *Compl. Body of Heraldry*; Strype's edit. of Stow's *Survey of London*, Farringdon Ward within.)

BA'RBITON, in *music*, the name of an instrument in use among the ancients; and that it was a kind of lyre we cannot for a moment doubt, though writers on the subject seem very willing to make it a matter of difficulty. M. Dacier, judging from a passage in Horace (lib. i. carm. 32), concludes that the barbiton was strung with thick flaxen cords. The writer in the 'Encyclopédie Methodique' infers, from the same ode, that the poet means to attribute to Alcæus the invention of the instrument, but it appears to us that he only intends to ascribe to him the invention of lyric poetry. M. de Castilhon is perplexed between Musonius and Athenæus; the one making Terpander, the other Anacreon, the inventor of the barbiton.

BARCAROLLE, in music, a kind of song in the Venetian language, sung by the gondoliers at Venice. Though these airs are composed for the common people, and often by the gondoliers themselves, yet they so abound in melody, that there is not a musician in all Italy who does not pique himself on knowing and being able to sing some of them. The privilege of free entrance to all the theatres in Venice, which these boatmen enjoy (says Rousseau, writing in the middle of the last century), enables them to cultivate their ear and taste, so that to the natural simplicity of their airs they add a degree of refinement which is by no means inconsiderable. The words of these barcarolles are commonly more than natural, partaking of the language employed in the conversation of those who sing them: but such as like a faithful representation of the manners of a people, and have any taste for the Venetian dialect, become passionately fond both of the poetry and music of these popular songs, insomuch that many persons possess large and curious collections of them.

Formerly most of the gondoliers knew by heart the greater portion of 'Gerusalemme Liberata' ('Jerusalem Delivered'), and some the whole poem: they passed the summer nights in their gondolas, singing it in alternate stanzas. Before Tasso, Homer alone had the honour to be thus sung; and no other epic poem has since been equally distinguished. (Rousseau.) But Tasso is now no longer sung by the gondoliers; they still have, however, their songs in response to each other, *improviso*, which the common auditor may be liable (and no doubt willing) to take for Tasso. The old barcarolle was sung in parts, at stem and stern of the same boat, by its own gondoliers.

Barcarolle, or boat-song, comes to us through the French from the Italian *barcarola*. The well known airs 'La Biondina in Gondoletta,' and 'O Pescator dell' Onde,' are pleasing specimens of this species of song.

BARD, an appellation of uncertain etymology, chiefly appropriated to the earliest poets of the Celtic tribes.

Lucan (lib. i. p. 447) describes the office of the bard, and gives his very name:

> Vos quoque, qui fortes animas, belloque peremptas
> Laudibus in longum vates dimittitis ævum,
> Plurima securi fudistis carmina Bardi.
>
> You, too, ye Bards! whom sacred raptures fire
> To chaunt your heroes to your country's lyre;
> Who consecrate in your immortal strain
> Brave patriot souls in righteous battle slain.—Rowe.

Tacitus uses a term, not found in any other writer, which seems derived from the name of bard. He says the Germans used songs, by the recital of which, called barditus, they sought to increase the fury of their warriors, and from the effect of the song drew omens as to the issue of the coming battle. ('Germania,' 3.)

The information, however, which remains to us from classical sources relating to the bards is, for the most part, scanty and detached; Strabo says that the bards (βαρδοι) were singers of hymns and poets among the Gauls. They were, no doubt, originally spread over the greater part of Western Europe, but gave way to southern civilisation; and it is from their latest retreats only, in Wales and Ireland, that we gain our best materials for their history.

Warton says the bards of Britain were originally a constitutional appendage of the Druidical hierarchy. In the parish of Llanidan, in the Isle of Anglesey, there are still to be seen the ruins of an arch-druid's mansion, which they call *Trer Drew*, that is, the Druid's mansion: near it are marks of the habitations of the separate conventual societies which were under his immediate orders and inspection. Among these is *Trer Beird*, or, as they call it to this day, the hamlet of the bards. (Rowland's 'Mona,' pp. 83, 88.) But so strong was the attachment of the Celtic nations (among which we reckon Britain) to poetry, that amidst all the changes of government and manners, even long after the order of Druids was extinct, and the national religion altered, the bards, acquiring a sort of civil capacity and a new establishment, still continued to flourish. And with regard to Britain, the bards flourished most in those parts of it which most strongly retained their native Celtic character. Amongst the Britons living in those countries that were between the Trent or Humber and the Thames, by far the greatest portion of this island, in the midst of the Roman garrisons and colonies, we cannot discover the slightest trace, in the poems of the bards, the lives of the British saints, or any other ancient monument, that they held any correspondence with the Welsh, the Cornish, the Cumbrian, or the Strathcluyd Britons. Amongst other British institutions grown obsolete among them, they seem to have lost that of bards; at least there are no memorials of their having had any, nor any of their songs remaining; nor do the Welsh or Cumbrian poets ever touch upon any transactions that passed in those countries after they were relinquished by the Romans.

And here we see the reason why the Welsh bards flourished so much and so long. But moreover the Welsh, kept in awe as they were by the Romans, harassed by the Saxons, and eternally jealous of the attacks, the encroachments, and the neighbourhood of aliens, were on this account attached to their Celtic manners; this situation and these circumstances inspired them with a pride and an obstinacy in maintaining a national distinction, and in preserving their ancient usages, among which the bardic profession is so eminent. (Warton, 'Hist. Engl. Poet.' vol. i. Diss. 1.) This also will account for their preserving the language in common use, while at the same time the use of the language has perpetuated a succession of minor poets, who have not altogether failed in maintaining the reputation of the older bards by their power and pathos. (Dr. Thomas Price on 'The Literature of Wales.')

By the laws of Hoel Dha, given about the year 940, the *Bardd Teulu*, or court-bard, was a domestic officer. He occupied the eighth place in the prince's court: he held his land free: the prince was to allow him a horse and a woollen robe, the queen a linen garment. At the three principal feasts, Christmas, Easter, and Whitsuntide, he was to sit next to the prefect of the palace, who delivered the harp into his hand; and at the same festivals he was to have the robe of the *disdain*, or steward, for his fee. When a song was required, the bard who had gained the badge of the chair (in musical contest) was first to sing a hymn in glory of God, after that another in honour of the prince, and then the Teuluwr, or bard of the hall, was to sing some other subject. If the queen desired a song, the bard was to attend in her chamber. When he accompanied the prince's domestic servants upon a foray, he was to have an ox or a cow given to him from the booty, and while the prey was dividing he was to sing the praises of the British monarchy. He was also to sing the praises of the British monarchy at the head of the detachment, when drawn up for fight. This, says Pennant ('Tour in Wales,' edit. 1784, vol. i. p. 461), was to remind them of their ancient right to the whole kingdom; for their inroads being almost always on the English territories, they thought they did no more than seize on their own. When invested with his office, the prince was to give the bard a harp, and the queen a ring of gold. Some copies of Hoel Dha's constitutions say a chess-board instead of a harp. The harp was on no account to be parted with. The bard was to lodge with the prefect of the palace. When he went out of the palace to sing with other bards he was to receive a double portion of the largesse or gratuity. If he asked any gift or favour of the prince, he was to be fined by singing an ode or poem; if of a nobleman, three; if of a common person, he was to sing till he was weary, or fell asleep. Any slight injury perpetrated on the royal bard was to be compensated by a fine of six cows and a hundred and twenty pence; his murder at a hundred and twenty-six cows. The marriage-fine of his daughter was estimated at a hundred and twenty pence. Her nuptial present was thirty shillings, and her dower three pounds. (See the 'Leges Wallicæ,' edited by Wotton, fol. Lond. 1730, lib. i. cap. 19, pp. 35, 36, 37.)

The *Pencerdd Gwlad* was another domestic bard of the higher order, who frequented the courts of the Welsh princes, though he was not a regular officer of the household. His privileges are described in the 'Leges Wallicæ,' lib. i. cap. xlv. pp. 68, 69. See also Pennant's 'Tour in Wales,' ut supra, p. 462.

Pennant says, "The bards of Wales were supposed to be endowed with powers equal to inspiration. They were the oral historians of all past transactions, public and private. They related the great events of the state; and, like the Scalds of the northern nations, retained the memory of numberless transactions, which otherwise would have perished in oblivion. They were likewise thoroughly acquainted with the works of the three primary bards, namely Myrddyn ap Morfryn, Myrddyn Emrys, and Taliesin ben Beirdd. But they had another talent, which probably endeared them more than all the rest to the Welsh nobility, that of being most accomplished genealogists, and flattering their vanity in singing the deeds of an ancestry derived from the most distant period."

The Welsh bards were reformed and regulated by Gryffyth ap Conan, king or prince of Wales, in the year 1078. (Warton, 'Hist. Eng. Poet.' dissert. ut supra.)

Pennant gives a minute account of the Eisteddfods, or sessions of the bards and minstrels, which were held in Wales for many centuries: one was held at the town of Caerwys; another at Aberfraw in Anglesea, for the bards of that island and the neighbouring county; and a third at Mathraval, for those of the land of Powis. The reason that these places were thus distinguished was because the two last were the residence of princes; and Caerwys, on account of the royal palace that stood below the town, the residence of Llewelyn ap Gryffydd.

At these eisteddfods, which Pennant terms the British Olympics, none but bards of merit were suffered to rehearse their pieces, and minstrels of skill to perform. These went through a long probation: judges were appointed to decide on their respective abilities; and suitable degrees were conferred, and permissions granted for exercising their talents in the manner already described. In the earlier period, the judges were appointed by commissions from the Welsh princes; and after the conquest of Wales, by the kings of England, notwithstanding that Edward I., according to constant but extremely doubtful tradition, exercised great cruelty over the bards of his time; yet future princes thought fit to revive an institution so likely to appease as well as to soften the manners of a fierce people. The crown had the power of nominating the judges, who decided not only on the merit but the subject of the poems, and as our modern lord chamberlains used to do, were certain of licensing only those which were agreeable to the English court.

A commission for holding an eisteddfod at Caerwys, in 1568, was, in Pennant's time, in the possession of Sir Roger Mostyn, together with the silver harp, which had from time immemorial been in the gift of his ancestors, to bestow on the *chief of the faculty*. This badge of honour was about five or six inches long, and furnished with strings equal to the number of the Muses. The commission, of which Pennant has given the form (as well as an engraving of the harp), is the last which was granted. It was dated 23d Oct. 9 Eliz. In consequence, an eisteddfod was held on the 26th May following, when various persons received degrees, some as chief bards of vocal song, others as primary, secondary, or probationary students; and many more as bards, students, and teachers of instrumental song upon the harp and crwth. Players on crwths with three strings, taborers, and pipers, were reckoned among the ignoble performers; they were not allowed to sit down, and had only a penny for their pains. The degrees consisted of four in the poetical, and five in the musical faculty. For the full details relating to them the reader is referred to Pennant, ut supra, pp. 467-474. The laws of Gryffyth ap Conan recognise the distribution of the classes.

"No public festivity," says Pennant, "great feast, or wedding could be duly solemnised without the presence of the bards and minstrels. A glorious emulation arose among them; and prizes were bestowed on the most worthy. In 1176 the Lord Rhys, prince of South Wales, made a great feast at Christmas, on account of finishing his new castle at Aberteifi, of which he proclaimed notice through all Britain a year and a day before: great was the resort of strangers, who were nobly entertained, so that none departed unsatisfied. Among deeds of arms, and variety of spectacles, Rhys invited all the bards of Wales, and provided chairs for them, which were placed in his hall, where they sat and disputed, and sang, to show their skill in their respective faculties; after which he bestowed great rewards and rich gifts on the victors. The bards of North Wales won the prizes; but the minstrels of Rhys's household excelled in their faculty. On this occasion the Brawdwr Llys, or judge of the court, an officer fifth in rank, declared aloud the victor, and received from the bard for his fee a mighty drinking-horn, made of the horn of an ox, a golden ring, and the cushion on which he sat in his chair of dignity." (Pennant, ut supra, p. 475.)

Since the days of Queen Elizabeth, as has been already said, no royal commission has been issued for holding an eisteddfod; but individual and collective exertions have not been wanting of later years, not only for the revival of the bardic profession, but for the general cultivation and encouragement of Welsh literature. The Gwyneddigion Society was established for this purpose in 1770, and the Cambrian Society in 1818. Annual meetings have also been held for the recitation and reward of prize-poems and performances upon the harp; and another society, since formed, immediately under royal patronage, called The Cymmoridion, or Metropolitan Cambrian Institution.

The Irish carry the history of their bards to the earliest date of the supposed Milesian invasion. The details of that history, in a diffuse form, are given in Walker's 'Memoirs of the Irish Bards,' 4to. Lond. 1786.

These bards were of three classes: 1. The *Ollamhain Redan*, or *Filidhe*, were poets who turned the tenets of religion into verse; they animated the troops before and during an engagement, and raised the war-song. 2. The *Breitheamhain* (Brehons), or legislative bards, who promulgated the laws in a kind of recitative, or monotonous chant, seated in the open air. 3. The *Seanachaidhe* were antiquaries, genealogists, and historians; they recorded remarkable events, and preserved the genealogies of their patrons in a kind of unpoetical stanza. Each province and chief had a Seanacha. Besides these three orders of bards, there was another of an inferior kind, composing the *Cleananaigh*, *Crutairigh*, *Clotairigh*, *Tiompanach*, and *Cuilleaunach*, all of whom took their several names from the instruments on which they professedly played. The head of this order was entitled *Ollamh-Receol*. The profession of these, as well as that of the higher classes of the bards, was hereditary.

Warton says, we are informed by the Irish historians that St. Patrick, when he converted Ireland to the Christian faith, destroyed three hundred volumes of the songs of the Irish bards. Such was their dignity in this country, that they were permitted to wear a robe of the same colour with that of the royal family. They were constantly summoned to a triennial festival, and the most approved songs delivered at this assembly were ordered to be preserved in the custody of the king's historian or antiquary. Many of these compositions are referred to by Keating as the foundation of his 'History of Ireland.' Ample estates were appropriated to them, that they might live in a condition of independence and ease. The possession was hereditary; but when a bard died, his estate devolved not to his eldest son, but to such of his family as discovered the most distinguished talents for poetry and music. Every principal bard retained thirty of inferior note as his attendants, and a bard of the secondary class was followed by a retinue of fifteen. They seem to have been at their height in the year 558. (Keating's 'History of Ireland,' pp. 127, 132, 370, 380, and preface, p. xxiii; Warton, 'Hist. Engl. Poet.' voi. i., Dissert. i. p. 46, note [e].)

According to Warton, the songs of the Irish bards are by some conceived to be strongly marked with the traces of Scaldic imagination, and these traces are believed still to survive among a species of poetical historians, whom they call *tale-tellers*, supposed to be the descendants of the original Irish bards. A writer of equal elegance and veracity relates, that a "gentleman of the north of Ireland has told me of his own experience, that in his wolf-huntings there, when he used to be abroad in the mountains three or four days together, and lay very ill a-nights, so as he could not well sleep, they would bring him one of these tale-tellers, that when he lay down would begin a story of a king, or a giant, a dwarf and a damsel." (Sir William Temple's 'Miscellanea, Part II., on Poetry.') Warton also says ('Dissertation,' i.), "we have already seen that the Scandinavian Scalds were well known in Ireland, and there is sufficient evidence to prove that the Welsh bards were early connected with the Irish. Even so late as the 11th century, the practice continued among the Welsh bards of receiving instructions in the bardic profession from Ireland." When Gryffyth ap Conan, king of Wales, reformed and regulated the Welsh bards in 1078, Powell acquaints us, that he "brought over with him from Ireland divers cunning musicians into Wales, who devised, in a manner, all the instrumental music now there used, as appeareth as well by the books written of the same, as also by the names of the tunes and measures used among them to this day." ('Hist. of Cambr.' edit. 1584, p. 191.)

The harp said to have belonged to Brien Boiromh, king of Ireland, who fell in the hour of victory against the Danes on the plain of Clontarf near Dublin, in 1014, is preserved, as a relic of bardism, in the Museum of Trinity College, Dublin, to which it was presented by the Right Honourable William Conyngham, in 1782.

Spenser ('View of the State of Ireland') gives no favourable idea of the Irish bards of his time. He speaks of them as "so far from instructing young men in moral discipline, that they themselves do more deserve to be sharply disciplined; for they seldom use to choose unto themselves the doings of good men for the arguments of their poems." He continues, "For a young mind cannot rest; if he be not still busied in some goodness, he will find himself such business as shall soon busy all about him. In which, if he shall find any to praise him, and to give him encouragement, as those Bards and Rhymers do for little reward, or a share of a stolen cow, then waxeth he most insolent and half mad with the love of himself, and his own lewd deeds. And as for words to set forth such lewdness, it is not hard for them to give a goodly and painted show thereunto, borrowed even from the praises which are proper to virtue itself. As of a most notorious thief and wicked outlaw, which had lived all his lifetime of spoils and robberies, one of their bards in his praise will say, that he was none of the idle milk-sops that was brought up by the fireside, but that most of his days he spent in arms and valiant enterprises; that he did never eat his meat before he had won it with his sword; that he lay not all night slugging in a cabin under his mantle, but used commonly to keep others waking to defend their lives, and did light his candle at the flames of their houses, to lead him in the darkness; that the day was his night, and the night his day; that he loved not be long wooing of wenches to yield to him, but, where he came, he took by force the spoil of other men's love, and left but lamentation to their lovers; that his music was not the harp, nor lays of love, but the cries of people and clashing of armour; and finally, that he died, not bewailed of many, but made many wail when he died, that dearly bought his death." This song, he adds, when it was first made and sung to a person of high degree in Ireland, was bought (as their manner is) for forty crowns.

The Celtic Highlanders of Scotland had also their bards or sennachies, who sung the deeds of their chiefs; but of their productions there are no genuine remains, though probably portions of Macpherson's Ossian may give a sort of traditional echo of some of them.

The Germans have adopted the word as descriptive of a species of devout battle-song or poem. Klopstock's 'Die Hermanns Schlacht,' 'Hermann und die Fursten,' and 'Hermanns Tod,' are called *barditen*. He had followers, who at first imitated Ossian, and failed; but later poets, as Kretschmann in the epic, and Gerstenberg in the lyric form, have had better success.

(For further information, exclusive of the works already quoted, the reader may consult Evans's *Dissertatio de Bardis*; Jones's *Musical and Poetical Relics of the Welsh Bards, with a History of the Bards and Druids*, 4to. Lond. 1794; Sir Richard Colt Hoare's *Giraldus Cambrensis*, vol. i. p. 300–319; and Beauford's *Origin and Learning of the Irish Bards*.)

BAREGIN. [GLAIRIN.]

BARGAIN. This word is immediately derived into the English language from the French *Barguigner;* and perhaps ultimately from the Italian *Bargagnare*. Its etymology is quite uncertain, but it appears to have been frequently used in the middle ages to signify the arrangement of the terms of a contract of purchase. (See Ducange, 'Glossar.' ad verbum Barcaniare.) In this sense it is commonly used in English law; and when a bargain and sale of goods is mentioned, the bargain denotes the arrangement of the terms upon which one sells and another buys; and the sale expresses the completion of the contract so as to pass the property from the seller to the buyer. In such cases the seller is called the bargainor, and the buyer is termed the bargainee. The two parts of the transaction taken together constitute the whole contract of buying and selling personal goods so as effectually to change the property. In order, however, to give validity to this contract, it is essential that there should be a consideration given or promised by the bargainee to the bargainor. Thus if a man verbally agrees to sell me a horse, and I neither pay him nor promise him any thing for it, this is what the English law, following the civil law, calls *nudum pactum*, a naked bargain, and not a sale, and, being wholly void, will not pass the property in the horse to me.

The term bargain and sale is now much more generally used in a more limited sense to denote a kind of conveyance of real property, which derives its effect from the statute 27 Hen. VIII. c. 10, commonly called the Statute of Uses. For nearly two centuries before that statute, it was the custom throughout England to convey lands to uses: that is to say, the legal possession of them was vested in one person, while the use or beneficial interest was enjoyed by another, who was called the *cestuique use*. This practice is said to have been first introduced by the monastic societies, for the purpose of evading the statutes of mortmain, which, while they prohibited a direct conveyance to those corporations, did not in terms extend to alienations to third persons for the use or benefit of religious houses. This defect was afterwards remedied by the statute 15 Ric. II. c. 5, which rendered uses subject to the penalties imposed by the statutes of mortmain. But the practice of conveying land to uses was found to be attended with so much convenience, that it still continued with respect to estates of private individuals. The courts of common law, indeed, refused to acknowledge any other title than that of the person who was actually in possession of the land. But the Court of Chancery, upon the ground that the legal tenants were bound in conscience to perform the trusts for which the land was vested in them, used to interfere to compel them to account for the profits of the land to the *cestuique use*, and to dispose of it according to his directions.

This was the origin of the jurisdiction of courts of equity over trusts, which has since assumed so extensive and complicated a shape. The interest in the use, being a creation of courts of equity, was of course subject to the modifications imposed by those courts. Hence, they permitted uses to pass by the will of *cestuique use* at a time when land itself was not devisable except by particular custom. Again, uses were not subject to aids, reliefs, wardship, marriage, escheat, or any other feudal incident, nor liable for the debts of *cestuique use*.

The use being, in contemplation of equity, thus separated from the possession of the land, it followed that the alienation of the one might be made without parting with the other. Thus, if a person, possessed of an estate in fee-simple, made a bargain with another that the estate should be his, but retained possession of the property, the Court of Chancery (provided the bargain was grounded upon a sufficient consideration) looked upon the bargainor as holding the estate to the use of the person from whom the consideration proceeded, and who was, according to the dictates of good conscience, to be treated as the real owner of the estate. Equity, however, following the rule of the civil law, not to enforce a *nudum pactum*, refused to compel the performance of any agreements except such as were founded either on *good* or *valuable* consideration. These two classes of contracts gave rise to two new kinds of conveyance, which, though disregarded by the courts of common law, became operative in equity. The first, namely a conveyance on a *good* consideration, was where the owner of the estate, in consideration of an intended marriage, or of the love which he bore his actual wife, child, or other blood relation, agreed by deed to hold the estate for the use of such wife, child, or other blood relation. This was called a covenant to stand seised, from the word 'seisin,' which in English law signifies possession of a freehold estate. The other was where the contract was founded on a *valuable* consideration; namely, one consisting of money or money's worth (as rent, or services incident to feudal tenure), and was called a bargain and sale. It was originally a mere contract for sale; but in process of time it became a mode of settlement of land, in which case the courts of equity did not inquire into the *amount* of the consideration, provided it were *valuable* according to the technical meaning of the term.

In process of time, the inconvenience of separating the real from the ostensible ownership of the land was found to counterbalance any advantages that might have been accidentally derived from the system. The departure from the principles of the common law of England, in permitting secret alienations to have the same effect as the open and notorious conveyances of former times, opened a wide door to fraud. The feudal lords, in particular, suffered by the system of uses to such an extent, that several legislative enactments were from time to time introduced in order to remedy the evil. [USES.] At length the legislature, in the 27th year of the reign of Hen. VIII., by a bold enactment abolished the distinction between ownership of the land and ownership of the use, by transferring uses into possession, that is to say, by giving to the person who had formerly only an interest in the use, a perfect, indefeasible, legal estate in the land.

So that where a person before the statute (having a freehold estate in lands) had agreed, for good or valuable consideration, that the use of such lands should belong to another, the statute divested the bargainor of all interest in the land, and conferred upon the person with whom the contract was made (or, in legal language, the bargainee) the same estate in the land that he formerly had in the use. But it is to be observed, that if the bargainor had an estate less than freehold in the land (as an estate for a term of years), the statute, which provides only for cases where persons are *seised* to the use of others, was held not to apply. Therefore, in that case the bargainee was left to his remedy in equity as before. But in conveyances of freehold estates, the statute gives such a title to the bargainee as he can enforce in a court of law without having recurrence to equity. The operation of the conveyance has been well described to be of such a nature, that the bargain first vests the use, and then the statute vests the possession in the bargainee. The words of the statute extend to every species of real property (except copyhold estates), whether corporeal or incorporeal, whether in possession, reversion, or remainder. Therefore, all such property (if actually in existence at the time of the creation of the use) may be the subject of conveyance by bargain and sale. (Sanders 'On Uses and Trusts,' vol. i. p. 107; and vol. ii. p. 51.)

The legislature having thus given a legal effect to this equitable mode of transfer of property, proceeded in the same session to provide against its being turned into an instrument of fraud. The secret nature of uses had been mentioned in the preamble of 27 Hen. VIII. c. 10, as one of the principal reasons for their abolition. To prevent the same objection from arising to the conveyance by bargain and sale under the statute, the statute 27 Hen. VIII. c. 16, provided that no bargain and sale should operate to pass an estate of freehold, unless made by writing indented, sealed, and enrolled in one of the king's courts of record at Westminster, or with the custos rotulorum, and two justices of the peace, and the clerk of the peace of the county or counties where the lands bargained and sold lay, or two of them at the least, whereof the clerk of the peace was to be one: the enrolment to be made within six months after the date of the writing. The act contains an exception of lands lying within cities, boroughs, or towns corporate, where the mayors or other officers have authority, or have lawfully used to enrol any evidences, deeds, or other writings. A bargain and sale, therefore, of such lands, operates to all intents and purposes, from the date of the conveyance. The writing required by this statute must be a deed; that is, must be delivered as well as sealed, as the requisition that it be indented implies; for the indented edge of the parchment is a symbol of a duplicate of the writing being in the hands of another contracting party: but actual indentation is now unnecessary, provided the deed *purport* to be an indenture, 8 & 9 Vict. c. 106, s. 5. ('Blackst. Com.' vol. ii. p. 336, Dr. Kerr's edit.; and see DEED, INDENTURE.)

The enrolment of a bargain and sale is a copy of the deed upon parchment preserved in the records of the court; and as the statute requires this to be made within six months, without saying *calendar* months, it is understood, according to a well known rule of law, to mean lunar months, consisting each of twenty-eight days. But a recent statute for the abolition of fines and recoveries (3 & 4 Will. IV. cap. 74) provides (s. 41) that bargains and sales made in pursuance of that act shall be good if enrolled within six *calendar* months. The deed may be enrolled upon proof of its due execution, without the concurrence of the bargainer.

As the statute of enrolments obstructs the operation of the conveyance until it be enrolled, frequent questions have arisen in our courts as to the legal rights of the bargainee in the interval between the execution of the deed and the enrolment. For most purposes the enrolment has a retrospective relation to the delivery of the deed, so as to give it the same effect as if the enrolment were immediate. But it has been held that, although the bargainee of a reversion is entitled to the rent incurred between the delivery and the enrolment, yet if the tenant pay the rent to the bargainor, the payment is lawful, and the bargainor is not compellable at law to account for it. Again, it seems that, if a bargainee before enrolment convey the estate by bargain and sale to another person, and then enrol the first deed, the second deed is void, though it be afterwards enrolled. So a lease made by a bargainee before enrolment is not valid. Upon this part of the subject see Saunders 'On Uses and Trusts,' vol. ii. p. 55. The 74th section of the 3 & 4 Will. IV. cap. 74, provides that every deed to be enrolled under that act shall take effect *as if enrolment had not been required*, but shall be void against a purchaser for valuable consideration claiming under a deed subsequent in date but enrolled before the other.

Enrolments of bargains and sales of freehold land being considered as deeds of record have been deemed so far worthy to be assimilated in their nature to records as to render a copy of an enrolment admissible, in the first instance, as evidence in a court of law, without any actual proof of its execution. This cannot be the case with any other kind of deed, except where the original is in the possession of the adverse party, who refuses, after notice given, to produce it. But stat. 10 Anne, c. 18, s. 3, in conformity (as it is said) with former usage, has given to enrolments of deeds of bargain and sale the same privilege with other records, by making copies of them of the same force, when produced in evidence, as the originals. Such copies must be examined with the enrolments and signed by the proper officer (whence they are called office copies), and must be proved upon oath to be true copies so examined and signed.

Some time after the passing of the Statute of Enrolments a method of evading the object of it was discovered. The statute, in terms, only extends to conveyances of estates of freehold or inheritance. Therefore if a person, being himself possessed of an estate of freehold (for otherwise, as we have mentioned above, the Statute of Uses itself did not apply), carved an interest for a term of years out of such estate by deed of bargain and sale, such deed did not require enrolment. And the Statute of Uses conferring upon such bargainee for years the legal possession of the land, he was in a condition to receive from the bargainor a release of the freehold reversion: for a release is a relinquishment of right, and by the rules of the common law can only be made to a person who has already some interest in the land, which enables him to avail himself of the right relinquished. [RELEASE, REVERSION.]

This was the origin of the now disused conveyance by lease and release, which, from its convenience in effecting a transfer of the legal freehold by the rules of the common law, without any additional ceremonies, had, at one time and until very recently, nearly superseded every other mode of alienation of freehold property. The modern conveyance by lease and release was a transaction compounded of a bargain and sale and a release at common law, in which two deeds were required. The first, which was generally a lease by bargain and sale for one year for a nominal consideration, by force of the Statute of Uses, gave the actual legal possession of the land, without a formal entry, to the bargainee. The second, which generally bore date the day after the date of the lease, was a deed of release of the freehold and inheritance of the land to the party who had already obtained possession by virtue of the lease for a year. For a further account of this mode of conveyance, see LEASE and RELEASE.

It is to be observed, however, that as before the Statute of Uses it was a rule of law that a corporation could not be seised to a use, so since that statute no corporation (even though otherwise not disabled in law from alienation) can convey by bargain and sale. Therefore such a corporation, in order to convey by lease and release, had to make a lease operating at the common law; in which case an actual entry upon the land by the lessee and payment of rent was to be made before the lessee had such a possession as to enable him to take a release of the reversion.

The operative words of transfer commonly used in a deed of bargain and sale are 'bargain and sell;' but it seems that if a man, for a pecuniary consideration, by deed indented, covenant to stand seised to the use of another, or give and enfeoff, or alien, grant, and demise to him, such deed, if properly enrolled, will operate as a bargain and sale. (Sanders, 'Uses and Trusts,' vol. ii. p. 49.)

A bargain and sale, as well as a lease and release, is said to be a harmless conveyance, that is, if a person by either of these modes of conveyance professed to grant a larger interest than he actually possessed in the land (as where a tenant for life attempted to convey the fee), the conveyance operated only to pass such interest as the grantor could lawfully convey. But if such tenant for life had formerly attempted an alienation by a more violent mode of conveyance (as by feoffment), a forfeiture of the life estate ensued, and the person next in remainder or reversion was entitled to take advantage of such forfeiture by an immediate entry upon the lands.

The act 8 & 9 Vict. c. 106, took away from the feoffment its tortious operation. The conveyance by bargain and sale has now become disused, the mode of transfer by lease and release having been superseded by simpler methods of transfer. All property can now be conveyed by a simple deed of grant, which requires in ordinary cases no enrolment, 8 & 9 Vict. c. 106, s. 2.

BARGE-BOARD; BARGE-COURSE. Barge-course is a term applied to that part of the tiling of a roof which projects over the gable end of a building. The under part of the barge-course, immediately over the external wall of the gable, is commonly stuccoed, and to protect this stucco from the weather, two boards, called *barge-boards*, following the inclination of the roof, are usually attached to the gables of old English houses, fixed near the extremity of the barge-course, and carved in the richest manner. These barge-boards may be considered as one of the peculiar characteristics of domestic Gothic architecture. Barge-boards were also placed on the ends of the gables of church-porches, when these were constructed of wood. Examples still remain of barge-boards of the 14th century, which are marked by the quiet richness characteristic of the carved-work of the English ecclesiastical architecture of that period. In the succeeding century they were less ecclesiastical in style; the cusps which were usual in the earlier ones were in the 16th century omitted, and the barge-board bore a hip-knob, which was carried upwards as a finial and downwards as a pendant: sometimes, however, the pendant only was used. Numerous fine examples of these barge-boards may be seen at Coventry, Shrewsbury, Oxford, Salisbury, and other towns which retain examples of our older domestic architecture. (See Pugin's 'Ornamental Gables,' in which the rich designs of many of these carved boards are admirably drawn.)

The word barge has been supposed to be a corruption of *bash*, which is used provincially to express beating in, beating on, and beating down; the barge-board being placed at the gable ends of buildings to protect the barge-course from the rain, which would otherwise beat in upon it: *barge*-board might, it was thought, therefore possibly be a corruption of *bash*-board. But it is perhaps more likely to be a corruption of *verge*-board. It sometimes occurs as *parge*-board, and may have been so called from its protecting the parget or plaster of the barge-course.

BARILLA, the commercial name given to the impure carbonate of soda formerly imported into this country, principally from Spain, the Canary Islands, and Sicily. The best was brought from Alicante, in the neighbourhood of which place it was prepared from two plants, the *salsola sativa*, or barilla, whence the name of the preparation, and the *salier*. These plants were very extensively cultivated in Valencia and Murcia, and the produce was annually exported from Alicante to the amount of 90,000 cwt. By far the largest proportion of this quantity found a market in this kingdom. The plants are raised from seed which is sown at the close of the year, and they are usually in a fit state to be gathered in the month of September following. They are then plucked up by the roots, and after they have been allowed to become heated by being thrown together in heaps, are dried in the sun by the same method as is used in England for making meadow-hay. In October the plants are burned. For this purpose, hemispherical holes are made in the earth capable of containing about a ton and a-half of soda; two iron bars are laid across each of these cavities, and the dried plants, mixed with straw and reeds, are placed upon these supports. The whole is then set on fire, when the soda which the plants contain is fused and flows into the cavity beneath in the form of a red-hot fluid. This burning is continued by the constant heaping on of plants until the pit is filled, when the alkali is covered over with earth and left to cool gradually, during ten or twelve days. At the end of that time the mass is found to be of a hard and spongy consistence; and this, when broken into fragments, is ready for shipment. Barilla of the best quality is of a bluish-gray colour; that which is made from other plants, and which is inferior, is of a colour approaching to black, and of greater specific gravity than barilla made from the plants above-named.

From 1829 to 1834 the importation of barilla into Great Britain for the manufacture of soap and glass averaged 252,000 cwts. Now little or none is imported. This change has been occasioned by the production of carbonate of soda from common salt, through the agency of sulphuric acid; salt having become much cheaper from the repeal of the duty, and sulphuric acid also from improvements in the manufacture. The quantity of carbonate of soda now consumed annually is calculated to be at least seven times as much as the largest importations of barilla in any single year. [SODA, MANUFACTURE OF.]

BA'RIUM (Ba), a peculiar metal, the basis of the alkaline earth baryta. Davy first gained indications of the decomposition of baryta in the end of October 1807; he obtained an alloy of it with iron in March 1808; and in the beginning of June, in the same year, he obtained the metal. To prepare barium, a quantity of the mineral substance called carbonate of baryta is made into a paste with water, and placed on a plate of platinum; a cavity is made in the paste to receive a globule of mercury; the mercury is rendered negative, the platinum positive, by means of a Voltaic battery containing about one hundred double plates. In a short time, the baryta of the carbonate is decomposed, and an amalgam of mercury and barium formed. This amalgam must be heated in a small bent glass tube, which contains no lead, and filled with hydrogen gas, or the vapour of naphtha; the mercury being volatilised, the barium remains. Barium may also be procured, without the aid of electricity, by passing a current of the vapour of potassium over red-hot baryta in an iron tube. By this a mixture of barium and oxide of potassium is obtained; from this the metal is to be extracted by amalgamation with mercury, and the amalgam is to be decomposed by heat in the mode already described. These methods do not give the metal in a state of purity, but it may be obtained pure by the voltaic decomposition of its fused anhydrous chloride.

Barium is a yellow metal of considerable lustre. It is much heavier than water, for it sinks even in sulphuric acid, though surrounded by bubbles of gas. It decomposes water readily, with the evolution of hydrogen gas; a solution of baryta is thus obtained. By exposure to the air, it is slightly covered with a crust of baryta; it fuses before it becomes red hot, and at this temperature it acts upon glass, without being volatilised. When exposed to the air, and moderately heated, it burns with a deep red light. It may be flattened a little, so that it is to a certain extent a malleable metal. Barium has however as yet been obtained only in small quantities, and consequently its properties are but imperfectly known. The equivalent of barium is 68·64. Barium forms two compounds with oxygen,—a protoxide and a binoxide.

Protoxide of Barium (BaO); *Baryta*; *Barytes*.—This oxide in combination occurs largely in nature, and was discovered in the year 1774 by Scheele; its name is derived from βαρὺς (*barys*), heavy. Baryta is met with combined with sulphuric acid, forming *heavy spar* or *cawk*, termed chemically sulphate of baryta, and with carbonic acid, constituting the mineral termed *witherite*, or carbonate of baryta; it may be procured by decomposing either of these native compounds. The simplest mode, when it is wanted free from water, is to convert the carbonate into nitrate of baryta, and this when strongly heated in an earthen crucible is decomposed, and the nitric acid being expelled, the baryta remaining has the following properties:—It is of a grayish-white colour. When moistened with water it becomes very hot, and in a short time falls into a fine white powder; if more water is added, it becomes a crystalline and very hard mass. The specific gravity of baryta is about 4·0; it is extremely poisonous, has an acrid, alkaline, caustic taste, and requires a high temperature to fuse it.

Baryta, or the protoxide of barium, is composed of

1 equivalent of oxygen	8
1 do. barium	68·64
	76·64

Baryta and water combine and form at least two compounds: the first hydrate, is procured when a small quantity of water is poured upon baryta, and during their action, as has been already stated, much heat is evolved, and the baryta becomes a white powder. This hydrate contains one equivalent of water; it is fusible at a red heat, but does not part with its water even when heated to whiteness.

According to Davy, 20 parts of water at 60° dissolve one part of baryta: the solution is called *baryta water*, and is frequently used as a chemical re-agent. With carbonic acid baryta forms an insoluble carbonate, and both baryta and baryta water speedily acquire carbonic acid by exposure to the air. Baryta water acts strongly as an alkali, converting vegetable yellows to brown, restoring the blue colour to reddened litmus, and saturating acids. Water at 212° dissolves, by Davy's experiments, half its weight of baryta, of which a considerable portion separates in the state of crystals as the solution cools; these crystals contain ten equivalents of water.

Peroxide of Barium (BaO_2), *Binoxide of Barium*, is prepared by heating baryta to low redness in a platinum crucible, gradually adding to it about one-fourth of its weight of chlorate of potash; this yields oxygen to the baryta or protoxide of barium, which thus becomes peroxide, but mixed with chloride of potassium, which may be dissolved by cold water, while the peroxide of barium remains undissolved, combined with water; it may also be prepared by passing oxygen gas over baryta heated to redness. It is composed of two equivalents of oxygen and one equivalent of barium. It is decomposed by acids, and is used only in preparing the binoxide of hydrogen.

Neither nitrogen nor hydrogen unites with barium.

Chloride of Barium (BaCl + 2HO).—Chlorine and barium combine to form one chloride, consisting of

1 equivalent of chlorine	35·47
1 do. barium	68·64
	104·11

The best mode of preparing chloride of barium is to dissolve carbonate of baryta in hydrochloric acid, and evaporate the solution so as to obtain crystals, which should be then purified by re-crystallisation. Chloride of barium is a colourless salt, soluble in water, but insoluble in alcohol. Five parts of water at 60° dissolve one part of chloride of barium. Chloride of barium is used as a chemical re-agent for the detection and quantitative determination of sulphuric acid.

Protosulphide of Barium (BaS).—Sulphur and barium combine in several proportions, but the protosulphide is the only compound of importance. It may be prepared by heating together finely-powdered sulphate of baryta and powdered charcoal in a covered crucible; in this case the charcoal takes oxygen both from the sulphuric acid and the baryta, and protosulphide of barium remains, which dissolves readily in boiling water, and the solution on cooling deposits colourless transparent crystals; these crystals are protosulphide of barium, containing six equivalents of water.

Protosulphide of barium thus prepared is much used for the production of other salts of barium, as it is readily decomposed by all acids, even the carbonic acid. Thus chloride of barium may be formed by adding hydrochloric acid to protosulphide of barium.

$$\text{BaS} + \text{HCl} = \text{BaCl} + \text{HS}.$$

Phosphide of Barium (BaP).—*Phosphuret of Barium*.—Phosphorus and barium combine to form the phosphide, by heating baryta to redness in a glass matrass with a long neck, and throwing phosphorus upon it. There are formed both phosphate of baryta and phosphide of barium, as represented in the following equation:—

$$\underbrace{7\text{BaO}}_{\text{Baryta.}} + 6\text{P} = \underbrace{5\text{BaP}}_{\substack{\text{Phosphide of}\\ \text{Barium.}}} + \underbrace{2\text{BaO}, \text{PO}_5}_{\substack{\text{Phosphate of}\\ \text{Baryta.}}}$$

The mass fuses, and on cooling has a brown colour and a metallic lustre. When too strongly heated the phosphide of barium is decomposed, phosphorus is volatilised, and baryta remains. Phosphide of barium decomposes water; phosphuretted hydrogen gas is evolved, and hypophosphite of baryta remains in solution.

Iodide of Barium (BaI).—Iodine and barium unite and form the iodide of this metal. It may be prepared by acting upon baryta or its carbonate with hydriodic acid, and evaporating the solution obtained. It is very soluble in water, and crystallises in acicular crystals, which deliquesce slightly by exposure to the air.

Bromide of Barium (BaBr + 2HO).—Bromine and barium, when combined, form the bromide. It may be obtained by boiling excess of moist carbonate of baryta in a solution of protobromide of iron; the filtered solution is to be evaporated to dryness and the residue made red hot; by dissolving this in water, and by careful evaporation, colourless rhombic crystals are obtained, which are soluble in alcohol.

Fluoride of Barium (BaF).—Fluorine and barium may be made to combine by digesting fresh precipitated and moist carbonate of baryta in hydrofluoric acid; the carbonate is decomposed, and the fluoride of barium is formed, and separates in the state of a white powder. This may be heated to redness without decomposing, and is slightly soluble in water. The solution, by evaporation, yields crystalline grains, which are readily dissolved by hydrochloric and nitric acids.

Having described the principal binary compounds of barium, we proceed to notice the more useful of the numerous salts formed by combining the protoxide of barium (baryta) with different acids. The following are the only barytic salts which are extensively employed.

Acetate of Baryta ($BaO, C_4H_3O_3 + 3HO$).—This salt may be prepared by dissolving either baryta or the carbonate in acetic acid, or decomposing the solution of protosulphide of barium with it. By evaporation, crystals of acetate of baryta are obtained in slender prisms, resembling those of acetate of lead. These crystals effloresce by exposure to the air; they dissolve in 1·75 part of cold water, and in 1·03 of boiling water; 100 parts of cold alcohol dissolve one part of these crystals, and when boiling, one part and a half. This salt is composed of

1 equivalent of acetic acid	51·0
1 do. baryta	76·6
3 do. water	27·0
	154·6

The taste of this salt is saline and bitter. It is decomposed by the fixed alkalies and their carbonates, and by carbonate of ammonia; it is also decomposed by sulphuric acid and the sulphates, which precipitate sulphate of baryta.

According to Mitscherlich, when this salt crystallises at the temperature of 55° Fahrenheit, it contains only 6·6 per cent. of water; but when below this temperature it contains, as above stated, about 17·5 per cent. of water of crystallisation.

Carbonate of Baryta (BaO, CO_2).—This substance occurs to a considerable extent as a mineral product, and is by mineralogists sometimes called *witherite*. It is a dense substance, its specific gravity being about 4·331; it is sometimes translucent and nearly colourless, but is often opaque. It sometimes occurs crystallised, and the primary form is a right rhombic prism, but it usually has the form of a six-sided prism.

Carbonate of baryta is so nearly insoluble in water as to require about 4300 times its weight at 60°, and 2300 at 212° for solution; and it is still more insoluble in water containing any salt in solution. It is poisonous, and suffers no change by exposure to the air. When heated to whiteness with charcoal it is decomposed, and on the addition of water a solution of baryta is obtained. It consists, according to Dr. Thomson, of

1 equivalent of	carbonic acid	. . . .	22·0
1 do.	baryta	. . . . . .	76·6
			98·6

It is used for the purpose of dissolving in various acids to procure barytic salts, and, when heated with charcoal, also for preparing baryta, especially when it is wanted merely in solution in water. Bicarbonate and sesquicarbonate of baryta may be formed, but they are unimportant compounds.

Nitrate of Baryta (BaO, NO_5) is readily procured by adding nitric acid either to baryta, its carbonate, or to the solution of protosulphide of barium. The solution is colourless, and by evaporation yields crystals, the form of which is the regular octahedron.

This salt requires 12 times its weight of water at 60° for solution, and between 3 and 4 times its weight at 212°. It is not altered by exposure to the air, but when strongly heated it is, as already noticed, decomposed, and baryta remains in a pure state. This salt consists of

1 equivalent of	acid	. . . . . .	54·0
1 do.	baryta	. . . . . .	76·6
			130·6

The crystals contain no water.

Sulphate of Baryta (BaO, SO_3); *Heavy Spar.*—This compound occurs largely in many parts of Great Britain, especially in the lead-mines of the north of England. It occurs both amorphous and crystallised. In the former state it is sometimes colourless and transparent, but frequently opaque. The crystals are often very large, and the primary form, subject to many varieties, is a rhombic prism. It is extremely heavy, its specific gravity being about 4·7. It is unalterable in the air, insipid, and insoluble in water; indeed, strong sulphuric acid is the only fluid which dissolves it in any notable quantity, and from this it is precipitated by water. It is composed of

1 equivalent of	sulphuric acid	. . . .	40·0
1 do.	baryta	. . . . . .	76·6
			116·6

Sulphate of baryta may also be prepared artificially by adding either dilute sulphuric acid or any soluble sulphate to a solution containing baryta or any of its salts. The sulphate of baryta precipitates as a heavy white powder, insoluble in water, acids, and alkalies.

Heat produces no decomposition in sulphate of baryta; but, as already noticed, when heated with charcoal it is converted into sulphide of barium. When boiled also in a solution of carbonate of potash, a portion of it is converted into carbonate of baryta; but the decomposition takes place only to a limited extent.

On account of the extreme insolubility of sulphate of baryta, its constituents are delicate tests of each other's presence, and both sulphuric acid and baryta are almost invariably converted into this salt when their weight has to be estimated in quantitative analysis.

When sulphate of baryta is moderately heated with carbonaceous matter, a substance is produced called *Bolognian phosphorus*, which possesses the property of exhibiting luminosity in the dark for some time after it has been exposed to the direct rays of the sun.

BARIUM, SALTS OF. [BARIUM.]

BA'RIUM, CHLORIDE OF—*Medical Properties of.*—This compound never occurs native, but is always obtained either by the decomposition of the native carbonate of barytes, or witherite, as directed by the London Pharmacopœia, or of the sulphate, or heavy-spar, as directed by the Edinburgh College. This last seems the preferable mode, not only from the abundant occurrence of heavy-spar, but because the salt so procured is generally purer (Christison); and as it is more employed as a chemical test than in medicine at the present day, purity is an essential condition for its utility. It crystallises in white, transparent, shining, right rhombic prisms, sometimes in double eight-sided pyramids, or, by rapid evaporation, in thin plates (Geiger). It is permanent at the ordinary temperature of the air, but efflorescent in a very dry atmosphere. Its specific gravity is 2·825. It is of easy solubility in water: 100 parts dissolve 43·5 at 60° Fahr.; at 212°, 78 parts. Pure alcohol does not dissolve any of it; rectified spirit, a minute quantity. The only officinal preparation is the watery solution, Liquor Barii Chloridi.

Chloride of barium possesses acrid-narcotic properties, its taste being irritating and burning. It resembles medicinally chloride of calcium, but is more potent; in poisonous doses its action is similar to arsenic, with this difference, that it requires a larger dose to destroy life, and while its local action is less marked, producing less disintegration of the stomach, it is more rapidly absorbed and produces death more speedily. It is rarely employed as a means of self-destruction, or of intentional injury to others. Fortunately an efficient antidote exists in agents readily procured, and invariably efficacious if speedily administered. Any alkaline sulphate, such as Epsom or Glauber salts, or sulphuric acid greatly diluted, will instantly form an insoluble and harmless sulphate of barytes. Medicinally this compound is employed in very minute doses in various forms of scrofula. It possesses slight tonic powers, improves the appetite, and promotes absorption, reducing the glandular enlargements. It once enjoyed, chiefly from the testimony of Hufeland, a high celebrity. But like many other muriates once confided in for the removal of scrofula, it has almost fallen into disuse, particularly since iodine has become known. Some practitioners, thinking that two agents which are thought singly to be of use, must do good when combined, have formed an iodide of barium. This salt has a disagreeable nauseating taste. It is given in the dose of the eighth of a grain, in some aromatic water, three times a day. An ointment is also formed of it.

Pure air, exercise, regular, and above all early hours, appropriate diet, and other points of regimen, such as warm clothing, will do more to eradicate scrofula than any medicines.

(Lugol, *On Scrofula*, translated by Ranking, 1844.)

BARK. There are several kinds of bark which enter largely into commerce, and are used for processes in the arts, or for medicines. The principal kinds in the first of these classes are the barks of the oak, the cork, the mimosa, and the quercitron. Among the descriptions of bark used for medicines we shall notice only that known under the name of Jesuits' or Peruvian Bark: the others are not of much commercial importance. Some other kinds of bark, as Cinnamon and Cassia, will be noticed in other parts of this work.

Oak Bark.—(German, *Eichenrinde Lohe;* Dutch, *Run, Runne;* Danish, *Bark, Garverbark;* Swedish, *Bark, Ekbark;* French, *Tan Brut, Ecorce de Chêne;* Italian, *Scorza di Quercia—Corteccia della Quercia;* Spanish, *Corteza de Encina;* Portuguese, *Casca do Carvalho;* Russian, *Dubowui Kora;* Polish, *Dab Garbarski;* Latin, *Quercus Cortex.*) For a long time, oak-bark was the only substance used in England for the process of tanning; and it was thus employed for ages, without the tanners knowing what were the properties of the substance which produced the chemical change whereby hides are converted into leather. The increasing demand for oak-bark beyond the means of supply so raised its marketable value, that an investigation became necessary, in order to ascertain whether, when the nature of those properties was discovered, some cheaper substances might be found to answer as substitutes. Other substances besides oak-bark had before that time been used for tanning in certain foreign countries; such as heath, gall-nuts, birch-tree bark, myrtle-leaves, leaves of wild laurel, and willow-bark. In 1765 oak saw-dust was applied with some success in England to the purpose of tanning; and this plan has been since pursued in Germany.

The result of investigations showed that the tanning power of oak-bark resided in a peculiar astringent substance, to which, from the use to which it is applied, the name of *tannin* has been given. In more recent times, Sir Humphry Davy determined, by a series of experiments, the relative value to the tanner of different substances in which tannin is found; and he has shown that 8½ lbs. of oak-bark are, in this respect, equal to 2½ lbs. of galls, to 3 lbs. of sumach, to 7½ lbs. of bark of the Leicester willow, to 11 lbs. of bark of the Spanish chestnut, to 18 lbs. of elm-bark, and to 21 lbs. of common willow-bark.

To prepare oak-bark for use, it is ground to a coarse powder between cast-iron cylinders, or in bark-mills which implement makers have lately invented. In the ground state it is put into the tan-pit, in alternate layers, with the skins to be prepared. A better method sometimes employed is to make an infusion of the bark in water, which dissolves and holds the tannin. The action of this substance upon skins may be explained in a few words. Before the skin is subjected to the tanning process, the hair, epidermis, and any fleshy or fatty parts adhering to them, must be removed; the remainder consists wholly of gelatine, a substance capable of being dissolved in water, and which then forms the substance well known as glue. Tannin, as we have seen, is likewise readily soluble in water; but the two substances, when brought together, form the insoluble and imputrescent compound called leather. See further on this subject under TANNING.

It has been found that the proportion of tannin which oak-bark contains varies materially according to the season in which it is cut. If taken in the spring, it has four and a half times the quantity, in a given weight, compared with what it would have if cut in winter. Sir Humphry Davy likewise discovered that the proportion is influenced by the age of the tree, tannin being more abundant in the bark of young than of old trees.

There are no means of knowing what quantity of oak-bark is used annually by the tanners of this country. Of that which is imported, about half comes from Holland and Belgium.

Cork Bark.—This substance is described in a separate article. [CORK AND CORK-CUTTING.]

Mimosa, or Wattle Bark.—This bark is collected from two species of the mimosa, which are plentifully found in New South Wales, Van Diemen's Land, and New Zealand, where, at least in the British settlements, it is used for the manufacture of leather. This bark contains about 150 lbs. of pure tannin in every ton weight, which is only about three-fifths of the proportion yielded by the best white oak bark. It is also said that it gives a reddish colour to the leather, which, although it does not actually lower its value in use, creates a prejudice against it in the market. As long ago as 1823 a small quantity of fluid extract of this bark was brought to London from Australia, and, after having been subjected to trial by some tanners, was purchased by them. Since that time, importations of the bark in its crude state, as well as in the form of an extract, have continually been made.

Quercitron Bark.—This name has been given to the bark of a description of oak, the *Quercus nigra*, or *tinctoria*, which is a native of North America. It is used as a dye stuff for imparting a yellow colour, the different shades of which depend upon the choice of the substance employed as a mordant. This bark was first brought into use in England by Dr. Bancroft, who obtained an exclusive patent for its application to this purpose. The colouring matter resides wholly in the inner bark of the tree; the outer bark is therefore removed previous to its being packed in casks for shipment. Quercitron bark which has been previously ground in a mill, gives out its colouring matter to water when heated to the temperature of 100° Fahr. If a higher degree of heat be used, the *tannin* which the bark contains will also be dissolved, and this will impart a brown tinge to the dye which it is desirable to avoid. For this reason the dye must always be separated from the bark before it is used. The colouring matter obtained from the quercitron-bark of commerce is equal to that yielded by eight or ten times its weight of weld.

Peruvian Bark.—German, *Chinarinde, Fieberrinde*; Dutch, *Kina, Quinquina*; Danish, *Kina, Chinabark*; Swedish, *Feberbark*; French, *Quinquina*; Italian, *China*; Spanish, *Quina*; Portuguese, *Quinquina*; Russian, *Chinchina*; Polish, *Kwinkwinna*; Latin, *Cinchona, Cortex Peruvianus.* Three principal species of this bark are known in commerce, namely, the pale, the red, and the yellow. The first of these, the original cinchona of Peru, is now become scarce. It is the produce of the *Cinchona lancifolia*, and is imported in chests, each containing 200 lbs. weight, and carefully covered with skins. It comes in quilled pieces from 8 to 10 inches long, and of various thicknesses. Internally the colour is of a pale fawn or cinnamon hue, but when moistened the bark assumes a pale orange colour. It is nearly odourless when dry, but is very sensibly aromatic while under the process of decoction. The *red* bark is taken from the *Cinchona oblongifolia*, which is found growing on the Andes. It is imported in various-sized pieces packed in chests, containing each from 100 to 150 lbs. Its colour is that of a reddish brown; its taste is not so bitter as that of the pale variety, but greatly more astringent. The *yellow* bark was first brought into use in England about the year 1790: it is obtained from the *Cinchona cordifolia*, which grows at Quito and Santa Fé. This variety is imported in pieces, some quilled and others flat, of from 8 to 10 inches in length, packed in chests containing from 90 to 100 lbs. each. The colour approaches to that of an orange; it gives out, in decoction, an odour very similar to that of pale bark; its taste is more bitter, but it is not astringent. Its goodness is judged of by the colour. If it loses its orange tint, and takes that of pale yellow, it is not so valuable, and it is still worse when of a dark colour, between red and yellow.

It is said that the native Indians were unacquainted with the medicinal virtues of this bark, and that its efficacy in cases of fever was accidentally discovered by the Jesuits, whence the name, by which it is very generally known, of Jesuits' bark. It was first brought to Europe in 1632, but more than half a century elapsed thereafter before its use became at all extensive in this quarter of the world. Humboldt states that from 12,000 to 14,000 quintals, or cwts., are annually exported from Peru.

During the three years ending with 1858, the average quantity of tanners' bark imported was 365,000 cwts. annually—duty free.

BARK.—*Medical Uses of.*—[CINCHONA.]

BARK-BED, in horticulture, is a bed formed of the spent bark used by tanners, placed in the inside of a brick pit in a glazed house, constructed for forcing, or for the growth of tender plants.

The object of a bark-bed is to produce artificial warmth by the fermentation of the materials of which it consists, and at the same time to keep the atmosphere of the house constantly damp. Gardeners use it for all plants which require what they call bottom heat; that is to say, for all species which are natives of tropical climates, and for pineapples especially; but it is not employed in the cultivation of greenhouse plants, except sometimes for striking their cuttings. [CUTTINGS.]

In constructing a bark bed, the coarsest bark which can be obtained after the tanners have used it should be selected, because it is found that the slowness of the fermentation, and consequently the steadiness of the heat given off, is in proportion to the size of the fragments of bark employed: small tan, broken into minute pieces by machinery, although often the only material to be had, should consequently never be used if it can be avoided. After having been slightly dried by being spread in the sun, the tan is first laid in heaps, covered with mats, until fermentation has commenced; it is then transferred to the brick pit, in which it is finally to remain. Having been lightly but evenly arranged in the pit, and the glass roof of the house having been closed, the tan is left to undergo fermentation; which at first is violent, evolving more heat than any plants could bear. But in a few days it subsides; and when the temperature of the bed has fallen to 96°, it is in a proper state to receive the pots, which are to be plunged in it. The heat will gradually, but very slowly diminish to 60°, below which it is scarcely desirable, in the opinion of gardeners, that the tan should be retained; but the temperature may a second time be raised to 70° or 80°, by turning the tan over, or fermentation may be further renewed by the addition of a small quantity of yeast. The temperature of the tan is generally judged of by feeling the end of a stick which is thrust into the centre of the bed; but as it is impossible to use so rude a test as this with any accuracy, it is now more customary to employ what is called a Breegazzi's thermometer introduced into the hollow end of a pole, and thus protected from being broken when thrust into the tan.

It is, however, found that, after procuring the best kind of material, the heat of a bark-bed cannot be maintained so steadily or so long as is desirable; and it has been recommended to substitute fallen oak-leaves, which can easily be collected in the autumn. These ferment much more slowly than oak-bark, and never acquire so high a temperature as the maximum of that substance; and as they are less expensive, they should always be used when they can be procured. It is, however, to be remembered, that no other leaves than those of the oak, or of some other plant equally abounding in tannin, answer the purpose so well.

Notwithstanding the quantity of heat given out by a bark-bed, it is always found necessary to employ some other mode of warming a house in addition—either by smoke-flues, or hot-water, or steam-pipes; and this being the case, and such contrivances being of themselves sufficient to raise the atmosphere to any temperature that can be required, a question has been started, whether a bark-bed is really of any use. We have already stated that the object of a bark-bed is to produce artificial warmth by fermentation, and moisture in the atmosphere by parting with its water. So far as these objects go, they can certainly be abundantly and more efficiently supplied by other means: the warmth by flues or water-pipes, and the moisture by open tanks, or by steam-cocks, or by watering the floors and walls of a hot-house. But there still remains what gardeners call *bottom-heat*—that is to say, a steady temperature around roots somewhat higher than that of the atmosphere surrounding the stem and leaves. All experience shows that this is of the first importance in gardening, as indeed was to be expected when it is considered that the mean temperature of that part of the soil in which plants grow is universally something higher in nature than that of the air itself; so that in all cases plants are stimulated by some amount of bottom-heat. Thus, even near London, the average temperature of garden-ground at two feet below the surface is in March 41°·57 (Fahr.), while the mean temperature of the atmosphere in that month is only 40°·49. See Lindley's 'Theory and Practice of Horticulture,' 2nd ed. book ii., chap. i., where this subject is fully discussed.

BARLEY is a grain too generally known to require a minute description. It is readily distinguished from other grain by its pointed extremities, and by the rough appearance of its outer skin, which is the corolla of the flower closely enveloping the seed, and, in most varieties, adhering strongly to it.

Barley belongs to the family of the *Gramineæ*: its botanical characters are described in the article HORDEUM, in NAT. HIST. DIV.

According to the most ancient authors, barley formed a principal part of the food of man in the early ages, and it continues to do so at this day, in many countries where the progress of agriculture and the increase of wealth have not yet enabled the inhabitants to exchange the coarser barley loaves for the more palatable and nutritious wheaten bread, and where the soil is not well adapted to rye, or the climate to maize.

Of all the cultivated grains, barley is perhaps that which comes to perfection in the greatest variety of climates, and is consequently found over the greatest extent of the habitable world. It bears the heat and drought of tropical regions, and ripens in the short summers of those which verge on the frigid zone. In genial climates, such as Egypt, Barbary, and the south of Spain, two crops of barley may be reaped in the same year, one in spring from seed sown the preceding autumn, and one in autumn from a spring sowing. This explains a passage in Exodus (ix. 31), where the effect of the hail is mentioned which desolated Egypt, in consequence of the refusal of Pharaoh to let the children of Israel depart: "The flax and the barley were smitten, for the barley was in the ear, and the flax was bolled; but the wheat and the rye were not smitten, for they were not come up." Commentators agree that this event happened in the month of March; the first crop of barley was therefore nearly ripe, and the flax ready to pull: but the wheat and the rye sown in spring were not yet sufficiently advanced in growth to be injured by the hail.

Agricultural writers in general have distinguished the different species of barley, either from the time of sowing them, into winter barley and spring barley, or, from the numbers of rows of grains in the ears, into six-rowed, four-rowed, and two-rowed, or flat barley. Another distinction may be made, between those which have the corolla strongly adhering to the seed, and those in which it separates from it, leaving the seed naked, from which circumstance these are called *naked* barleys. Without entering into any discussion whether these differences are sufficient to constitute distinct species, or are to be considered as varieties produced by climate, soil, or cultivation, we shall only observe that those kinds which are hardier, and will bear the winters of our climate, may also with success be sown in spring, as is the case with the Scotch bere or bigg. There seem, in fact, to be only two very distinct species of barley generally cultivated: one which produces three perfect flowers, and as many seeds united at the base, at each joint of the *rachis*, or middle of the ear, alternately on each side (*fig.* 1), and another, in which the middle floret is perfect, and the two others barren, forming a flat ear, with only one row of grains on each side, as our common spring barley (*fig.* 2). The first species

Fig. 1.

a Winter barley.
b The same, with part of the seed pulled off the rachis.
c A side view of the last, to show the shape of the rachis.
d The three perfect grains adhering together by the base, as pulled off the rachis.

has sometimes the middle floret small or abortive, and consequently only four rows of grains, giving the ear a square appearance; but that this is only an occasional deviation is proved by its returning to the perfect ear with six rows, in rich soils, and under proper cultivation.

In some varieties of both kinds the seeds stand more apart from each other, and at a greater angle with the rachis; the ear is also shorter, giving it the appearance of a bat or fan, whence it has been called Battledore Barley; it is also known by the name of Sprat Barley. In others the corolla separates from the seed when ripe, and the awns fall off: these are the naked barleys. Each of these has been in repute at different times, and is worthy of the attention and careful cultivation of the practical and experimental agriculturist.

Winter barley is mostly sown in those countries where the winters are mild, and the springs dry, as in the south of France, Italy, and Spain, or in those where the snow lies deep all the winter, and where the sun is powerful immediately after the melting of the snow in spring, as is the case in parts of Russia, Poland, and some parts of North America. In most climates, where the winter consists of alternate frosts and thaws, and the early part of spring is usually wet, as is the case in England, Scotland, and Ireland, the young barley is too apt to suffer from these vicissitudes, and the spring-sown barley gives the more certain prospect of a good crop: but the grain of the latter is seldom so heavy as that which has stood the winter, and, being harvested later, it interferes with the wheat harvest, which is an inconvenience.

The winter-sown barley is generally of the six-rowed sort, of which the bere or bigg is an inferior variety, though, being hardy, and of rapid growth, it is well suited to exposed situations and inferior soils. The *Siberian barley*, a variety of which, with naked seeds, has been highly extolled by foreign agricultural writers, especially by Thaer, under the name of *Hordeum cœleste*, seems to be a superior sort in rich soils, not only for its heavy and nutritious grain, in which particulars it is said to approach to the quality of rye, but also for its succulent

Fig. 2.

a An ear of common, or Norfolk, spring barley.
b The same, with the grain partly pulled off.
d The single grain, with the remnant of the two abortive flowers.

stems and leaves, which make it by far the best sort to sow for the purpose of green food for cattle and sheep, and, if fed off early, the roots will, in a rich soil, shoot out an abundance of fresh stems, and produce a good crop of grain at harvest.

The barley most commonly cultivated in England is that which has only two rows. It is almost universally sown in spring. The varieties produced by difference of soil and cultivation, as well as by seed occasionally brought from other countries, are innumerable; they have been divided by most agricultural writers into early and late sorts; but this is a distinction which is not very accurate. It is well known that hot gravelly soils bring any grain to perfection in less time than the stronger and colder soils, and that the produce acquires from the soil in which it grew a disposition to ripen earlier or later. This property it retains for a few seasons, by some modification of its vegetating power, to which, for want of a better name, that of *habit* may be given, being analogous to the alterations produced on living animals by habit. Thus seed sown repeatedly in a light dry soil becomes early ripe, and that sown on the heavy moist land late ripe, although originally the same. The early grain is always less heavy than the late; and from these circumstances the experienced cultivator of barley chooses his seed from such land as may modify the habit produced by his own, giving him a crop with as heavy a grain as his soil can produce, and within a convenient period.

The common, or Norfolk, spring barley, so called because it is the principal sort cultivated in that county, has a moderate-sized ear, containing from ten to fifteen seeds on each side, on an average (*fig.* 2). The straw is not very long, and makes good fodder for cattle in winter. Some prefer the long-eared, which contains from twelve to twenty seeds in a row, but it has a weaker straw, and is subject to be beaten down by rains from the weight of the ear. Particular varieties have been in great repute at different times, when first introduced, and then seem to have degenerated and lost their superiority. Of this kind is the *Moldavian* barley. This barley was much sought after some years ago; and of late years the *Chevalier* barley (*fig.* 3), so called from the gentleman who first brought it into notice. It is said, that having observed an ear of barley in his field greatly superior to the rest, he carefully saved the seed, and cultivated it in his garden, till he had a sufficient quantity to sow it in a field. It has since been extremely multiplied and diffused through the country. Some eminent maltsters and brewers have declared, that it contains more saccharine matter than any other sort; and the trials hitherto made have convinced many agriculturists that it is not only heavier in the grain, but also more productive. In 1832 Mr. Coke, of Norfolk, who was always foremost in all agricultural experiments and improvements, sowed a con-

Fig. 3.

Chevalier Barley.

siderable portion of land with this barley, and the result is said to have been perfectly satisfactory. In the year 1833 the writer of this article sowed two acres of Chevalier barley in the same field with some of the best of the common barley. The soil was poor light sand, but in good order, and very clean. The produce of the whole was nearly the same, four quarters per acre; but the Chevalier barley weighed 57 lbs. per bushel, while the common weighed only 52. This gives the farmer an advantage of nearly ten per cent. The sample was very fine, and the whole that he could spare was eagerly purchased by his neighbours for seed at his own price. It is long in the ear and very plump, and the plants tiller* so much, that half a bushel may be saved per acre in the seed. This is probably owing to its grains being all perfect, and vegetating rapidly. The straw, like that of the other long-eared barleys, appears weak in proportion to the ear; it is said also to be harder, and not so palatable to cattle. These are circumstances which experience alone can ascertain. That hitherto it has a decided superiority over the common sorts, no one who has tried it fairly in well-prepared land seems to deny; but unless great care be taken in cultivating picked parcels for seed, selecting the finest ears and plumpest grain, it will probably share the fate of its predecessors—degenerate, and lose its reputation. This contingency, though anticipated many years ago, has not, however, yet (1859) befallen the Chevalier barley: it is still held to be among the best varieties we possess. There are many additional sorts of two-rowed barley deserving the attention of growers, under the different circumstances of soil and climate in which this grain is cultivated, as the Dunlop, the Annat, the so-called Italian; and other varieties might be named. The Annat barley and Italian are good, stiff strawed sorts, standing well where other kinds would be laid; the Dunlop is an early kind. A black, two-rowed barley, later than the kinds just named, but, in the instances in which we have known it tried, remarkable for its good malting quality, may also be named. There is also a black, six-rowed barley not however of greater merit for late cold climates than the hardy bere commonly grown in Ireland and the highlands of Scotland.

The Sprat, or Battledore, Barley (*fig.* 4), also called Putney Barley, from having been once extensively cultivated near that place, is in much esteem in Germany. It is the *Hordeum Zeocriton*; also called *German rice*, or *rice barley*, not from any resemblance it bears to rice,

* A plant is said to *tiller* when it produces several stems from the crown of the root (*fig.* 5, *a*) at the surface of the soil.

but because, when deprived of its skin and made into pot barley, it swells by boiling, and makes a good substitute for rice in broths and

Fig. 4.

Sprat (or Battledore) Barley.

puddings. It is not much cultivated in England at present, but it is hardy and productive, and grows well in stronger soils, especially the marly, and is well worth the attention of experimental agriculturists. It certainly was once in good repute in this country, and may suit particular soils and situations.

Might not the cultivation of the various kinds of grain purposely for seed be more generally practised, and form a distinct branch of agriculture? And would not this be well adapted to small occupiers and cottagers, who may have had allotments of land given or let to them, to enable them to live by their own labour and industry, without parochial aid? Thus the good qualities of any grain might be perpetuated, new varieties might be produced, and the defects corrected by cultivation, as is the case with horticultural plants.

All kinds of barley require nearly the same soil, and whether they are sown before winter or in spring, the ground must be well prepared, and the soil pulverised by repeated ploughings and harrowings, or by the operation of those instruments which have been invented for this especial purpose; in order that the fibres of the roots, which are very minute and delicate, may penetrate the soil easily in search of nourishment.

The cultivation of all the varieties is nearly the same, and is best understood in the counties of Essex, Norfolk, and Suffolk, in which a great quantity of excellent barley is produced and malted for the London market. In the light soils, barley is invariably sown after turnips, which have been fed off the land by sheep, or been drawn to feed the cattle in winter in the yards or stalls, which, by means of an abundance of litter, make a vast supply of manure ready for the next turnip crop. When the land has been properly prepared for turnips [TURNIPS], and well manured, and the turnips have been carefully hoed, so that no weeds of any kind remain, it is then in the finest state for barley as soon as the turnips are off. Turnips require a well-pulverised soil, and so does barley. If the soil is very dry and light, the sheep folded upon it consolidate the surface by their treading, and enrich it by their urine and dung. As soon as a part of the field is cleared and the hurdles removed, the land is ploughed with a shallow furrow, and thus the sheep and the ploughs are often seen in the same field succeeding each other, that no time may be lost in turning in and covering the dung, which is very volatile, and would soon lose much of its qualities by the action of the sun and winds. This is sufficient preparation for the seed, which may now be sown or drilled without delay.

In heavier soils, which have become tenacious by the winter's rains, or on which the sheep have been folded in wet weather, the soil may not be in a sufficiently divided state to receive the seed with advantage. In that case it must be worked and stirred till a proper tilth is produced: this is a great loss and hindrance, by increasing the labour at the busy time of sowing, but it cannot be avoided; the experience and judgment of the cultivator must direct him as to the best mode of proceeding, ever bearing in mind that it is an irretrievable error to sow barley on land not properly pulverised, and that, if it is once fine and dry, a little delay in the sowing is of much less importance. It can scarcely be too dry on the surface at the time of sowing, at least in this climate; and, provided a few showers supply the moisture necessary to make it vegetate and spring up, there is no great danger to be apprehended from too dry weather. Barley has been known to grow and ripen, when not a single shower refreshed the soil from the day it was sown to that in which it was reaped.

When the soil is of a strong, compact nature, but fertile, and turnips cannot be well fed off the land, nor taken off in carts, on account of the damage which would be done to the soft moist soil in winter, by the tread of the sheep, or the wheels of the carts, recourse is sometimes had to a *long fallow* during eighteen months, from harvest till the second spring, giving the land the benefit of two winters' frosts, a tillage in autumn, in summer, and in two springs. Thus the land is perfectly cleaned, and, if properly managed, quite mellow and fine; and the barley sown on such land always produces a crop, not only abundant, but of the best quality; so that the lines of Virgil in his 'Georgics,' i. 48, whether literally applicable or not, are verified in the result:—

> "Illa seges demum votis respondet avari
> Agricolæ, bis quæ solem, bis frigora sensit."

This practice has been alluded to in the article Arable Land, and is common in the heavier soils of Essex and Suffolk. The loss of time by so long a fallow is amply repaid by the state of the land and the subsequent crops. It was once the universal custom to sow wheat after a fallow, and barley after wheat, unless clover was sown with the wheat, which was the first step to improvement; but after the barley another fallow became necessary. By sowing barley after the fallow, the land is much more perfectly cleaned, and the clover sown with the barley is the best preparation for the wheat, which may be succeeded by beans, and if these are well manured and properly hoed, another crop of wheat may be taken before a second fallow is necessary. By comparing the probable produce of the two different rotations, the advantage will be evident in favour of that which begins with barley.

Fig. 5. Fig. 5.*

5. A root of self-sown barley in a rich light soil.
5* The same in a poor stiff soil.

In some particular cases, however, when a very dry autumn allows the wheat stubble to be ploughed and well cleaned before winter, and several ploughings and harrowings can be given in spring, barley may be sown with advantage after wheat; but then it is seldom advisable to sow clover and grass seeds with the barley, the land not being sufficiently free from weeds. But the *Trifolium incarnatum*, lately introduced from the south of France, which succeeds well in our climate, would be admirably adapted to be sown on the barley stubble: the land being slightly ploughed or scarified immediately after harvest, and the seed rolled in. It will grow so rapidly in spring as to smother all seed weeds, and will give a heavy green crop to be cut for horses and cattle early in May, and excellent winter fodder if made into hay. [Trifolium in Nat. Hist. Div.; Clover.]

The quantity of barley sown formerly was four or five bushels per acre: but, if the land is duly prepared and the seed good, from two to three bushels is an ample allowance, especially if sown by the drilling machine, which it always ought to be; for if the land be too rough to allow of drilling, it is scarcely fit to sow barley in, and oats will be a more advantageous grain.

The proper time for sowing barley depends much on the season and the state of the land. The best practical rule is, to sow as soon in March as the ground is dry. Earlier sowings may sometimes succeed well, but in this climate cold wet weather often prevails in the end of February, and this is by no means favourable to young plants of barley. The early-sown crops are, however, in general the heaviest, especially of the sort which ripen later: they require less seed, having more time to tiller before the hot weather draws up the stems. There are, however, seasons when the later-sown crops are the best: a good rule is, to sow a quick-growing sort when the sowing is unavoidably deferred, and in this case more seed must also be allowed.

The depth at which the seed should be deposited depends on the nature of the soil and on the season. Winter barley need only be slightly covered, and will tiller astonishingly in good light soils. The examination of two roots, one of which (*fig.* 5) proceeded from a grain dropped on the surface of the soil, and the other (*fig.* 6) buried one or two inches under the surface, clearly shows the difference. In the first, the crown (*a*), from which the stems tiller, has the seed still adhering to it; in the other, they are separated by a strong tough ligament (*c*). This forms two distinct centres, from which the roots spread; and, in very light soils and dry seasons, the roots, springing immediately from the seed, are less exposed to be dried up. But in stiff soils the seed buried deep may have much difficulty in germinating, the air not having sufficient access, and the first shoot, which forms the ligament (*c*), not being able to pierce the compact soil above

Fig. 6. Fig. 6.*

6. A root of barley in a good soil.
6*. The same in a poor soil.

it. As a general rule, a depth of from 1½ to 3 inches, according to the nature of the soil, is most likely to enable the seed to sprout well, and give a sufficient hold of the land by the roots to avoid the danger of lodging. It is of consequence that all the seeds be deposited at a uniform depth, to ensure their shoots rising at the same time: for where some rise earlier and some later, it is impossible to reap the whole in good order; some of the ears will be too green, while others are shedding the seed from being too ripe. This is one reason why the drilled crops are, in general, so much more regular in their growth than the broadcast. After sowing barley, it is useful to pass a light roller over the land, across the ridges, if there are any, to press the earth on the seed, and prevent too great evaporation of the moisture. When the plants begin to tiller, another rolling, and in some cases a slight harrowing, to loosen the surface and thin out the plants where they grow too close, is very useful. This also is the best time to sow clover and grass seeds, if not done with the first rolling. Barley is not usually hoed, because the land should be perfectly clear of weeds and their seeds, before it is sown, and because clover and grass seeds are usually sown either with the barley or immediately after it; but if hoeing is thought necessary to loosen the soil, instead of merely harrowing it, the clover or grass seeds are sown at the last hoeing. After this no attention is required to the crop till harvest, unless docks or thistles should make their appearance, which must then be carefully pulled up.

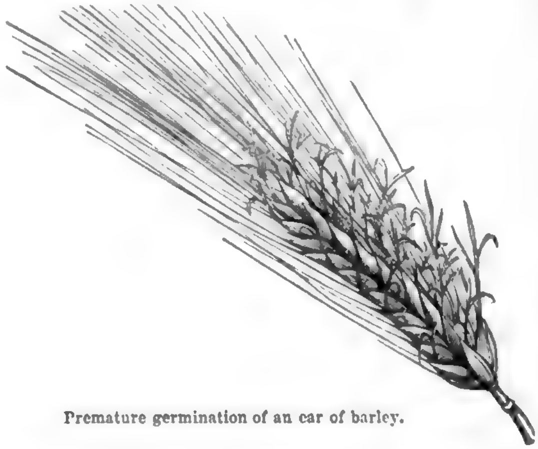
The practice of sowing clover, rye grass, or other seeds, with the barley, is almost universal, and is considered as one of the great modern improvements in agriculture. There is no doubt a great advantage in having a profitable and improving crop to succeed the barley, without further tillage; and clover prepares the land admirably for wheat. Still there are some doubts whether this be profitable in all cases. There are seasons when the clover materially injures the barley by its luxuriance; and, in wet seasons at harvest, it is very difficult to dry the straw sufficiently, mixed as it is with the succulent stems of the clover, or to prevent its heating in the stack. The clover, as far as the barley is concerned, may be looked upon as a weed, which, like all other weeds, must take a part of the nourishment from the crop, and check its tillering. If the clover is sown late among the barley, the danger is less. It will not be able to grow so high as to do much injury, but the fear of losing the plant of clover makes most farmers prefer sowing it soon after the barley.

In Flanders, clover is seldom, or never, sown with barley, but chiefly with rye: but they sow a species of white carrot instead, in the sandy soils. These push out very little of the green top, but shoot their fibres downwards, which form the rudiments of the carrot. After harvest, the ground is well harrowed, and watered with liquid manure. The carrots, which could scarcely be observed above ground, soon spring up, and a good crop is secured before winter, extremely useful for feeding cattle and swine, and greatly increasing the urine of cows and bullocks, the favourite manure for light soils in that country.

As soon as the ears of the barley droop, it should be reaped. In the case of wheat it is well to reap before the grain has fully hardened in the ear—for the last stage in the process of ripening converts a portion of the farinaceous contents of the seed into a woody husk, comparatively useless as food. The quantity of bran in a fully ripened grain of wheat is greater than if it had been harvested earlier. In the case of oats again, it is generally well to reap even before the green hue of the crop has entirely gone, for if the plant be allowed thoroughly to dry and ripen standing, the seeds will be extremely liable to be shaken out by wind. In barley, on the other hand, which has to be converted into malt, the quality of which depends on the germinating process being carried on uniformly throughout the mass, it is necessary that the grain be all of one uniform stage of ripeness when cut, and this is generally only to be ensured by taking care that it be all dead ripe. When therefore the ears have all turned down, it may be reaped. This is usually done by mowing it with a scythe, having a hoop, or an appendage called a *cradle*, fixed to it, so as to lay the swathe regularly. The *Haynault scythe*, a short, broad scythe used with one hand, while a light hook is held in the other to lay the straw even, so as to be readily tied up into sheaves, is another good tool; and the heavy "bagging" hook is often used for the same purpose; but the horse-drawn reaping machine is now rapidly gaining its way, and will no doubt soon, to a great extent, supersede manual labour, so far as the mere cutting is concerned. [HARVEST.] Binding into sheaves is a great advantage: much less corn is shed, which, in the common method of raking into heaps, often amounts to more than would fully sow the same extent of land. The sheaves set up on end are in less danger from the weather, and when the stack is built, all the ears may be laid inward and much grain saved, which, if on the outside, would soon be the prey of birds: smaller stacks may be made, and the danger of heating entirely avoided. The stacks should be built on frames, supported by stone or cast-iron pillars, with flat caps on them to keep out vermin; and, in large stacks, it is useful to have a kind of open cage in the middle, to allow the admission of air to the centre. This dries the grain better than a kiln, and when the stack is properly thatched with straw, the crop may be considered as safe till it is carried into the barn to be thrashed. [HARVEST; FARM.]

In thrashing barley, an extra process has to be adopted in order to break off all the awns close to the grain. A thrashing machine does not accomplish this perfectly by only once passing the straw through the rollers; it is consequently usually put through a second time, especially if it has not been tied into sheaves. But it is generally necessary, after the barley is thrashed, to effect this by another operation, which is called *hummeling*, for which purpose several different kinds of instruments are used. A simple one consists of a cylinder composed of small bars of iron, and placed on an axis, which is rolled backwards and forwards over the grain; or, where a thrashing machine is used, a plate of iron, perforated like a nutmeg-grater, is fixed to the inside of the drum in which the beaters revolve, and the awns are effectually broken off by this rough surface. This process is, however, more generally now effected by an addition to the thrashing machine, through which all the grain when separated from the straw is passed, coming under the action of rapidly revolving knives, which break the brittle awn into dust, to be afterwards separated by the blast and riddles of the winnower.

The diseases to which barley is subject while growing are those which attack all other grain—the smut, the burnt ear, blight, and mildew; but it is less liable to these than wheat. The greatest enemy is a wet harvest. It is so apt to germinate with the least continuance of moisture, that even before it is reaped, it often exhibits an ear in full vegetation, every grain having sprouted (see *fig.*). It is then of little



Premature germination of an ear of barley.

value, and even when this is checked by dry weather or in the kiln, the grain is so impaired as to be fit only to feed fowls and pigs. A strong plant of clover, by keeping the wet longer about the barley, often contributes to increase this evil, as has been hinted before.

The principal use of barley in this country, and wherever the climate does not permit the vine to thrive, and no wine is made, is to convert it into malt for brewing and distilling. [MALT.] The best and heaviest grain is chosen for this purpose, and, as it must have its germinating power unimpaired, the least discoloration, from rain or heating in the stack, renders it suspected, and consequently not so saleable. It is, however, still fit for being ground into meal, for feeding cattle and pigs, when it is not used for human food; or it may be made into pot-barley by the process of shelling. [BARLEY, POT and PEARL.]

The produce of barley, on land well prepared, is from 30 to 50 bushels, and more, per statute acre, weighing from 45 to 55 lbs. per bushel, according to the quality.

On all good loamy soils barley is a more profitable crop than oats, and is supposed to exhaust the soil less, and of late years (1857-8) the extraordinary prices it has reached have rendered it more profitable than even wheat. On stiff cold clays it does not thrive so well, and there oats are to be preferred. In some districts, where the best barley is grown, the farmers seldom sow oats, and many prefer buying them for their own use, with the additional expense of market and carriage. In Scotland, and some parts of the north of England, oats are in greater request, being the chief food of the labouring classes, and preferred by them to barley, except it be in the form of pot-barley in their broth.

Barley in its green state, especially the Siberian winter barley, makes excellent spring food for milch cows, as is well known to the cow-keepers about London; it comes in early, and greatly increases the milk. It is also very good for horses, provided it be given sparingly at first, as it purges them; but after a little time, when the stomach becomes accustomed to it, it increases their flesh and condition wonderfully, and is much more wholesome than the usual spring physic, as it answers the purpose of gently clearing the intestines, without any risk of irritation. For sheep it is more nourishing than rye, and comes earlier: when fed off quite close in April, it will spring up again, and, on good land, produce a fair crop of grain in August, but in general it is ploughed up as soon as it is fed off, and succeeded by spring tares or turnips.

Barley has always been considered as possessing medicinal virtues; decoctions of it have long been used for the sick, especially in all pulmonary complaints; and with the addition of some vegetable acid, it is extremely grateful in fevers, allaying thirst, and giving such a degree of nourishment as is indispensable, without exciting the circulation.

Professor Johnston gives the composition of barley-meal as follows :—

Water	14 per cent.
Gluten	14 „
Starch	68 „
Fatty matter	2 „
Ash	2 „
	100

The whole grain, according to Mr. Horsford's analysis, contains 15·3 per cent. of gluten and other nitrogenous compounds. Dr. Playfair, in Morton's 'Cyclopædia of Agriculture,' puts it as follows :—

Nitrogenous substances	13 per cent.
Starch	56 „
Woody fibre	13½ „
Ash	3½ „
Water	14 „
	100

A crop of 36 bushels on about 1½ tons of straw from each acre, will contain,—according to Dr. Playfair's statement, as follows :—

	In the Grain. lbs.	In the Straw. lbs.	In both. lbs.
Nitrogenous matter	243	62	305
Starch and fibre	1301	2987	4288
Ash	66	191	257
Water	262	398	660
	1872	3638	5510

The ash contains the following ingredients :—

	Of the Grain.	Of the Straw.
Potash	15·61	22·17
Soda	5·03	0·84
Lime	3·06	7·59
Magnesia	8·04	3·55
Iron and loss	1·24	4·35 (?)
Phosphoric acid	35·68	3·22
Sulphuric acid	1·22	2·61
Silica	28·97	46·30
Chloride of sodium	0·45	9·37

These are Dr. Playfair's figures: they agree pretty accurately with those of Messrs. Way and Ogsten, as given in the Journal of the English Agricultural Society. The remarkable feature in these analyses, as compared with those of wheat and oats, is the presence of so large a percentage of magnesia. The quantity of silica in the ash of the grain of barley, is due to the chaff or husk of the floret, which in barley adheres to the grain. The ash of naked barley would more nearly resemble that of other grains.

In the three years ending with 1858, the quantity of foreign barley imported amounted on an average to 1,398,000 quarters annually.

BARLEY, POT and PEARL. Pot-barley is barley of which the outer skin only has been removed; whereas pearl-barley is the small round kernel which remains after the skin and a considerable portion of the barley have been ground off.

Both these preparations of barley are made by means of mills constructed for the purpose, and differ only in the degree of grinding which the grain undergoes.

There are two kinds of mills for making pot and pearl barley. The mill which was probably the earliest in use, and which is still common in parts of Germany and France, to take off the husk of the barley, is similar to a common flour-mill, having two millstones, of which one is fixed and the other revolves horizontally over it; but these stones are of less diameters than common millstones, not exceeding three feet each. The upper stone has six grooves, in the form of the fourth part of a circle, cut in the lower surface from the centre to the circum-

Fig. 1.

ference; the width and depth of these grooves increase from one inch in the centre to two inches at the circumference (see *fig.* 1). This stone has a perforation in the centre, as a common upper millstone, and revolves on a vertical axis or spindle of iron, the lower point of which moves in a metal cup fixed on an elastic horizontal beam. It is absolutely requisite that this axis be perfectly vertical, and the stones accurately horizontal, in order that the upper stone may move parallel to the lower, at such a distance as to rub the grain without crushing it. The mill is fed by a hopper through the central aperture, as in the common corn mill. The stones are surrounded by a circular case, leaving a space of from two to three inches between the circumferences. The top or flat part of this case is of wood, and has an aperture corresponding with the central aperture of the upper stone; but the circumference consists of thin plates of iron perforated from the outside, by means of a flat punch, with holes, as near each other as possible, making the inside of the case rough, like a nutmeg-grater. A square opening in this case, with a sliding door over it, serves to let out the barley after it has been sufficiently ground. In order to loosen the skin without rendering the substance of the grain too soft, the barley, which is chosen dry and hard, is sprinkled with water on the floor, and turned over two or three times in the course of eight or ten hours: it is then fit to be put into the mill. The upper stone is made to revolve from 200 to 300 times in a minute. The barley, gradually supplied from the hopper, is carried round in the grooves of the upper stone and rubbed on the under without being broken. The centrifugal force and the strong current of air produced by the grooves and the rapid motion, drive the grain, partially ground, against the rough case, and complete the removal of every part of the skin. The rubbed grain is then let out through the square opening, and falls on a sieve, which separates the naked grain from the bran. This is pot-barley. To make pearl-barley, the operation is continued till the required degree of fineness is produced. As the greater part of the finer particles of the barley ground off escape through the holes in the case, it is surrounded by another to collect this meal, or a cloth is fixed all round, which lets it fall gently in a bin below; thus nothing is lost. This meal is excellent food for cattle, pigs, or poultry. The chief objection to mills of this construction is, that they require great nicety in the adjustment of the stones, and are very apt to waste the barley by grinding it unequally, and that, at all events, the larger grains are more ground than the smaller; but for pearl-barley, which ought to be of a uniform size, this is rather an advantage. But, on the other hand, the process goes on without interruption, and if two or more pairs of stones are placed under each other, the barley may pass from the first into the hopper of a second, and from this into a third, so as to come out of the last of any required degree of fineness. It may be observed, that the

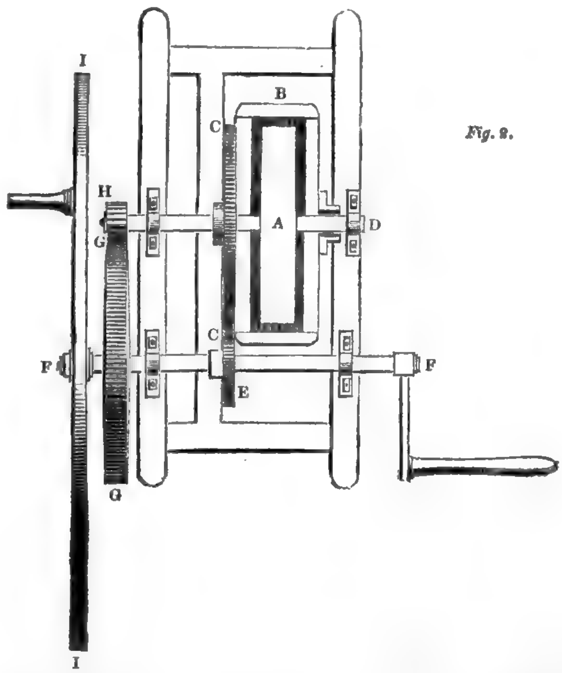


Fig. 2.

The construction of this machine may be thus briefly described: A, section of the stone turned by the axis D. B, section of the case which turns on the axis D, by means of brass bushes in its centre. C C, a wheel having sixty teeth, or cogs, fixed to the side of the case. C E, a smaller wheel, or pinion, with fifteen teeth, moving the wheel C C, and fixed on the axis F F, by which the whole is moved. G G, a wheel with sixty teeth, on the axis F F, moving the pinion G H, which has twelve teeth, with the axis D, which carries the stone. I I, a fly-wheel, which equalises the motion of the whole.

principal use of the upper stone and its grooves is to carry the barley round and throw it against the case, and therefore any hard wood with similar grooves, will answer the purpose as well as stone; and this is said to be the construction of several of these mills.

The other kind of mill is in general use in Scotland, where most of the pot and pearl-barley used in this country are prepared. It was originally introduced from Holland, whence formerly all Europe was once supplied with pearl-barley, commonly called Dutch pearl-barley. This mill consists of a common grindstone such as cutlers use, about three feet in diameter, revolving vertically on a horizontal axis. A case, similar to the one already described, revolves on the same axis, and in the same direction, with a slower motion. Sometimes flat, the sides of this case, as well as the rim or circumference, are composed of perforated plates of iron; but this is not absolutely necessary. The barley, prepared as before, is put in by a square opening in the circumference, the slide shut, and the machinery is set in motion, until the barley, tossed between the stone and the case by the double motion, has been entirely deprived of its skin, and is become pot-barley; or till it is ground into the small round shape of pearl-barley. The mill is then stopped, the slide pulled out, and the case being turned so as to have the opening undermost, the prepared barley falls out into the bag or bin placed to receive it. The grain scarcely wants any sifting; for such is the violence with which it has been tossed about, that all that is ground off is driven through the holes in the case, and is collected in a close chamber which surrounds the apparatus, as in the other mill. The mechanism by which the motions of the stone and case are produced, is extremely simple, and will be easily understood by reference to a figure, which, although taken from a portable hand-mill for making pearl-barley, is on the same principle as the larger.

By this combination of wheel-work, if the handle turns once in a second, the case turns fifteen times in a minute, and the stone 300 times. This is the usual velocity in large mills. A hand-mill may be moved with one-half or two-thirds of this velocity, the stone being also smaller. When the power is sufficient to turn a stone three feet in diameter 300 times in a minute, three bushels of barley may be converted into pot-barley in an hour, and into pearl-barley in two hours.

The advantages of the mill shown in the next figure are considerable. It requires no very nice adjustment, and is not easily put out of order. The stone may continue in use, although considerably worn down, even to half its original diameter. There is no danger of crushing any of the grains, nor much waste; and whatever be the size of the grains, it grinds them equally. If the pearl-barley is required very equal in size, it may easily be sorted by wire sieves. The only defect of this construction is the loss of time and of power which it occasions, by the case being stopped to take out the prepared grain, and replace it by fresh barley. Ingenuity will probably find means of removing this defect; but we are not aware of any late improvements in the construction of these mills.

Pot and pearl-barley are very wholesome and nutritious, and have a more agreeable taste than barley-meal; and it is to be regretted that they are not more used as food by the labouring classes in England, as

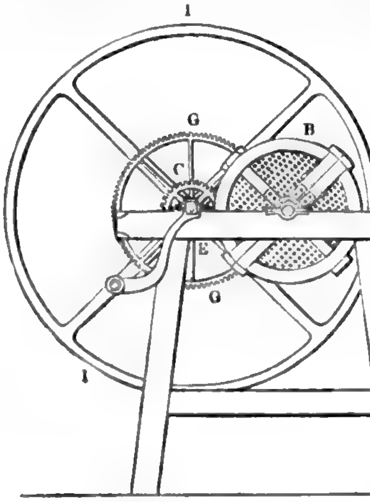


Fig. 3.

[Hand Barley Mill, with the perforated plates on the case.]

they are in Scotland, Germany, and Holland. The essential oil of barley, which gives it its peculiar taste, resides chiefly in the skin and adjacent parts of the grain; the interior is a purer farina, more nearly resembling that of wheat. This has probably suggested the idea of removing these outer parts, as less palatable, and given rise to the manufacture of pearl-barley, the farina of which approaches nearer to pure fecula, or starch. This farina, obtained by grinding pearl-barley in a common mill, is sold under the name of patent barley, and is used extensively for readily making barley-water for the sick. But if the essential oil of barley possesses any medicinal properties, it is evident, from what was observed before, that common pot-barley would be preferable for making a decoction of barley when prescribed as a remedy. The great use of pot and pearl-barley is in broths, stews, and puddings, as a substitute for rice. It swells, and has the property of uniting well with the fat and oily matters extracted from meat in boiling. Barley-broth is a constant and principal dish at every family dinner among the middling ranks in Scotland, and not despised by the higher. Even the bran, having been steeped in water, and allowed to ferment till it becomes acid, is relished by the lower orders in the mess called *sowens*. In Holland, pot-barley, boiled in butter-milk and sweetened with treacle, is a common food for children and servants.

BARLEY-BREAK, a popular pastime of the reign of James I., allusions to which repeatedly occur in our old writers. It was played by six people, three of each sex, who were coupled by lot. A piece of ground was then chosen and divided into three compartments, of which the middle one was called hell. It was the object of the couple condemned to this division, to catch the others who advanced from the two extremities; in which case a change of situation took place, and hell was filled by the couple who were excluded, by pre-occupation, from the other places. In this "catching," however, there was some difficulty, as, by the regulations of the game, the middle couple were not to separate before they had succeeded, while the others might break hands whenever they found themselves hard pressed. When all had been taken in turn, the last couple was said *to be in hell*, and the game ended.

Several poetical descriptions of this amusement are extant: one in 'Barley-breake, or a Warning for Wantons,' written by W. N. Gent., 4to, Lond. 1607; another in Sir Philip Sydney's 'Arcadia;' and a third in Sir John Suckling's 'Poems,' the two last of which have been quoted by Brand in his account of Barley-break, 'Popular Antiquities,' vol. ii.; see also Gifford's 'Notes' to his edition of Massinger, who has frequent allusions to Barley-break.

Dr. Jamieson, in his 'Etymological Dictionary of the Scottish Language,' gives an account of this game as it is still played in the north of Scotland. He calls it "a game generally played by young people in a corn-yard; hence called 'Barla-bracks about the stacks.' One stack is fixed on as the dule or goal; and one person is appointed to catch the rest of the company, who run out from the dule. He does not leave it till they are all out of his sight. Then he sets off to catch them. Any one who is taken, cannot run out again with his former associates, being accounted a prisoner, but is obliged to assist his captor in pursuing the rest. When all are taken, the game is finished; and he who was first taken, is bound to act as catcher in the next game." He adds, "This innocent sport seems to be almost entirely forgotten in the south of Scotland; it is also falling into desuetude in the north."

Nares, in his 'Glossary,' 4to, Lond. 1822, says, our very puerile game of *tag* seems to be derived from barley-break; there was a tig or tag in the Yorkshire game of barley-break, as played within memory; the touch of the person called tig or tag made a prisoner.

BARM. [YEAST.]

BARN. [HOMESTEAD.]

BARO'METER, from two Greek words, *βάρος*, weight, and *μέτρον*, a measure, or *the measurer of weight*, a term generally applied to those instruments in which a column of air is weighed against a column of mercury.

The invention of the barometer is one of the most curious in the history of philosophy. No new discoveries, not even those first substantiated by the telescope, ever knocked so hard at the door of a received system, or in a manner which so imperiously demanded admission, as this one. It will therefore be worth while to state the circumstances attending it.

The phenomena of the common pump had been well known for more than a century at least before the commencement of the Christian era. The mode of explaining them was simply by means of the well-known maxim, that "nature abhors a vacuum." Nor do we know of any experimental attempt to discover why nature abhorred a vacuum before the time of Galileo. The phrase itself, considered simply as a representation of a well-known fact—namely, that the laws of nature will not permit a vacuum to exist—may be as useful now as then. But considered as an explanation, we need not dwell upon its utter worthlessness. We might equally well explain how a stone falls 16 feet 1 inch in the first second of its descent by saying that its nature has an antipathy to more, and a repugnance (if we wish to vary the phrase) to less.

Very general terms, such as *vacuum*, *space*, &c., furnish no tests of the validity of a method of explanation, when compared with others which have direct numerical meaning. The common story is, that the pump-makers of the Duke of Florence found that water would not rise in the pipe of the pump higher than 32 feet, or thereabouts, when the air was exhausted from it. They applied to Galileo for a solution of this problem, and he, having his mind pre-occupied by the usual form of words, gave them a very simple answer, namely, that the power of nature to contend against a vacuum ceased when she had destroyed one of 32 feet high. [GALILEO, BIOG. DIV.] That the mysterious indefinite *nature* should be in constant hostility to the equally mysterious indefinite *vacuum*, would not then appear ludicrous; but *thirty-two feet* must have destroyed all the poetry of the explanation, and it had nothing else to depend upon. The above story is told in several different ways (it has been said, for instance, that the answer of Galileo was ironical), but whichever may be true, it is most probable that it led him to abandon the theory of nature's horror, though without substituting any other. It has been thought that before his death he suspected at least the true explanation. His pupil Torricelli first imagined that the weight of the atmosphere might be the counterpoise to the 32 feet of water; or at least he was the first whom we know to have applied himself to try this hypothesis by experiment. He saw that, if it be a weight of air which counterpoises the 32 feet of water, it must follow that by the substitution of mercury instead of water, the height of the column necessary to counterpoise the weight of air would be reduced in the proportion in which mercury is heavier than water. For instance, that if mercury be fourteen times heavier than water, bulk for bulk, the fourteenth part of 32 feet, or about 2 feet 4 inches, would supply the place and produce the effect of the water. He accordingly filled a tube, more than 3 feet long, and open at one end only, with mercury; and then stopping the open end with the finger, he placed the tube in an open vessel of mercury with the open end downwards. On removing the finger, the mercury in the tube sank until it stood in the tube at about 28 inches higher than the mercury in the vessel. He thus constructed what is at this time considered the best form of the barometer.

Torricelli died shortly afterwards (1647), leaving his great discovery not quite complete; for though he had made it apparent that the weight of the water and of the mercury was a counterpoise of something, most probably of a weight of air, the latter was not quite certain. The invention however was taken up by Pascal, Mersenne, and others in France, and by Boyle in England. The latter, by means of the air-pump, was enabled to subject air of different degrees of density to the test of the barometer. Pascal did the same; and, in addition, first suggested (in 1647) that if the mercury were sustained by the weight of the air, it would necessarily fall in ascending a high mountain, by the diminution of the superincumbent column of air. He accordingly requested his relative, M. Perrier, to try the barometer at the summit and the base of the mountain of Puy de Dôme, in Auvergne, and the result was that the mercury, which at the base stood $26\frac{1}{2}$ inches (French), was only $23\frac{1}{6}$ inches at the summit. Pascal afterwards found the same result to be sensibly shown in the ascent of a church tower and of a private house. The fact was now completely established, that the weight of the air upon any horizontal base was equivalent, roughly speaking, to a weight of mercury of the same base, and about 28 inches high. The ancient philosophers might have come to a corresponding conclusion; for, as Deluc remarks, though they had not mercurial barometers, they had pumps, with which, had the taste for experimental inquiry existed, they might easily have performed Pascal's experiment. But the personification of nature answered every purpose, and checked every inquiry.

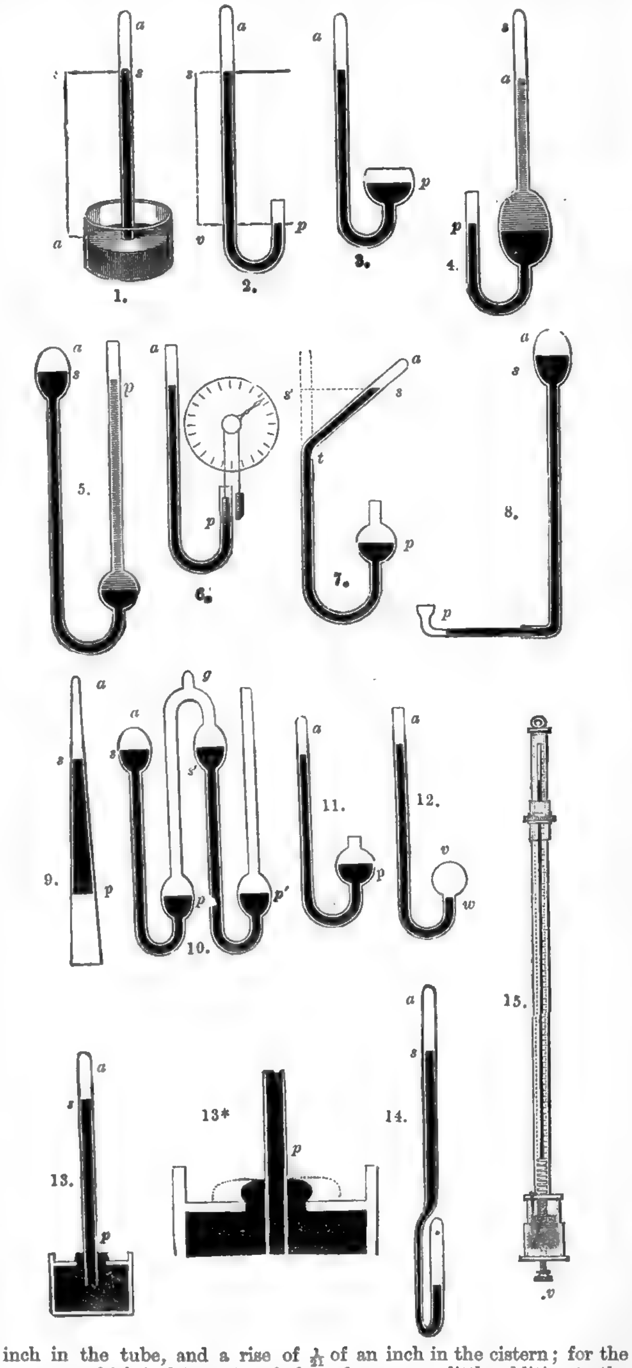
Soon after the first discovery of the barometer, many different methods were imagined for improving the construction of the instrument. The continual variations of the altitude of the mercury did not escape notice; and the idea of the *weather-glass* was almost contemporaneous with that of the *barometer*. It was observed, that changes in the height of the mercury corresponded to changes of the weather, though experience was not yet sufficiently extensive to decide in what manner. The very gradual progress of these changes, and the frequent smallness of their amount, rendered it desirable so to construct the instrument that the effect should be multiplied as much as possible. And since an alteration of level in the tube of the barometer also produces an alteration of level in the cistern with which it communicates, it soon became evident that no fixed scale of inches would serve to show the difference of levels (or, as it is called, *the height of the barometer*) merely by reading off the height of the mercury in the tube.

We shall now give an account of the most remarkable among the various constructions which have been employed or suggested. Most of them are from De Luc, 'Recherches sur les Modifications de l'Atmosphère.' In all the diagrams, *a* is the closed or vacuum end of the tube, and *p* the place where the mercurial or other column communicates directly with the atmosphere. The bulbs which are drawn as such should all, properly speaking, be cylinders. Enough is introduced to show the principle of the construction, but not the method of mounting the instrument. In the following descriptions each article is headed by the name of the inventor, or by that of the instrument.

Many of the following contrivances, though not at present in use, may suggest ideas of value for other purposes:—

1. *Torricelli.*—This is the simple apparatus already described. The inverted tube, full of mercury, 33 or 34 inches in length, is placed in the cistern of mercury. The fluid sinks until the column contained between the two levels counterbalances the pressure of the air. From *a* to *s* there is a vacuum, named, in honour of the inventor of the instrument, *the Torricellian vacuum*, or at least a space only filled with the *vapour of mercury*, which we shall presently mention.

2 and 3.—The *siphon* barometer, No. 2, was early adopted as a more convenient form than that of Torricelli. The pressure of the air at *p* is counterbalanced by a column of mercury in length *s v*. But the indications of this barometer are not nearly so great as those of Torricelli's; for an inch of variation in the difference of levels makes the mercury in the closed tube descend half an inch, and that in the open tube ascend half an inch, or *vice versâ*; thus altering *s v* by one inch (*s* falling half an inch, and *p* rising half an inch). In Torricelli's barometer, if the horizontal section of the cistern (the part occupied by the tube excluded) were twenty times that of the tube, then a diminution of an inch in *s v* would be marked by a fall of $\frac{20}{21}$ of an



inch in the tube, and a rise of $\frac{1}{21}$ of an inch in the cistern; for the mercury which is driven out of the tube causes a little addition to the cylinder of mercury in the cistern, of twenty times the base it occupied while in the tube, and therefore of only one-twentieth of its height. No. 3 is a siphon barometer, with a similar method of increasing the variation in the tube. The siphon terminates in a basin of greater diameter than the tube. If the horizontal section of the basin be twenty times that of the tube, we have again the case just explained.

4. *Descartes.*—Here we have the top of a barometer so constructed, that a narrow tube shall open into a wider cistern, which opens downwards into a tube. Any light fluid, say oil, is first poured in, and afterwards mercury; the vacuum is then made as in Torricelli's experiment, and the quantity of oil and the diameter of the cistern are so adjusted, that the extreme variations of the weight of the atmosphere shall allow some mercury to remain in the cistern. Let us say that the specific gravity of the oil is one-twentieth that of mercury, or that a column of oil is of the same weight as a column of mercury one-twentieth of its length; and let us suppose a fall of an inch in the purely mercurial barometer. Let us also suppose the horizontal section of the cylinder to be ten times that of the tube above and

below; then any descent of the mercury in the cylinder is shown by ten times as great a descent of the point s in the upper tube, because a portion of the cylinder must be filled out of the tube. When Torricelli's barometer falls an inch, the mercury here will fall $\frac{1}{2}$ of an inch, and the oil $\frac{13}{2}$, or $6\frac{1}{2}$ of an inch; this $\frac{13}{2}$ of an inch of oil being equivalent only to $\frac{1}{2}$ of an inch of mercury; and a fall of $\frac{1}{100}$ of an inch of Torricelli's barometer would be marked by a fall of $\frac{1}{16}$ of an inch in that of Descartes. Huyghens tried to construct this barometer (Descartes having died before he completed it), but found that the air contained in the upper fluid always escaped into the vacuum. He therefore suggested the next plan.

5. *Huyghens.*—To the siphon barometer he added a cistern at the vacuum end of the tube, equal in diameter to the cistern in which the mercury communicates with the air. The latter cistern communicates with a narrow tube, say one-tenth of the horizontal section of the cistern, and the barometer was completed with such a quantity of mercury as would always leave some in both cisterns. The remainder of the lower cistern, and a portion of the tube above it, were filled with water. Now it is evident, that the water is merely to be considered as a very small addition to the weight of the atmosphere. A depression of an inch in Torricelli's barometer would cause a depression of half an inch in the higher cistern, and a rise of half an inch in the lower. Neglecting the effect of the weight of the column of water, it appears that a rise of half an inch in the lower cistern would be accompanied by ten times as great a rise of the water in the tube, on account of the proportion of the horizontal sections. Hence the water multiplies the indications of Torricelli's barometer five times. The objections to this construction are: that the portion of the tube abandoned by the sinking of the water remains wet, or a part of the water is left behind, so that it appears to have descended somewhat lower than it ought to do; and also that the evaporation of the water produces a similar effect. We need hardly observe that, except for extreme exactness of observation, no improvement upon Torricelli's barometer is here pretended to have been made; so that, if this end be not answered, the whole peculiarities of the construction are useless. Dr. Hooke slightly varied this barometer, by adding another fluid above the first, and making the tube terminate in a third cistern.

6. *Hooke's* wheel barometer is a well-known plaything, for as to accuracy it scarcely deserves a better name. On the mercury in the siphon barometer a weight is placed, which is very nearly counterpoised over a pulley by another weight. The ascent of the mercury raises the weight, and the string which connects the weights makes the pulley revolve more or less. A hand attached to the pulley shows the quantity of revolution, and the plate is divided so as to show how much revolution of the pulley corresponds to a hundredth of an inch (usually) of rise or fall in the barometer. In the common instruments it is usual to mark *fair*, *changeable*, &c., at certain places; an innocent practice, because those who use the instrument are generally aware that it is not the *state* of the barometer which furnishes any probable test of the weather, but the *change* which is taking place for the time being. For observing the mere fact of a change, and roughly whether it is much or little, this instrument is sufficiently well adapted for those who wish to "give an air of philosophy to their parlours," but for marking the exact quantity of the change, or the absolute height of the column, it is worth very little.

7. *Sir Samuel Morland.*—By inclining the tube of the barometer its indications were supposed to be rendered more sensible. The mercury standing at s' in the upright barometer (dotted) would stand at s on the same level in the *oblique* or *diagonal* barometer, by a well-known law of hydrostatics; and since any difference of levels cuts off a longer space from an inclined, than from a vertical line, the indications of change on the former must be more marked than on the latter; but the friction of the mercury is increased, and the place of the head of the column of mercury is difficult to be read by a vertical scale, because of its inclination.

8. *John Bernoulli.*—The mercurial column is here made to end in a smaller horizontal tube of considerable length, the pressure of the air acting horizontally against the column of mercury. The vacuum is made in a cistern, as in No. 5. This, and the smallness of the horizontal tube, render the indications very great, in the manner already explained. There is no change in the lower level of the mercury; but other circumstances render this construction not more worthy of confidence than the preceding. An improved form of this instrument has lately been introduced by M. de Celles.

9. *Amontons.*—A conical tube of glass is closed at the upper end. It is partly filled with mercury, and the tube is inverted. The pressure of the air from underneath prevents the total descent of the mercury, but allows it to descend in the cone until it forms a column of a height sufficient to counterpoise the weight of the atmosphere. It is evident, that in a conical tube the column, as it descends, will spread horizontally and decrease in height. But by the laws of hydrostatics it is the vertical height of the column only on which depends the pressure per square inch on the base. If the weight of the air decrease, the mercury must fall until, by increase of its horizontal dimensions, the height has been decreased as much as is necessary. But a tube of the requisite degree of accuracy is almost an ideal supposition. The principle itself is the most simple and elegant of all those which have been applied to the instrument.

10. *Amontons.*—This is a barometer in which the column of external air is balanced by several different columns of mercury, as follows:—From a to s is a vacuum as usual; from s to p mercury; from p to s' air; from s' to p' mercury. When $a\,s\,p$ has been filled in the usual manner, the mercury $s'\,p'$ is admitted at g, which is then closed. Neglecting entirely the weight of the air $p\,s'$, and considering it merely as a medium for communicating pressure, the difference of levels of p and s, and of p' and s', will each be half of the column for the time being in the Torricellian barometer. For the pressure of the external air at p' is counterbalanced by the pressure of the two columns, that of the column beginning at s being communicated to that beginning at s' by the intermediate air $p\,s'$. By a repetition of the same principle, each column might be made one-third, one-fourth, &c., of the Torricellian column. But the exactness required in the several parts is impossible to be attained.

11. *Mairan.*—This is a simple siphon barometer, so short in the tube that the mercury does not descend until the density of the superincumbent air is considerably less than that of natural air. It is used under the receiver of an air-pump [AIR-PUMP] to indicate the degree of exhaustion which has taken place.

12. *Hooke.*—This barometer was intended to be used at sea. It is not a mercurial barometer, but a portion of air confined in the bulb $r\,w$ by the liquid which mounts in the tube. Any increase of weight in the exterior air compresses the air in the bulb by pressing on the liquid. This is not at all to be depended upon, as the effect of changes of temperature makes it rather more of the thermometer than the barometer.

13. *Prins.*—This is a Torricellian barometer, with a contrivance for keeping the lower level always the same. The cistern is closed at the top, excepting an orifice very little larger than is necessary to admit the tube. The mercury escaping through this orifice, and its cohesion, with the repulsion which it exercises towards glass, preventing any part separating from the rest, it forms a bulb round the tube, which bulb, when the mercury falls into the tube, instead of rising, spreads itself out upon the glass, in the manner shown in the dotted section. (*Fig.* 13*.)

14. *Gay Lussac.*—This barometer is very convenient for carriage. It is a siphon barometer, differing from others of that species only in form, and communicating with the external air through a hole g, pierced too small to allow mercury to pass through it.

15. *Fortin.*—This barometer is distinguished from the rest by a method of adjusting the lower level of the mercury exactly to the zero point of the scale before commencing the observation. It is a Torricellian barometer, in which the bottom of the cistern can be raised or lowered by a screw. An ivory needle points downwards, the point of which is on a level with the zero of the scale. The bottom of the cistern is raised or lowered by the screw, until the point of the needle and its image in the mercury precisely coincide. The observation is then made.

Several other forms of barometer will be described hereafter.

In order to construct good barometers, such that two or more may always stand (if possible) at the same height when in the same place, or may be correct indexes of the differences of height in different places, the following points must be attended to:—

1. The mercury must be chemically pure, and the interior of the tube must be freed from that coating of air which adheres to all bodies in their natural state, which, if allowed to enter with the mercury, would in time expand and render the vacuum above the mercury imperfect. It was formerly thought sufficient to expel the air by simply boiling the mercury in the tube previously to inverting it, and allowing the vacuum to form. De Luc found that all his barometers gave different heights until he boiled the mercury, after which the greater part of the difference disappeared; but he was not aware that, however carefully a barometer is prepared on this plan, it is liable to slow but certain deterioration by the infiltration of the air, as will be explained at greater length presently. The old plan was to boil a portion of the mercury first in the tube, and then to add the rest in a hot state, after which the boiling was repeated. One of the best tests of a good vacuum is when, by gently inclining the tube backwards and forwards, the mercury strikes the glass at the closed end of the tube with a hard, well-defined, and instantaneous tap. The vacuum can never be quite perfect; for, generally speaking, a small quantity of air will remain; and besides this, mercury itself will rise in vapour into the presumed vacuum [MERCURY], though not to so great a degree as to cause any perceptible pressure [ATMOSPHERE], and not more than it would rise in the air. The presence of mercurial vapour is a fact established as well by chemical tests as by the effect upon human health of breathing an atmosphere to which much of the metal has been exposed. If there be moisture in the supposed vacuum, the mercury will sink on applying the hand or any other warm substance.

Many barometers likewise, when the mercury is shaken in the dark, exhibit a luminous appearance in the vacuum over the mercury, and known as the *barometrical light*; the light being sometimes apparently uniform throughout the vacuum, sometimes appearing almost entirely on the surface of the mercury. This appearance was first noticed by Picard, and afterwards by Cassini, Lahire, &c. Though it appears to be an electrical phenomenon, we are not aware that any satisfactory explanation has been given of it, and particularly of the reason why it appears in some barometers and not in others, and why the same barometer sometimes loses the property, and afterwards recovers it. For a full account of the discovery, and of early hypotheses respecting it, see the first volume of De Luc's 'Recherches sur les Modifications de l'Atmosphère.'

In order to compare two barometers which are in different places, the temperature of the mercury must be attended to; for, as mercury expands with increase of temperature, a higher column of the fluid will be required to counterpoise a given weight of air. To observe the temperature of the mercury, a thermometer is attached to the best instruments, the bulb of which is in the cistern. All observed heights should be reduced to what they would be at some given temperature,- say the freezing point of water. And it must be remembered, that the scale itself on which the heights are measured, expands or contracts with the mercury. If the two expanded or contracted equally, there would be no occasion for any correction; but if the mercury expand more than the scale, it is the difference of the expansions by which the observed height will be wrong. Mercury expands more than the material of any scale which is ever employed.

In this country the scale is usually engraved on some mixed metal, and no very satisfactory value of the expansion can be given. It will be sufficiently accurate to suppose the expansion of mercury for every degree of Fahrenheit to be ·0001 of its bulk at the freezing point, and to neglect that of the scale altogether, which gives the following rule :—

To reduce an observed altitude to that of mercury at the freezing point, subtract the ten-thousandth part of the observed altitude for every degree by which the mercury is above the freezing point (of water, of course). At a height of 30 inches, and a temperature of 50° (Fahr.), this correction would be ·054 of an inch.

The expansion of the barometer-tube itself need not be attended to. The consequence of it is, that more mercury is drawn out of the cistern to form the requisite column; but the height of the column is unaltered.

(Remember that the *cubical* expansion, not the *linear*, must be used for the mercury in the formula.)

2. The height observed requires another correction for the *capillary* repulsion, by which it stands somewhat lower than it otherwise would do. On this subject a paper has recently been read to the Royal Society of London by Mr. Ivory, to which we refer for an accurate and clear account of the effects of capillarity on the barometric column, the effect of which is always to depress the mercury by a certain quantity inversely proportional to the base of the tube. The following table shows very clearly the amount of correction to be *added* :—

Diameter of Tube.	Correction for Unboiled Tubes.	Correction for Boiled Tubes.
Inch.	Inch.	Inch.
0·60	0·004	0·002
0·50	0·007	0·003
0·45	0·010	0·005
0·40	0·014	0·007
0·35	0·020	0·010
0·30	0·028	0·014
0·25	0·040	0·020
0·20	0·060	0·029
0·15	0·088	0·044
0·10	0·142	0·070

We must observe, that in the siphon barometer, No. 2, and also in the modification of it proposed by Gay Lussac, No. 14, no correction for capillarity is necessary; for the depressive force is equal on both sides. In all other barometers the capillary action of the cistern is insensible, owing to the magnitude of its diameter, so that only that of the tube need be attended to. Perhaps the best way of settling the exact amount of capillary depression would be by a very large number of observations upon two good barometers of different-sized tubes standing in the same place. The tube must be very exactly cylindrical, or the capillary correction will not be the same in all its parts.

3. The *index* correction must next be applied. This is the amount of difference between the particular instrument and the readings of the Royal Society's flint-glass barometer, or that of the Kew Observatory, when properly corrected. This correction however is generally attended to chiefly in the case of ships' barometers.

4. The barometer must hang quite vertically; for any deviation from the vertical converts the instrument, *pro tanto*, into the diagonal barometer, No. 7, and makes the divisions on the scale too small.

5. The scale is usually divided into tenths of inches, and is also furnished with a vernier, by which the height may be measured within the 200dth of an inch. [VERNIER]. Many observers profess to go nearer; but, considering the uncertainty (if we speak of thousandths of inches) of the corrections both of temperature, capillarity, of the zero point of the scale, &c., this must be considered as mere play. Whatever reliance may be placed on the mean of a large number of observations, we think we may safely defy any one to show an even chance that a single observation will be free from instrumental errors, even as far as the 200dth of an inch.

6. The exact determination of the level of the mercury in the cistern is in many barometers impossible. All the best instruments have some method of adjustment, either as described in Fortin's barometer, No. 15, or by placing a float on the surface of the mercury with a needle rising vertically from it, some point of which needle is adjusted by raising or lowering the bottom of the cistern.

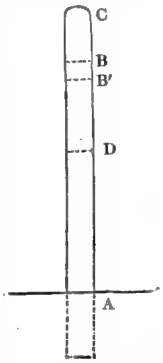
If a barometer be made, which is not a siphon barometer with uniform tube, No. 2, or with means of adjusting the lower level of the mercury, it should certainly be the simplest form of Torricelli's instrument, namely, a perfect cylindrical tube immersed in a perfectly cylindrical cistern. The larger the cistern, the less the error arising from variation of the lower level; the actual error may easily be calculated thus: Let K and k be the areas of the sections of the cistern and tube respectively; let a be the height of the column of mercury above the zero point at any time when that in the cistern is *at* the zero point, b the corresponding height at any other time, so that $b-a$ is the difference in *apparent* height; and let c be the depression of the mercury in the cistern below the zero point at this *latter* time; so that c is the error required to be *added* to the *apparent* height to give the *true* height. Now, by the laws of equilibrium of fluids, we shall easily have,

$$\mathrm{k} \times (b - a) = \mathrm{K} \times c.$$

$$\therefore c = \frac{\mathrm{k}}{\mathrm{K}}(b - a)$$

$$\therefore \text{ The } \textit{true} \text{ height required } = b + \frac{\mathrm{k}}{\mathrm{K}}(b-a) = b\left(1 + \frac{\mathrm{k}}{\mathrm{K}}\right) - \frac{\mathrm{k}}{\mathrm{K}}a$$

An *imperfect* barometer is one into which some air or gas has penetrated, and so caused a depression of the upper surface of the mercury below its proper level. When the barometer is to be employed in determining the relative heights of ground, it may not be possible to get this air out of the tube by any means in the power of the observer, and it then becomes necessary to have a formula by which a correction may be applied to the observed height of the mercury at any station in order to have the height at which the top of the column would stand if the tube were free from air.



For this purpose, before setting out, the height of the column of mercury in the defective instrument must be compared with the height in one which is perfect, in order to obtain the measure of the elasticity of the air which is confined in the upper extremity of the tube. Let A C be the length of the bore of the tube above A, the surface of the mercury in the cistern, A B the height of the column in a barometer free from air, and A B′ the observed height in the defective instrument. It being understood that these heights are read at the same time and place, so that the temperature and density of the air may be the same; and also that both instruments are provided with adjusting screws, so that the surfaces of the mercury in the two cisterns may be made to coincide with the zeros of the scales of inches. Then the pressure of the external atmosphere supporting the column A B, and the difference between that pressure and the pressure equivalent to the elasticity of the air in C B′ supporting the column A B′; it follows that the weight of a column of mercury in B B′ measures the pressure last mentioned; let this be represented by ml, in which l is equal to the height B B′.

Now, on removing the instrument to another, suppose a higher, station, let the observed height of the mercury in the imperfect barometer (no more air being supposed to have entered) be A D; then the air which, before, occupied the space C B′, occupies C D, and its elastic force is diminished in the inverse ratio of those spaces or heights therefore, if C B′ be represented by a, and C D by b,

$$b : a :: ml : m\frac{al}{b};$$

and the last term expresses the pressure of the confined air on D, the top of the column of mercury. This term added to the weight of the column of mercury A D, which may be represented by mh (h being the observed height A D), will be equal to the weight of the column of mercury at the same time and place in a barometer which is free from air. This last being represented by mh'; it follows that $h' = h + \frac{al}{b}$, or $\frac{al}{b}$ is to be added to the observed height, in order to obtain the corrected height of the column of mercury at the station.

Barometrical Measurement.—The use of the barometer for *Hypsometry*, or the measurement of heights, depends upon the fact of the diminution of atmospheric pressure as we ascend from the earth's surface. The best form of mountain-barometer is described in the article on 'Barometrical Measurements,' in the 'Encyclopædia Britannica.' The humidity of the air also materially affects its elasticity, so that the hygrometer, as well as the thermometer, should be used in correcting these observations; besides which, we must take into account the decrease of the earth's attraction at the point. The general method is as follows: Let x and x' be the heights in feet of the two stations, and let us suppose the atmosphere to consist of strata of one foot thick, throughout each of which the pressure is the same, but that in passing from one to another of them the pressure diminishes in a geometric progression whose ratio is r. This, we may add, is easily proved to be the case; see Goodwin's 'Course of Mathematics,' p. 332, from which we deduce the expression $r = 1 - \frac{g}{k}$, when g = force of gravity. Let the heights of the barometer at the two stations be h h', which are proportional to the atmospheric pressures, so that

$$\frac{h}{h'} = \frac{r^{x}}{r^{x'}} = \left(1 - \frac{g}{k}\right)^{(x - x')}$$

$$\therefore \quad x - x' = \frac{\log \frac{h}{h'}}{\log \left(1 - \frac{g}{k}\right)}.$$

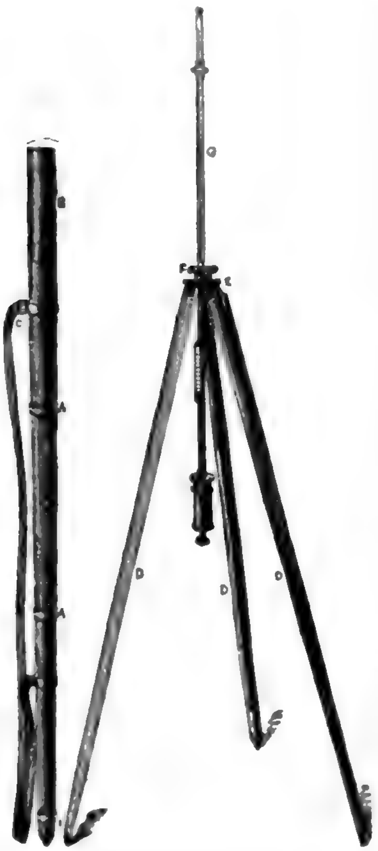
The rules for finding the heights by the barometer are summed up in the following words :—

1. Correct the length of the mercurial column at the upper station, adding to it the product of its multiplication into twice the difference between the degrees on the attached thermometers, the decimal point being shifted four places to the left.

2. Subtract the logarithm of this corrected length from that of the lower column, multiply by 6, and move the decimal point four places to the right; the result is the approximate elevation expressed in English feet.

3. Correct the approximate elevation by shifting the decimal point three places back to the right, and multiplying by twice the sum of the degrees on the detached thermometers; this product being now *added* will give the true elevation.

The annexed figures represent a convenient form of portable barometer manufactured by Messrs. Negretti and Zambra. The first figure represents the instrument packed in its case with a strap C, and the other figure mounted for an observation; D D is the tripod stand, and G the barometer tube.



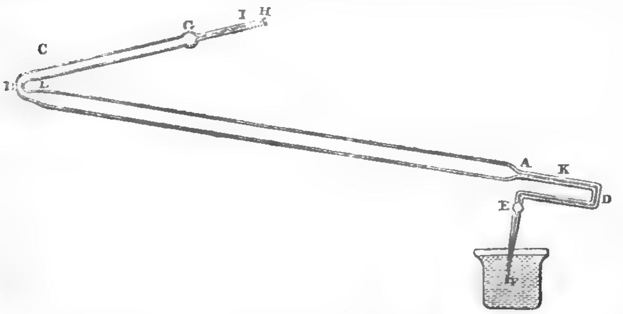
Standard Barometer.—In preparing a standard barometer for the Royal Society, the late Professor Daniell, of King's College, endeavoured to get rid of the objections to the boiling of the mercury in the tube by first abstracting the air by means of an air-pump, the presence of moisture being avoided by the use of sulphuric acid. Accordingly a barometer tube was fitted with a stopcock, which was screwed into the under surface of the pump-plate; while, on the upper surface, was a glass dish perforated in the centre, and containing the acid. In this dish was placed a stand with glass legs for receiving a funnel, the stem of which, being drawn out into a capillary tube, passed down into the mouth of a small paper cone resting upon the tube. The aperture at the upper part of the stem was closed by an iron plug, between which and the capillary opening cotton was placed. The glass funnel was filled with carefully prepared mercury, and the whole was covered with a glass receiver, furnished at the top with a sliding rod, the lower end of which could be screwed into the plug so as to draw it up and replace it. The air was now exhausted to ·5 inch, and the plug being withdrawn, the mercury was allowed to trickle into the tube. In its fall it was, however, broken into globules, which formed minute cavities as the tube was filled. As these cavities could not entirely be got rid of, the apparatus was varied by passing a small tube to the bottom of the barometer tube, so that the mercury could trickle down this and deliver itself slowly into the barometer tube; by this means the mercury rose in the latter in perfect and uninterrupted contact with the glass. The success of this experiment was such, that under ordinary circumstances it would not have been thought necessary to boil the mercury in the tube, but the prejudices of the day required that this troublesome and hazardous process should be gone through. Many tubes were destroyed in the boiling, after all the trouble of measuring and filling had been taken. The tube finally selected was 33¾ inches long, and ·530 inch bore. The boiling was not performed, however, in the ordinary manner, over a charcoal fire, but during the process of filling under diminished pressure, as already described. When 17 inches of mercury had been introduced, the tube was gradually heated before a fire, and a large spirit lamp flame was applied to the upper part of the mercury; when this had reached the point of ebullition the boiling was slowly continued downwards, and when it had reached the bottom it was again as gradually conducted to the top. "The bubbles of vapour freely passed, with the assistance of a slight degree of agitation, from one end of the column to the other; and very bright flashes of green light accompanied their extrication. One minute globule of air alone was detected during the heating, notwithstanding the diminished pressure, and this was readily extricated; and there was not the slightest condensation of moisture visible in the cold portion of the tube." The cooling was conducted very slowly; when the second portion of mercury was introduced, making the column equal to 29¼ inches, the air was abstracted, and the boiling begun as before from the top and carried downwards to about two inches below the union of the two portions of mercury. The last 3½ inches of the tube were filled up with hot mercury, and the whole was left for 48 hours. When the tube was inverted in the cistern, this great body of mercury did not descend until it had received two or three smart concussions; a good proof of the displacement of air. By vibrating the mercury in the tube, beautiful green flashes of barometric light were seen in the vacuum, and the crackling sound of electrical excitation was heard on approaching the finger.

This fine instrument was not destined to remain long a faithful representative of the atmospheric pressure. The mercurial column, which was originally perfectly bright and compact, became, in the course of some months, dull and speckled, arising from the pressure of minute air-bubbles; the air, in fact, had insinuated itself between the metal and the tube where the latter dipped into the cistern, and creeping up into the Torricellian vacuum, opposed a resisting medium to the oscillations of the column; which, consequently, no longer represented the atmospheric pressure, but the difference between that pressure and that of the air contained in the space at the top of the tube. Hence it was evident that all barometers, constructed with a straight tube dipping into an open cistern of mercury, must be liable to a constant process of deterioration; and consequently all the registers which had been so industriously kept by scientific men in various parts of the world, were no longer trustworthy. The effect of this deterioration would be to produce a gradual lowering of the mean annual height of the barometer; but in order to trace it, it was necessary to compare periods of five or six years or more with each other. The 'Ephemerides' of the Meteorological Society of the Palatinate furnished the materials for this comparison. Taking the series of observations made at Mannheim for the twelve years 1781 to 1792 inclusive, and dividing them into two periods of six years each, the mean of the last period was found to be ·62 inch lower than that of the first period. A similar comparison for the observations made at Padua gave ·044 inch lower for the second period than for the first. For Rome, the difference was ·114 inch; for Buda, ·035 inch; for Brussels, ·044 inch; for Munich, ·026 inch; for Peisenberg, in Bavaria, ·026 inch; and for Mount St. Gothard, ·026 inch. These examples establish the fact of the gradual depression of the mercurial column by the infiltration of air; and it may further be seen, that the amount of the effect depends in some degree upon the elasticity of the atmosphere in which it takes place. The five series of observations, the mean pressure of which is 29·235 inches, show an average depression of ·059 inch in 12 years; while the three series, the mean pressure of which is 25·977 inches, show a depression of only ·026 in the same period.

The remedy proposed by Professor Daniell against this serious source of deterioration, which would render barometrical observations comparatively worthless, was to weld to the barometer tube near its open end a ring of platinum, so that when the tube was dipped into the cistern, the mercury, by wetting the platinum, would produce such perfect adhesion as effectually to exclude the infiltration of atmospheric air. Accordingly this plan was adopted, and for many years all the best barometers were furnished with a platinum guard. It was thus supposed that the evil complained of, was most effectually cured; but time, which is as delicate a test as any that a chemist can offer, showed that the platinum guard was not free from defects. The mercury formed an amalgam with the platinum, which, during the oscillations of the barometer, got sucked up into the vacuum, and, clinging about the tube, impeded observation. The next remedy was the simple and apparently obvious one of turning up the end of the tube, as represented in the annexed figure; but as this involved a new method of filling, we must, in order to describe it, again recur to the difficulties of boiling, especially when the tube is of large dimensions.

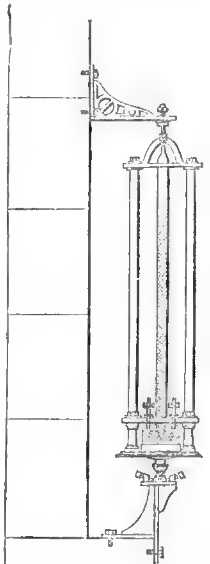
In the years 1853 and 1854 several attempts were made, under the superintendence of the Kew Observatory Committee of the British Association, to prepare a barometer tube of large size in the usual manner. Mr. Negretti succeeded in filling tubes fully one inch in internal diameter; but many of these, before they could be mounted, broke spontaneously, some within a few hours, and others after an interval of several days after the boiling. Two or three tubes were mounted, but did not work satisfactorily; the adhesion of the mercury to the glass was such, that when the barometer was set up the convexity of the top of the column was destroyed, and the surface even became concave; after a few days' working, rings of dirt or other impurity were formed on the glass near the top of the column, and they continued to increase so as to interfere with observation. Nevertheless, care had previously been taken to render the mercury chemically pure; and, when examined by Professor Miller of King's College, no impurity was detected in it. The great heat to which the glass is exposed during the boiling, applied as it is in an irregular and unequal manner, probably has the effect of reducing the glass to its unannealed condition, in which the particles are held in a state of unstable equilibrium (as in the Bologna phial), so as to be liable to be overturned from a very slight cause. The fouling of the mercury seems to have arisen from impurities in the glass tubes; for when greater care was taken by the glass-blower, the effect on the mercury was decidedly diminished; and when the tubes, before being filled, were thoroughly cleansed by sponging them with whiting and spirits of wine, a satisfactory result was obtained; for after a year's trial it was found that the top of the column presented a good convexity in all states of the barometer, with only a very slight trace of dirt. In this case the standard barometer was filled, not by boiling, but by a method devised by Mr. Welsh of the Kew Observatory, and described by him in a paper communicated to the Royal Society in 1856.

The tube to be filled was first prepared in the following manner: To its upper end was attached a bent capillary tube, A, D, E, F, with its bore much contracted at the apex, D, with a small bulb at E, and drawn out to a fine point at F, where it was sealed. To the lower end of the large tube was attached a smaller tube B, C, G, ·3 inch bore and 10 inches in length, and to this was added the short capillary tube, G H, with a bulb at G. The end H of the capillary tube was next connected with a good air-pump, and the air was very slowly extracted



while the whole tube was being strongly heated by passing a large spirit-flame along it. When the air had been as far as possible extracted in this way, and while the air-pump was still being worked, and the heat still applied, the capillary tube G H was sealed at I by means of a blowpipe flame. When the tube had cooled it was placed at a small inclination with the end F in a vessel of well-boiled mercury, when, the point F being broken off under the mercury, the metal rose in the tube by atmospheric pressure, and continued to rise until the bulb at G was more than half-filled, the remaining space being occupied by the air which the pump had not extracted. The pressure of this residual air was calculated to be less than ·05 inch. The basin of mercury was then withdrawn from beneath the tube, leaving the point F exposed, while the small tube remained quite filled with mercury. The blowpipe was then applied at F, and the opening sealed. When the glass at F had cooled, the tube was placed erect, the mercury separating at the contracted part, D, leaving the tube from D to F filled or very nearly so, and from D to A empty. The tube was next sealed at K, and the portion K D E F removed. Lastly, the lower end of the tube was broken under mercury at C, leaving about an inch of the siphon. This barometer tube has an internal diameter of 1·1 inch. It is supported over a glass cistern, in a strong brass frame, secured by brackets to the wall of the old mural quadrant of the Kew Observatory, the height of the mercury being measured by a cathetometer fixed to the same wall at a distance of five feet. A conical point at the lower end of a short rod of steel is adjusted by a screw to the surface of the mercury in the cistern, as shown in the figure. At the upper end of the steel rod, and above the level of the glass cistern, is a fine mark, the distance of which from the conical point is 3·515 inches. In making an observation, the lower point is adjusted to exact contact with the mercury in the cistern; the telescope of the cathetometer is then levelled, and its horizontal wire made to bisect the mark on the upper end of the steel rod; the scale reading of the cathetometer being noted, the telescope is then raised, again levelled, and the wire made a tangent to the surface of the mercury in the tube, the cathetometer scale being again observed; the difference between the two readings of the cathetometer, added to the length of the steel rod, is the column of mercury. To prevent light from being reflected into the telescope from the surface of the mercury in the tube, a moveable screen, the upper part of which is black and the lower part of oil-paper, is so adjusted as to shut off all light that comes from a higher level than the top of the mercury, by which means the surface of the column presents in the telescope a well-defined dark outline. A window behind the barometer illuminates the paper screen by day, and a lamp by night. A thermometer with its bulb in the mercury of the cistern, gives its temperature, and the brass scale of the cathetometer is corrected by means of the usual tables.

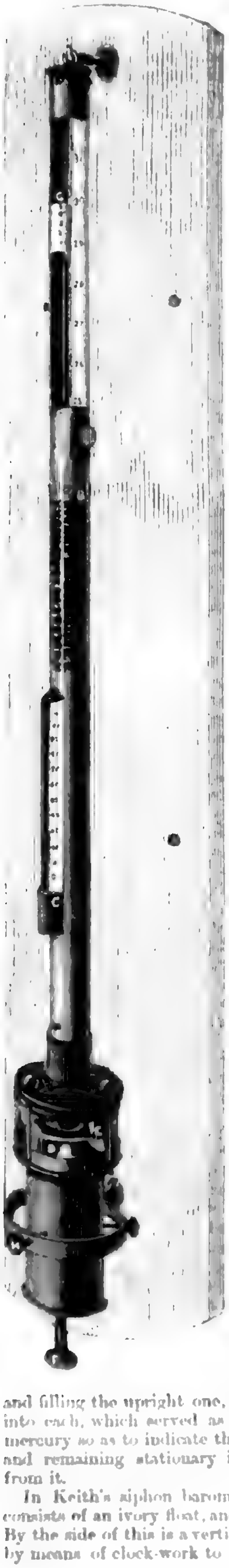
This fine instrument is used as the standard for correcting the barometers supplied by the Board of Trade to captains of merchant ships, willing to make observations at sea, and also to various meteorological stations in the colonies.* The method of testing is described by Mr. Welsh, 'Phil. Trans. 1856'; and also in the 'first number of 'Meteorological Papers, published by the authority of the Board of Trade, 1857,' from which we gather the following particulars: In the barometers used at sea, the usual method of adjusting the mercury in the cistern to the zero point or the reverse, previous to an observation, cannot be adopted on account of the motion of the ship, which motion would produce in an ordinary barometer an oscillation of the mercurial column known by the name of *pumping*. To prevent this, part of the tube of the marine barometer must be very much contracted, one consequence of this construction being that the index correction varies through the range of scale readings in proportion to the difference of capacity between the cistern and the tube. To find the index correction for a land barometer, comparison with a standard at any part of the scale at which the mercury may happen to be, is usually considered sufficient; but to test the marine barometer it is necessary to find the correction for scale readings at about each half-inch throughout the range of atmospheric pressure to which it may be exposed. Hence it is necessary to have means at command for changing the pressure of the atmosphere on the surface of the mercury in the cistern. For this purpose the barometers to be tested are placed with a standard in an air-tight chamber of iron from which a portion of the air can be pumped out, so as to diminish the pressure, or air can be forced in so as to increase the pressure. The tube of the standard is contracted as in the marine barometer, but provision is made for adjusting the mercury in its cistern to the zero point. The upper part of the air-chamber contains glass windows through which the scales of the thermometers are visible, but as the verniers cannot be got at, the height of the mercury is read by means of the fixed vertical scale and cathetometer already referred to. The fixed scale is 5 or 6 feet from the chamber, and its divisions exactly correspond with those on the tube of the standard: a vernier and telescope slide on the scale by means of a rack and pinion; the telescope has two horizontal wires, one fixed and the other moveable by a micrometer screw, so that the difference between the height of the column of mercury, and the nearest division on the scale of the standard, and also of all the other barometers placed by the side of it for comparison, can be measured either with the vertical scales and vernier or the micrometer wire. In this way the barometers are usually tested at every half-inch, from 27·5 to 31 inches. In some barometers the errors are so large as to read half-an-inch and upwards too high, while others read as much too low. In some cases those which were correct in some part of the scale, were found to be from half-an-inch to an inch wrong in other parts. Indeed the marine barometer, until lately in common use, was so faulty in construction that the cistern was not large enough to contain all the mercury, which descended in a low atmospheric pressure, so that in some cases it was found that 29 inches was the minimum pressure that the barometer could indicate.



The marine barometer recently introduced on the recommendation of the Kew Committee, is a superior instrument. The diameter of the cistern is about $1\frac{1}{4}$ inch, and that of the tube about $\frac{1}{4}$ inch. The scale, instead of being divided into inches in the usual way, is shortened in the proportion of about 0·04 of an inch for every inch, which prevents the necessity for applying a correction for difference of capacity between the cistern and the tube. To check the pumping of the mercury the tubes are so contracted through a few inches, that when first suspended the mercury may be twenty minutes in falling from the top of the tube to its proper level. This contraction of the tube causes the marine

* In the year 1853, a conference of maritime nations was held at Brussels on the subject of meteorology at sea. The report of this conference was laid before Parliament, which voted a sum of money for the purchase of instruments, and the discussion of observations under the superintendence of the Board of Trade. Arrangements were then made in accordance with the views of the Royal Society and the British Association for the Advancement of Science, for the supply of instruments properly tested.

barometer when used on shore to be always a little behind an ordinary barometer, varying in amount according to the rate at which the mercury is rising or falling, and ranging from 0·00 to 0·02 of an inch. It is supposed that as the motion of the ship at sea causes the mercury to pass more rapidly through the contracted tube, the readings are about the same as they would be if the tube were not contracted.



The standard barometer manufactured by Messrs. Negretti and Zambra on Fortin's principle (No. 15), in which the reading is made from an ivory point in the cistern, is represented in the adjoining figure. The tube, which is filled by boiling, is enclosed within a brass tube, B, furnished at the upper part with two longitudinal openings opposite each other; on one side of the front opening is the scale of English inches divided to show, by means of a vernier, $\frac{1}{500}$th of an inch; on the opposite side is sometimes divided a scale of French millimêtres, reading also by a vernier to $\frac{1}{10}$th of a millimêtre; the reservoir, or cistern of the barometer is of glass, closed at bottom by means of a leather bag, acted upon by a thumb-screw, F, passing through the bottom of an arrangement of brass-work, by which it is protected. This instrument is sent out in three parts, packed separately for safety in carriage. They consist first, of the barometer-tube and cistern, filled with mercury; secondly, the brass tube, with its divided scale and thermometer, C; and thirdly, a mahogany board with a bracket at the top, and a brass ring with three adjusting screws at the bottom. The board is to be fixed as nearly vertical as possible; the barometer tube and its cistern are screwed into the brass tube; and an experiment is made to see whether the tube is free from air. For this purpose the screw at the bottom of the cistern is lowered three or four turns, so that the mercury in the tube when held upright may fall 2 or 3 inches from the top. The mercury is then made to strike the top of the tube as already noticed; if a sharp tap be heard, the instrument is perfect; but if the tap be dull, or not audible, there is air above the mercury, which must be driven into the cistern by inverting the instrument and gently tapping it by the hand. The barometer is next suspended on the brass bracket, and the cistern passed through the ring at the bottom, and when it has settled in a vertical position it is clamped by means of the three thumb-screws, H. Before making an observation, the mercury in the cistern must be raised or lowered, by means of the thumb-screw, F, until the ivory point, E, and its reflected image, are just in contact; the vernier is then moved by means of the milled head, until its lower termination just excludes the light from the top of the mercurial column, when the reading is taken by means of the scale on the limbs and vernier.

Self-registering Barometers.—Various attempts have been made so to construct barometers that they shall register their own proceedings. In 1830, Dr. Traill constructed an apparatus consisting of two diagonal barometers, one inverted and resembling in principle the rectangular barometer; both were attached to the same frame, but before bending and filling the upright one, a piece of smooth steel wire was introduced into each, which served as indices by being driven forwards by the mercury so as to indicate the maximum or minimum for a given time, and remaining stationary in the tube when the mercury retreated from it.

In Keith's siphon barometer, as improved by Bryson, the register consists of an ivory float, and a kneed wire ending in a small knife-edge. By the side of this is a vertical cylinder of tinned iron, japanned, made by means of clock-work to move round on its axis once in 24 hours; the surface of this cylinder being thinly coated with a mixture of chalk and water, the knife-edge is made to touch the cylinder every hour, and by cutting through the chalk shows a black line on a white ground. At the end of 24 hours the first cylinder is removed, and a second one substituted, while the marks on the first can be read off and recorded by means of a scale of equal parts.

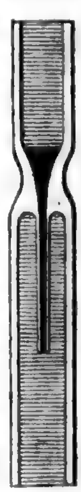
Messrs. Negretti and Zambra register the highest and lowest readings in the following manner:—To the longer leg of a siphon barometer, 8 inches from the top, is joined a bent glass tube, carried up for 6 inches parallel to the principal tube, and joining it at 2 inches from the top. The mercury flows freely in and out of this tube, and maintains the same level as that in the larger tube. This bent tube contains a small piece of steel, which is kept in position by means of fine glass springs: as the mercury rises the steel is pushed up, and remains stationary when the mercury recedes. The lowest readings are indicated by a similar contrivance in the shorter leg.

Mr. Yeates' registering apparatus consists of a revolving cylinder 4 inches in length, around which is paper ruled into thirty-one vertical portions, and horizontally into 10ths of inches, and numbered from 27 to 31 inches. To the receiver is attached a pencil for marking the paper. The ivory point is adjusted to the surface of the mercury by means of a plunger.

Of late years, the self-registration of the barometer has been effected in meteorological observatories by means of photographic apparatus. The principle of the contrivance is to direct the light of a lamp through the Torricellian vacuum upon a surface of sensitive paper, as it is gradually unwound from a cylinder. In this way a broad trace is left on the paper, the breadth of which varies with the height of the mercury in the tube.

Attempts at self-registration have also been made by furnishing the upper part of the tube with wires, connected with certain voltaic arrangements, in which the currents are closed by the ascent of the mercury in the tube. M. Hardy, an instrument maker of Paris, has fitted a siphon barometer with an apparatus consisting of a float in the open limb, which float acts upon an aluminium rule; this is furnished with a pencil, and is made to move up and down before a vertical cylinder, but the pencil is at the distance of one millimêtre from the cylinder. The cylinder is moved by clockwork, which every five minutes sends an electric current through an apparatus which sets a hammer in motion, and this striking on the barometer tube performs the office of the finger of the observer in tapping the instrument so as to produce a more exact level of the mercury. Half a minute after the hammer has ceased, the clock sends a current through an electro-magnet, the armature of which strikes on the aluminium rule, and forces the pencil up to the register paper on the cylinder.

Miscellaneous.—Various forms of barometer were brought under the notice of the Jury (Class X) of the Great Exhibition of 1851. Mr. John Griffith exhibited a barometer so constructed as to give the power at all times of securing a vacuum above the mercury. The top of the tube is furnished with a crook for the purpose of trapping all the air which may be above the column; the tube is bent at the lower part, while near the middle of the tube is a joint with a trap; there is also a stop-cock, and a stretcher for closing the open part of the glass tube when necessary. The reading is by means of a brass bar, carrying two cylinders at the distance of 29·722 inches, and moved up and down by means of a steel screw, with twenty-five threads to the inch, working in a matrix by means of a milled head. The bar has a pointer for reading to 100ths of an inch, and there is also suitable apparatus for reading to 1000th of an inch.



Messrs. Negretti and Zambra had a barometer with an air-trap glass cistern, to be read off by means of a sliding scale adjustable to the surface of the mercury by means of a fine ivory point. The tube and cistern were blown together, and at intermediate junctures were three points and three small tubes or traps, communicating with each other to prevent the admission of air. The construction of these air-traps will be understood by referring to the accompanying figure, in which it will be seen that air, creeping up the tube, would evidently pass up into the hemispherical part or trap, where it would be retained instead of passing up that part of the tube which is drawn nearly to a point, and leads directly into the Torricellian vacuum.

The same excellent makers also exhibited a folding barometer, consisting of a tube with a steel stop-cock in the centre, which when folded up, carries with it the two valves of the tube with which it is connected.

In Mr. Abraham's barometer the scale was suspended over a pulley by means of a counterpoise, the lower end of the scale being connected to a float in the shorter leg of the siphon. Mr. Ross had a self-compensating barometer on the same principle.

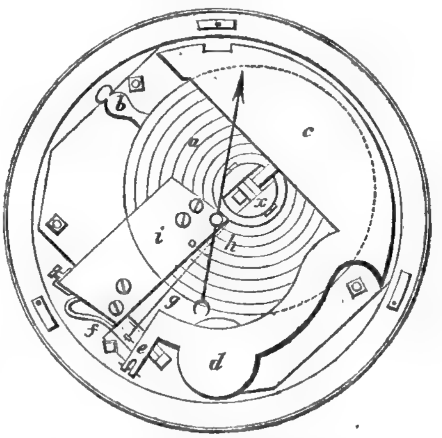
Among the numerous forms of barometer which are being constantly devised, we may mention that by M. Trouessart, in which the curved portion of a siphon barometer is made of caoutchouc, which allows the observer to augment the capacity of the barometer chamber at will, and consequently to vary the height of the mercurial column so as to be able to deduce from it the atmospheric pressure. In M. Blondeau's instrument, the dimensions of which are very much less than in the ordinary form, a volume of air of the pressure intended to be measured is taken and dilated so as to occupy double its former volume. Under such circumstances, the elasticity of the air producing equilibrium at the pressure of only half an atmosphere, causes such a difference in the height of the mercury in the tube communicating with it, as to show at once the value of the pressure of this half-atmosphere, whence may be deduced the pressure of the air at the time of observation.

Water-Barometer.—Attempts have been made at various times to construct a *water-barometer*, under the idea that its greater oscillations as compared with the mercurial-barometer might throw some light on several points of physical science. Mariotte formed a water-barometer, and noticed that when the mercurial-barometer stood at 28 *pouces*, the water indicated 31½ *pieds*. "Ce qui donne," he remarks, "le rapport du mercure à l'eau de 13½ à 1." Otto Guericke had a water-barometer rising along the wall with a toy of the shape of a man floating on the top of the water; the lower part of the tube was concealed under the wainscoting, so much so, that the little image only made its appearance in fine weather. This contrivance was named an *Anemoscope* or *Semper Virum*. It does not appear that in these instruments any attempts were made to purge the water of air by boiling, and to prevent its re-absorption, nor did the tube consist of one whole length. These objections Professor Daniell determined to obviate in the water-barometer, which it was proposed to erect in the hall of the Royal Society at Somerset House, in the year 1831. The tube was drawn without any difficulty by Messrs. Pellatt and Co., it was 40 feet in length, 1 inch in diameter at its lower extremity, and 0·8 inch at its upper. The tube was conveyed in a packing-case to its position in the Society's Hall, and its lower end was passed through a stuffing-box into a steam boiler, so arranged that the water could be first thoroughly boiled, and then, by closing a stop-cock, raised in the tube by the elastic force of the vapour acting upon its surface until it issued in a jet from a small stop-cock at the top of the tube. This operation was at length, after some failures, conducted successfully. As the apparatus cooled the column of water subsided until it was balanced by the pressure of the atmosphere, and the water in the boiler, which now constituted the cistern of the barometer, was covered with half-an-inch of castor oil to prevent the atmosphere from communicating with the water, and the air from being absorbed. The adjustment of the scale with the necessary correction was next attended to. Of course one of the most important corrections would be for the elasticity of the aqueous vapour at the observed temperature. An extensive series of observations during two years showed that the instrument was undergoing deterioration, and on opening the cistern it was found that some of the liquid had escaped, and that the oil had undergone decomposition. On taking some of the water out of the boiler and placing it under the receiver of an air-pump, air-bubbles were extricated in abundance, showing that the attempts to prevent the absorption of the air had failed. The indications of this instrument, however, clearly established the fact that the water-barometer precedes by one hour the barometer of half-an-inch bore, and the latter, the mountain-barometer of 0·15 inch bore by the same interval in their indications in the horary oscillations. It was also curious to watch the water-barometer in windy weather; the column of water appeared to be in a perpetual motion resembling the slow action of respiration. At the end of 1844, the barometer was examined, the gas collected in the vacuum proved to be pure nitrogen, the oxygen having been absorbed in passing through the oil, making it rancid and producing other changes. In January, 1845, the instrument was emptied, cleaned, and refilled as before, when instead of covering the water in the cistern with oil, a solution of caoutchouc in naphtha was substituted to the depth of between two and three inches. This, however, did not prevent the entrance of air, so that the attempt to establish a water-barometer must be regarded as a failure.

In the theatre of the Natural Philosophy class in the University of Edinburgh, is a water-barometer constructed by Adie, not for meteorological purposes, but as a class illustration for exhibiting the Torricellian experiment in a striking manner. It consists of a fine drawn tube of tin of ½-inch bore, rising 30 feet from a copper basin, enclosed under the benches of a class below, and cemented at the top to a glass cylinder, 2 inches wide and about 6 feet high, exposed to view but terminating in a small basin containing water. Both ends of this compound column are fitted with stop-cocks, which may be opened or shut at pleasure by means of concealed wires.

It may also be noticed, that in the Great Exhibition of 1851, Mr. Brown exhibited a barometer 39 feet high, containing two immiscible liquids of nearly equal specific gravity, and their point of meeting which may be placed at any part of the scale, was indicated by one liquid being coloured.

The Aneroid Barometer.—The weight of a column of air, which in the ordinary barometer acts on the mercury, in the aneroid presses on a small round metal box, from which nearly all the air has been extracted, and as its indications are obtained without the use of mercury or any other fluid, we have the etymology of the word in the Greek, ἀ without, and νηρὸς fluid.* It was invented some years ago by M. Vidi of Paris. It is inferior in value to the mercurial barometer, but has some advantages in sensibility and portability. It admits of being carried in the pocket, and may be used on a journey in situations where the mountain barometer would be inconvenient. Its variations from temperature seldom exceed $\frac{1}{10}$th inch in a range from 28° to 80°, a variation to which the mercurial barometer is liable, only in this case its exact amount for every degree of temperature has been determined.† The external appearance of the aneroid is that of a brass box with an enamelled dial face covered with glass. In the centre of the dial is a pivot for the reception of a needle, which moves over a series of graduations marked from 28 to 31 to represent the inches of the ordinary barometer, and over these graduations are the usual words 'stormy,' 'much rain,' 'rain,' &c. Attached to the face are also two thermometers, one graduated according to Fahrenheit, and the other according to the centigrade scale. On removing the dial-face, but retaining the needle, we have the appearance represented in the accompanying figure, in which *a* is the flat circular box made of white metal, previously exhausted of air through the short tube *b*, and made air-tight by soldering: the upper and lower surfaces of the box are corrugated in concentric circles, which improves the elasticity of the metal. This box is attached to the bottom of the brass external case. In the centre of the upper surface of the elastic box is a solid cylindrical socket *x*, about half-an-inch high, to the top of which the principal lever *c*, *d*, *e*, is attached; this lever brings the box into a state of tension by separating the surfaces, and rests partly on a spiral spring *d*, and partly on two fulcra, having knife-edges, which are free to move. The end *e* of the principal lever is attached to a second lever *f*, from which a fine watch-chain *g*, extends to *h*, where it works on a drum attached to the arbour of the hand. A hair-spring at *h*, attached to the metallic plate *i*, regulates the motion of the hand. As the weight



of the atmosphere becomes increased or diminished the surface of the box becomes depressed or elevated, while the spiral spring *d*, upon which the principal lever rests, shares in the motion, which is thus communicated through the levers to the arbour of the hand at *h*. At the back of the instrument is a screw for the purpose of adjusting the hand to the height of the mercurial barometer.

The neglect of this last point has led to considerable misconception on the part of persons using the instrument, and also on the part of some writers who have described it. They regard the aneroid as an independent instrument, which it was never intended to be, for it requires to be set originally by a barometer, and to be adjusted from time to time by reference to the same instrument. In the Meteorological Papers published by the Board of Trade there is the following testimony to its value: "The aneroid is quick in showing the variation in atmospheric pressure, and to the navigator who knows the difficulty of using barometers at times, this instrument is a great boon, for it is steady under all circumstances of weather, at the same time giving indications of increased or diminished pressure. It is a good weather glass, to be suspended on or near the upper deck for easy reference. In ascending or descending elevated land, the hand of the aneroid may be seen to move like the hand of a watch, showing the height above the level of the sea." Mr. Belville of the Royal Observatory, Greenwich, in his "Manual of the Barometer," in giving the meteorological results of a tour in Wales obtained by means of the aneroid, says, "It was a delightful companion and highly useful; its indications preventing many an excursion which would have ended in disappointment."

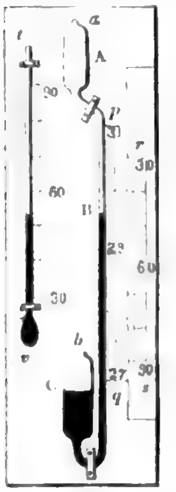
* It has been however said, that M. Vidi intended this word to be derived rather from ἀνὴρ, a man, because the pressure is similar to that produced by the same cause on a man's body. Thence he intended to call it an aneroid baroscope. [BAROSCOPE.] The derivation given above, is probably more correct. Others derive it from ἀνέρομαι, to inquire or observe.

† The inventor has introduced into the vacuum-box a small portion of gas, which, changing its bulk with change of temperature, is intended to act as a compensation for the effects of heat and cold.

A *Metallic Barometer*, a modification of the aneroid, was invented by Bourdon, in 1850. It consists of an elastic flattened tube of metal, completely exhausted of air, and bent very nearly into the form of a circle. In this condition the flattened tube has the property of expanding: the ends separating further from each other when the atmospheric pressure is diminished, while a contrary effect takes place when the pressure increases. A lever is attached to the end of the tube, and is connected by suitable mechanism to an index hand, which traverses a divided dial-plate. This plate is graduated by placing the instrument, together with a standard barometer, within the receiver of an air-pump, and the points of coincidence are determined by varying the pressure. An instrument of this kind is well adapted for steam-engines, gasometers, &c., since it will measure a pressure up to 500 lbs. and upwards on the square inch.

The *Sympiesometer* (from *συμπιεσις, compression*, and *μέτρον, measure*), was invented by Adie, of Edinburgh, in 1819, to serve as a barometer, for the purpose of measuring the pressure of the atmosphere, or of exhibiting the variations of its density near the earth. An account of its construction is contained in the first volume of the 'Edinburgh Journal of Science.' It consists of a glass tube B about 18 inches long and seven-hundredths of an inch in diameter internally: at the upper extremity is a cylindrical vessel A, half an inch in diameter internally and two or three inches long; and the lower extremity, being turned upwards, terminates also in a vessel C. The vessel A and the upper part of the tube B are filled with an elastic fluid, such as hydrogen gas, while the vessel C and the lower part of the tube contain almond-oil, coloured with some tincture such as that of anchusa root.

In order to introduce the gas and oil, the extremities *a* and *b* of the vessels A and C being open, and the former extremity being drawn in the form of a slender tube, the instrument is quite filled with mercury; when, being held in a horizontal position with the orifice *b* covered by the finger, that the mercury may not run out, the slender pipe at *a* is put in communication with the gasometer. The hydrogen gas entering at *a*, and the instrument being now brought to a vertical position, on removing the finger from *b* the mercury will flow out till its upper surface is at the same level in the tube B and the vessel C, the gas occupying its place in the former. The extremity *a* is then hermetically sealed, and, the instrument being inverted, the mercury in C runs out, while that which remains in the tube B prevents the gas from escaping. The instrument being afterwards returned to its former position, the vessel A uppermost, the oil is poured into the vessel C: then, the gas being heated, by its expansion it drives the mercury in B into the vessel C; and, the instrument being now held in an inclined position, the oil is by the pressure of the atmosphere forced into the tube B in proportion as the gas by cooling becomes contracted in volume. The remaining mercury is lastly poured out of the vessel C; and the end *b* being left open, the pressure of the atmosphere on the oil is, the instrument being again put in a vertical position, a counterbalance to the weight of the column of oil in B and to the expansive force of the compressed gas which is in the upper part of the tube and in the vessel A.



In order to form a scale for the sympiesometer, the instrument, together with a good barometer and a thermometer, must be placed in a glass receiver in which, by proper syringes, the air may be rarefied or condensed at pleasure: then, on bringing the air in the receiver successively to such states, with respect to density, that the top of the column of mercury in the barometer may stand at 27, 28, 29, and 30 inches, and marking the points on the tube or frame of the sympiesometer at which the top of the column of oil stood when the air was in those states, the distance between every two of these points being divided into one hundred equal parts, the scale *p q* of the instrument is constructed. The particular graduation at which, on the scale, the top of the column of oil stands at any time should indicate the number of inches and hundredths of an inch at which the top of the column of mercury in a barometer would stand at the same time in the same place.

But the volume of the hydrogen gas changes in consequence of variations in the temperature of the atmosphere; and therefore a correction, depending on the amount of the variation in the volume of gas for given increments of heat, should be applied to the number of the graduation on the scale of the sympiesometer in order to obtain the true height of the mercurial column in a barometer.

But, to avoid the trouble of computing and applying this correction, the scale *p q* of the sympiesometer is made to slide on one side of a scale *r s* which is graduated like that of a thermometer, by communicating different degrees of heat to the vessel A while the pressure of the atmosphere on the upper surface of the oil in C remains the same (suppose that which corresponds to 29½ inches on the scale of a barometer) and observing the points at which the top of the column in B stands: these points on the scale *r s* are numbered so as to express, in degrees, the temperature of the gas; and the scale *p q* being moved till its index (at 29½ inches) coincides with the degree of the scale *r s* corresponding to the temperature of the atmosphere, expressed by the degree of a thermometer *t v* attached to the instrument, the graduation on *p q* corresponding to the top of the column of oil in B expresses the height of a column of mercury in a barometer.

Dr. Robert Gordon, the writer of the article Meteorology in the 'Edinburgh Encyclopædia,' having made a series of observations for the purpose of comparing the indications of the sympiesometer with those of a barometer, found that the former stood higher than the latter by quantities varying between 0·03 inch and 0·017 inch, the temperature varying between 42°·3 and 62°·6 (Fahr.): he found at the same time that, in general, the difference between the indications of the two instruments increased as the temperature and pressure diminished. The excess of the indications given by one instrument over those given by the other may be conceived to have arisen from some inaccuracy in the construction of the sympiesometer: but the variation of the excess is not so easily accounted for; it may, however, be supposed to be caused in part by the expansions of the gas not being exactly proportional to the increments of heat, a circumstance which is assumed in the subdivisions of the scale *r s*, between each of the complete inches, being made equal to one another, and in part from some absorption between the oil and the gas. It is inferred, therefore, that the indications of the sympiesometer cannot always be relied on as accurate measures of the density of the atmosphere; but, since it has been observed that the instrument is frequently affected by changes in that density, which are too small to be perceived on the scale of a barometer; and since it is well known to be less deranged than the latter instrument by the motion of a ship at sea, it follows that, in these respects, it possesses great advantages as a marine barometer in indicating the approach of gales of wind.

M. Pouillet, in the 7th edition of his 'Éléments de Physique,' 1856, gives a description of M. Bunten's sympiesometer. It is formed of an alcohol-thermometer, and an air-tube curved and open at its upper end. The reservoir of the air-tube is in the interior of the cistern of the thermometer, and completely surrounded by alcohol. The lower part of the reservoir and air-tube contains a column of oil of almonds, acted on by atmospheric pressure, so that the temperature of the air is always indicated approximately by the alcohol-thermometer. This temperature remaining constant, if the pressure is increased, the oil will descend in the open branch, and will rise if it be diminished. Similarly, if the pressure be constant, the oil rises or falls in the open branch, according to the temperature.

With respect to the proper hours of the day for observation, these, as Professor Daniell remarks, are indicated by the barometer. "The maximum height of the mercurial column is about 9 A.M., the mean at 12, and the minimum at 3 P.M. If a person have time to make three observations in the day, these are the hours which he should select; if circumstances only allow of his observing twice, 9 A.M and 9 P.M. are the proper periods; if only once, noon is the time. These, fortunately happen to be, probably, the most universally convenient hours that could have been selected. In national observatories it would not be too much to expect that observations at 3 P.M. should be added to the preceding. Even those who merely consult the barometer as a weather-glass, would find it an advantage to attend to these hours; for I have remarked, that by much the safest prognostications from this instrument may be formed from observing when the mercury is inclined to move contrary to its periodical course. If the column rise between 9 A.M. and 3 P.M., it indicates fine weather; if it fall from 3 to 9, rain may be expected." This subject is fully entered into in books on meteorology. We may especially refer to a paper on Meteorology, by Sir John Herschel, in the 'Admiralty Manual of Scientific Enquiry,' and also to a paper in the same work on Atmospheric Waves and Barometric Curves, by W. R. Birt, Esq.

Some interesting barometrical and meteorological observations have recently been made during four balloon ascents, made by Mr. Welsh, under the direction of the Kew Observatory Committee of the British Association, the results of which are published in the 'Philosophical Transactions' for 1853. These ascents were made in the latter part of 1852, and the objects especially aimed at were the determination of the temperature and hygrometric condition of the air at different heights, analysis of the air, and examination of the light reflected from the upper surface of the clouds. The barometer used was of Gay-Lussac's form (No. 14), Regnault's condensing, and Daniell's dew-point hygrometer. When about 3000 or 4000 feet above the upper surface of the clouds, they were examined with a polariscope. The light reflected from the clouds *next* the sun gave no trace of polarisation, while those on the side *from* the sun gave very slight traces, the light of the sky being all the time strongly polarised. The height above the level of the sea attained by the balloon was deduced from the barometric readings by Laplace's formula expressed in English feet and Fahrenheit's degrees:—

$$z = \log\left(\frac{h}{h'}\right) \times 60159\left(1 + \frac{t + t' - 64}{900}\right)\left(1 + 0{\cdot}002837 \cos 2\,\mathrm{L}\right)\left(1 + \frac{z + 52251}{20886900}\right).$$

z = height required; h and h'; t and t' = height of barometer and temperature at lower and upper station, L = latitude.

The observers mounted to more than 13,000, 18,000, 19,000, and in the last ascent to 22,370 feet, by which ascent the temperature fell from 49° to nearly —10°, and the dew-point fell from 37° to 12°. The temperature of the air decreased uniformly on ascending, but not continuously. At a certain height, varying on the different days, the decrease was arrested, and for 2000 or 3000 feet, the temperature decreased but little, or even increased, in ascending. Above this, the diminution again went on at nearly the same rate as in the lower region. This interruption was also accompanied by a sudden fall in the dew-point, or by an actual condensation of vapour. This region is the *region of the clouds*, and the increase of heat appears to arise from the latent heat liberated when aqueous vapour is formed into clouds. Dr. Miller, of King's College, analysed the samples of air collected at the various heights, and found scarcely any sensible variation in its composition with regard to the nitrogen and oxygen, but the samples were too small to allow of a *quantitative* examination for carbonic acid.

The *following rules* are given by Mr. J. H. Belville, of the Royal Observatory, Greenwich, in the third edition of his excellent little 'Manual of the Barometer,' London, 1858. He calls them "Phænomena of the Barometer."

Strong winds in the winter from the west, with a steady high pressure, invariably bring a high temperature and very little rain; with winds from the east, a low temperature and sharp frosts.

If the mercury fall during a high wind from the south-west, south-south-west, or west-south-west, an increasing storm is probable; if the fall be rapid, the wind will be violent, but of short duration; if the fall be slow, the wind will be less violent, but of longer continuance; the disturbing cause is probably the same in each case, but its intensity unequal; nearly all our high winds from the south-west come with a falling barometer.

If the depression of the mercury be sudden and considerable with the wind due west, a violent storm may be expected from the north-west or north, during which the mercury will rise to its former height. If the mercury fall with the wind at north-west or north, a great reduction of temperature will follow; in the winter severe frosts, in the summer cold rains.

A steady and considerable fall of the mercury during an east wind denotes that the wind will soon go round to the south, unless a heavy fall of rain or snow immediately follow; in this case the *upper* clouds usually come up from the south. The deep snow of the severe winter of 1814 was a notable instance.

The lowest depressions occur with the wind at south and south-east, when much rain falls, and frequently, short and severe gales blow from these points. In the winter months, sudden depressions of the mercury with the wind in these quarters are attended with electrical phenomena.

A fall of the mercury with a south wind is invariably followed by rain in greater or less quantities.

A falling barometer with the wind at north, brings the worst weather; in the summer, rain and storm will follow; in the winter and spring, deep snows and severe frosts. This case is of rare occurrence.

A great depression of the mercury during a frosty period brings on a thaw; if the wind be south or south-east, the thaw will continue; if the wind be south-west, the frost will be likely to return with a rising barometer and northerly wind.

In the winter season, a rapid rise of the mercury immediately after a gale from the south-west with rain (the wind going round to north-west or north) is usually attended with clear sky and sharp white frosts.

Great depressions in the summer months are attended with storms of wind and rain with thunder and hail; cold unseasonable weather generally succeeds these depressions.

During a period of broken cold weather in the winter months with the wind at north or north-north-west, a sudden rise of the mercury denotes the approach of rain and a southerly wind; thaws also commonly set in during the night.

During a steady frost with the wind at north, north-east, or east, a continued slow rising of the mercury indicates snow and cloudy weather.

If the mercury rise with the wind at south-west, south, or even south-east, the temperature is generally high.

Observation does not show that *extremes of temperature* are contemporaneous with the greatest elevations and least depression of the mercurial column.

Meteors are not prevalent during very low pressures; the *aurora borealis* has been noticed at all heights of the barometer. Small flashes of lightning are of frequent occurrence during stormy weather in the winter season when the mercury stands low.

Great elevations in the summer are generally attended with dry warm weather.

Great depressions at all seasons are followed by change of wind and by much rain.

A rising barometer with a southerly wind is usually followed by fine weather. In the summer it is dry and warm; in the winter, dry with moderate frosts. This is of rare occurrence.

When the mercury is very unsteady during calm, rainy weather, it denotes that the air is in an electrical state, and that thunder will follow.

In the summer months, if a depression of two- or three-tenths of the mercury occur in a hot period, it is attended with rain and thunder, and succeeded by a cool atmosphere. Sometimes heavy thunderstorms take place overhead without any fall of the mercury; in this case reduction of temperature does not usually follow.

Rain in some quantity may fall with a high pressure, provided the wind be in any of the northerly points; and when much rain falls with a steady rising barometer and the mercury attains a great elevation, a long period of fine weather usually succeeds.

If, after a storm of wind and rain, the mercury remain steady at the point to which it had fallen, serene weather may follow without a change of wind; but on the rising of the mercury, rain and a change of wind may be expected. During a series of stormy weather the mercury is in constant agitation, falling and rising twice or thrice in the space of twenty-four hours, the wind changing alternately from south to west, and backing again to the south; this alternation of winds continues until the mercury rises to a bold elevation, when it ceases and the weather becomes settled.

Storms of wind, especially when accompanied with much rain, produce the greatest depressions of the mercury. No storm of wind on record has blown without some rain falling, although the time of its falling and its amount have been variable; sometimes the rain has increased with the increasing storm and sinking mercury; at other times the rain has fallen suddenly at the close of the storm, or at the time of the *minimum* pressure.

No great storm ever sets in with a steady rising barometer.

As far as regards the locality of Greenwich, the most violent gusts of wind come from due south, and those next in violence from due north; in both instances, the mercury is stationary at its *minimum* point during the greatest *horizontal pressure*; the winds from these quarters are of short duration, and limited in their extent. The ordinary south-west gales will blow unremittingly for twenty-four hours, and will sweep over the whole of the British Isles.

Note.—Although a rising mercury attends a northerly wind, great depressions occur previously to a great storm coming from that quarter.

In England, the winds which blow for the greatest number of days together without intermission, are the west and west-south-west: they blow chiefly during the winter months, and are the principal cause of our mild winters.

The east, and east-north-east, are the winds the next most prevalent. The great antagonist winds, the north and south, are the origin of our most violent storms.

The westerly winds surge mostly by night, and their average force is twice that of the easterly winds.

The easterly winds are generally calm at night, but blow with some power during the day.

On an average, sunrise and sunset are the periods of the twenty-four hours in which there is the least wind. An hour or two after noon is the period when the wind is the highest.

As a general rule, when the wind turns against the sun, or *retrogrades* from west to south, it is attended with a falling mercury; when it goes in the *same direction* as the sun, or turns direct from west to north, the mercury rises, and there is a probability of fine weather.

It never hails in calm weather. When hail falls, it is during sudden gusts of wind, and the mercury rises while the hail is actually falling.

If the weather during harvest time has been generally fine, and a fall of the mercury with a shower occur—if the wind turn a few points to the north, and the barometer rises above 30 inches,—the weather may be expected to be fair for some days.

The finest and most beneficial state of the atmosphere, more especially as regards the health of man, is with a uniform pressure at a mean height of the climate varying from 29·80 to 30·00.

When there is only one current of air subsisting in the atmosphere, there is seldom much variation in the height of the mercurial column. It is when two or more *strata* of the air are in motion in different directions at the same time, that great fluctuations of the mercury occur.

In high pressures, the *upper* current usually sets from the northward; in low pressures it sets from the south and south-west.

The variations of the barometer are always greater in the winter than in the summer.

In accounting for the different currents of the atmosphere, it must be remarked that the great heat of the torrid zone causes a constant ascent of air over it, which passes northward and southward; while an under current of cold air flows from the poles to supply its place; the diurnal rotation of the earth, combined with these currents, causes the trade-winds, whose direction is from east to west: these currents would from the same causes become in the north temperate zone south-east and north-west winds; but the great irregularities of the temperature from the seasons, the large tracts of ocean, and the different geographical formations of the land, subject them to interruptions, and give to every country its prevailing winds, derived from local causes. In England the south-south-west, south-west, and west-south-west winds set in towards the end of October, and blow with their greatest strength during November, December, and February, and are even powerful in June and July; the winds from the westerly quarters prevail in March, but they then veer more towards the north, whence they blow with greater violence; in April, the east and north-east, and the west and north-west winds balance each other, and their comparative strength is nearly equal; in May, the east, north-east, and north-north-east winds preponderate; the latter blows the less frequently, but with the greatest violence; in that month the average of the winds from the westerly quarters ranges low; their average strength also decreases, with the exception of that from the west-south-west, which ranges higher than in April. In August, the west and west-south-west winds prevail, but their power is moderate; the stormy winds of this month blow from the west-south-west and north-north-west. September is the calmest period of the year; in the month the north and south winds, and the east and west winds, balance each other; in January, the east and west winds upon an average are nearly equal, both as regards the number of times they blow, and their average strength; the winds from the south-south-west, west-south-west, and the north-westerly quarters are more rare, but they blow with great violence. As the winds from these opposite quarters predominate, so is the character of our winters determined as to mildness or severity.

Sudden depressions of the barometer sometimes occur in weather apparently calm. It is almost an established fact that storms have a circular motion; and if, when an exhaustion or sudden diminution of the atmosphere takes place, the mercurial column happen to be in the partial vacuum or centre of motion, the air will be at rest; while the surrounding air at a greater distance from the centre will be violently agitated with a less fall of the barometer. This circular motion of the atmosphere is not confined to one spot where the storm may commence and expend its violence, but it has a progressive cycloidal movement onwards, changing constantly the situation of its centre of motion, and, as it advances, enlarging its circumference, until, having traversed many hundred miles, it becomes exhausted, as the air recovers its equilibrium. These great rarefactions of the atmosphere are probably the effects of electricity; they are common in their most terrific form in the Indian Ocean, on the western coast of Africa, and in the West Indies.

In our own climate the approach of thunder-clouds produces violent squalls of wind; and dense and highly electrified clouds will sometimes raise miniature whirlwinds as they pass overhead.

BARON, BARONY. Sir Henry Spelman (*Glossarium*, 1626, in voce *Baro*) regards the word *baron* as a corruption of the Latin *vir*: but it is a distict Latin word, used by Cicero, for instance, and the supposition of corruption is therefore unnecessary. The Spanish word *varon*, and the Portuguese *barão*, are slightly varied forms. The radical parts of *vir* and *baro* are probably the same, *b* and *v* being convertible letters, as we observe in the forms of various words. The word *barones* (also written *berones*) first occurs, as far as we know, in the book entitled 'De Bello Alexandrino' (cap. 53), where barones are mentioned among the guards of Cassius Longinus in Spain; and the word may possibly be of native Spanish or Gallic origin. The Roman writers, Cicero and Persius, use the word *baro* in a disparaging sense; but this may not have been the primary signification of the word, which might simply mean *man*.

But the word had acquired a restricted sense before its introduction into England, and probably it would not be easy to find any use of it in English affairs, in which it denoted the whole male population, but rather some particular class, and that an eminent class.

Of these by far the most important is the class of persons who held lands of a superior by military and other honourable services, and who were bound to attendance in the courts of that superior to do homage, and to assist in the various business transacted there. The proper designation of these persons was the Barons. A few instances selected from many will be sufficient to prove this point. Spelman quotes from the 'Book of Ramsey' a writ of King Henry I., in which he speaks of the barons of the honour of Ramsey. In the earliest of the Pipe Rolls in the Exchequer, which belongs to the thirty-first year of King Henry I., there is mention of the barons of Blithe, meaning the great tenants of the lord of that honour, now called the honour of Tickhill. Selden ('Titles of Honour,' 4to. edit., p. 275) quotes a charter of William, Earl of Gloucester, in the time of Henry II., which is addressed "Dapifero suo et omnibus baronibus suis et hominibus Francis et Anglis," meaning the persons who held lands of him. The court itself in which these tenants had to perform their services is called to this day the Court-Baron, more correctly the Court of the Barons, the Curia Baronum.

What these barons were to the earls, and other eminent persons whose lands they held, that the earls and those eminent persons were to the king: that is, as the earls and bishops, and other great landowners, to use a modern expression, had beneath them a number of persons holding portions of their lands for certain services to be rendered in the field or in the court, so the lands which those earls and great people possessed were held by them of the king, to whom they had in return certain services to perform of precisely the same kind with those which they exacted from their tenants; and as those enants were barons to them, so were they barons to the king. But, inasmuch as these persons were, both in property and in dignity, superior to the persons who were but barons to them, the term became almost exclusively, in common language, applied to them; and when we read of the barons in the early history of the Norman kings of England, we are to understand the persons who held lands immediately of the king, and had certain services to perform in return.

Few things are of more importance to those who would understand the early history and institutions of England, than to obtain a clear idea of what is meant by the word baron, as it appears in the writers on the affairs of the first two centuries and a half after the Conquest. They were *the tenants in chief of the crown*. But to make this more intelligible, we may observe that, after the Conquest, there was an actual and fictitious assumption of absolute property in the whole territory of England by the king. The few exceptions in peculiar circumstances need not here be noticed. The king, thus in possession, granted out the greatest portion of the soil within a few years after the death of Harold and his own establishment on the throne. The persons to whom he made these grants were, 1. The great ecclesiastics, the prelates, and the heads of the monastic institutions, whom probably, in most instances, he only allowed to retain, under a different species of tenure, what had been settled upon them by Saxon piety; 2. A few Saxons, or native Englishmen, who, in a few rare instances, were allowed to possess lands under the new Norman master; 3. Foreigners, chiefly Normans, persons who had accompanied the king in his expedition and assisted him in obtaining the throne: these were by far the most numerous class of the Conqueror's beneficiaries. Before the fourteenth or fifteenth year of his reign the distribution of the lands of England had been carried nearly to the full extent to which it was designed to carry it: for the king meant to retain in his own hands considerable tracts of land, either to form chaces or parks for field-sports, to yield to him a certain annual revenue in money, to be as farms for the provision of his own household, or to be a reserve-fund, out of which hereafter to reward services which might be rendered to him. These lands formed the demesne of the crown, and are what are now meant when we speak of the ancient demesne of the crown.

When this was done, a survey was taken of the whole: first of the demesne lands of the king; and next of the lands which had been granted out to the ecclesiastical corporations, or to the private persons who had received portions of land by the gift of the king. At the same time, the commissioners, to whom the making of this survey was entrusted, were instructed to inquire into the privileges of cities and boroughs, a subject with which we have not at present any concern. The result of this survey was entered of record in the book which has since obtained the name of 'Domesday Book,' the most august as well as the most ancient record of the realm, and for the early date, the extent, variety, and importance of the information which it contains, unrivalled, it is believed, by any record of any other nation. We see there *who* the people were to whom the king had granted out his lands, and at the same time *what* lands each of those people held. It presents us with a view, which is nearly complete, of the persons who in the first twenty years after the Conquest formed the barons of England, and of the lands which they held; the progenitors of those who, in subsequent times, wrested from the crown the different charters of liberties, and confined the kingly authority of England within narrower limits than those which circumscribed the regal power in most of the other states of Europe.

The Indexes which have been prepared to 'Domesday Book,' present us with the names of about 400 persons who held lands immediately of the king. Some of these were exceedingly small tenures, and merged at an early period in greater, or, through forfeitures or other circumstances, were resumed by the crown. On the other hand, 'Domesday Book' does not present us with a complete account of the whole tenancies in chief because—1. The four northern counties are, for some reason not at present understood, omitted in the survey; and 2. There was a creation of new tenancies going on after the date of the survey, by the grants of the Conqueror or his sons of portions of the reserved demesne. The frequent rebellions, and the unsettled state in which the public affairs of England were in the first century after the Conquest, occasioned many resumptions and great fluctuations, so that it is not possible to fix upon any particular period, and to say what was precisely the number of tenancies in chief held by private persons; but the number, before they were broken up when they had to be divided among co-heiresses, may be taken, perhaps, on a rude computation, at about 350. In this the ecclesiastical persons who held lands in chief are not included.

When we speak of the king having *given* or *granted* these lands to the persons who held them, we are not to understand it as an absolute gift for which nothing was expected in return. In proportion to the extent and value of the lands given services were to be rendered, or money paid, not in the form of an annual rent, but as casual payments, which the king had a right, under certain circumstances, to demand. The services were of two kinds: first, military service, that is, every one of those tenants (*tenants* from *teneo*, to hold) was bound to give personal service to the king in his wars, and to bring with him to the royal army a certain quota of men, corresponding in number to the extent and value of his lands; and, secondly, civil services, which were of various kinds, sometimes to perform certain offices in the king's household, to execute certain duties on the day of his coronation, to keep a certain number of horses, hounds, or hawks for the king's use, and the like. But, besides these honourable services, they were bound to personal attendance in the king's court when the king should please to summon them, to do homage to him (*homage* from *homo*, to acknowledge themselves to be his *homines*, or *barones*), and to assist in the administration of justice, and in the transaction of other business which was done in the court of the king.

We see in this the rude beginnings of the modern Parliaments, assemblies in which the barons are so important a constituent. But before we enter on that part of the subject, it is proper to observe, that among the great tenants of the crown there was much diversity both of rank and property. We shall pass over the bishops and other ecclesiastics, only observing, that when it is said that the bishops have seats in Parliament in virtue of the baronies attached to their sees, the meaning of the expression is, that they sit there as other lay homagers or barons of the king, as being among the persons who held lands of the crown by the services above mentioned; which is correct as far as Parliament is regarded as a court for the administration of justice, but doubtful so far as it is an assembly of wise men to advise the king in matters touching the affairs of the realm. Amongst the other tenants, we find some to whose names the word *vicecomes* is annexed. On this little has been said by the writers on English dignities; and the title *viscount* can scarcely have been used in 'Domesday' as an hereditary title, but more probably as a title of office answering to the present *sheriff*. There is indeed no reason to believe that this title was an hereditary dignity in this country before the reign of Henry VI. The office of sheriff in some counties was hereditary, but it was not a title of nobility. Some we find in 'Domesday' who have indisputably a title, in the proper sense of the word, annexed to their names, and which we know to have descended to their posterity. These are the *comites* of 'Domesday Book,' where, by the Latin word *comes*, they have represented the *earl* of the Saxon times; and as these persons were raised above the other tenants in dignity, so were they, for the most part, distinguished by the greater extent of the lands held by them. Among those to whose names no mark of distinction is annexed, there was also great diversity in respect of the extent of territory granted to them. Some had lands far exceeding the extent of entire counties, while others had but a single parish or township, or, in the language introduced at the Conquest, but a single manor, or two adjacent manors, granted to them.

All these persons, the earls included, were the barons, or formed the baronage, of England. Whether the tenancy were large or small, they were all equally bound to render their service in his court when the king called upon them. The diversity of the extent of the tenure affords a plausible discriminatory circumstance between two classes of persons who appear in early documents—the greater and the lesser barons; but a better explanation of this distinction may be given. In the larger tenancies, the persons who held them granted out portions to be held of them by other parties upon the same terms on which they held of the king. As they had to furnish a quota of men when the king called upon them, so they required their tenants to furnish men equipped for military service proportionate to the extent of the lands which they held, when the king called upon them. As they had to perform civil services of various kinds for the king, so they appointed certain services of the same kind to be performed by their tenants to themselves. As they had to do homage from time to time to the king, and to attend in his court for the administration of justice and for other business touching the common interest, so they required the presence of their tenants to acknowledge their subjection and to assist in the administration of that portion of public justice which the sovereign power allowed the great tenants to administer. The castles, the ruins of which exist in so many parts of the country, were the seats of these great tenants, where they held their courts, received the homage, and administered justice, and were to the surrounding homagers what Westminster Hall, a part of the court of the early kings of England, was to the tenantry in chief. The Earl of Chester is said to have thus subinfeudated to only eight persons the vast extent of territory which the Conqueror granted to him. These vassals had accordingly each very large tracts, and they formed, with four superiors of religious houses, the court, or, as it is sometimes called, the Parliament of the earls of Chester, and are frequently called the barons of that earldom. These persons were for the most part persons of Norman origin, the personal attendants, it may be presumed, of the great tenant. There is no authentic register of them, as there is of the tenants in chief; but the names of many of them may be collected from the charters of their chief lords, to which they were in most instances the witnesses. These, it is thought, constitute the class of persons who are meant by the lesser barons, when that term is used by writers who aim at precision.

Whether these tenants, or vassals of the crown vassals, had right of seat and vote in the great council of the king, is another and a difficult question. The proceedings of the Council of Northampton, in 1164, as stated by Fitz Stephen, lend some colour to the notion of two classes of barons being there present. But it may be doubted whether such a distinction as that here hinted at can justify the expressions "barones majores" and "barones minores," for unless all tenants in capite by knight's service are to be deemed "barones," there is little, if any authority in ancient documents for assuming the existence of the "barones minores" as a recognised class in the councils of the realm.

Many of what we have called (following popular usage) the lesser barons, or barons of the barons, became the progenitors of families of pre-eminent rank and consequence in the country. For instance, the posterity of Nigellus, the baron of Halton, one of the eight of the county of Chester, through the unexpected extinction of the male posterity of Ilbert de Laci, one of the greatest of the tenants in chief beneath the dignity of an earl, and whose castle of Pontefract, though in ruins, still shows the rank and importance of its early owners, became possessed of the great tenancy of the Lacis, assumed that name as the hereditary distinction, married an heiress of the earls of Lincoln, and so acquired that earldom; and when at length they ended in a female heiress, she was married to Thomas, son of Edmund, earl of Lancaster, son of King Henry III. The ranks indeed of the tenants in chief, or greater barons, were replenished from the class of the lesser barons; as in the course of nature cases arose in which there was only female issue to inherit. But even their own tenancies were sometimes so extensive, that they were enabled to exhibit a miniature representation of the state and court of their chief: they granted lands to be held of themselves; had their tenants doing suit and service; and, in point of fact, many of the smaller manors at the present day are but tenures under the lesser barons, who held of the greater barons, who held of the king. The process of subinfeudation was checked by a wise statute of King Edward I., who introduced many salutary reforms, passed in the 18th year of his reign, commonly called the statute *Quia Emptores, &c.*, which directed that all persons thus taking lands should hold them, not of the person who granted them, but of the superior, of whom the granter himself held.

The precise amount and precise nature of the services which the king had a right to require from his barons in his court, is a point on which there seems not to be very accurate notions in some of the writers who have treated on this subject; and a similar want of precision is discernible in the attempt at explaining how to the great court baron of the king were attracted the functions which belonged to the deliberative assembly of the Saxon kings, and the *Commune Concilium* of the realm, the existence of which is recognised in charters of some of the earliest Norman sovereigns. The fact however seems to be admitted by all who have attended to this subject, that the same persons who were bound to suit and service in the king's court constituted those assemblies which are called by the name of Parliaments, so frequently mentioned by all our early chroniclers, in which there were deliberations on affairs touching the common interest, and where the power was vested of imposing levies of money to be applied to the public service. It is a subject of great regret to all who wish to see through what processes and changes the great institutions of the country have become what we now see them, that the number of public records which have descended to us from the first hundred and fifty years after the Conquest is so exceedingly small, and that those which remain afford so little information respecting this most interesting point of inquiry.

There is however no reasonable doubt, that the Parliament of the early Norman kings did consist originally of the persons who were bound to service in the king's court by the tenure of their lands. But when we come to the reign of King Edward I., and obtain some precise information respecting the individuals who sat in Parliament, we do not find that they were the whole body of the then existing tenantry in chief, but rather a selection from that body, and that there were among those who came by the king's summons, and not by the election and deputation of the people, some who did not hold tenancies in chief at all. To account for this, it has been the generally received opinion, that the increase of the number of the tenants in chief (for when a fee fell among co-heiresses it increased the number of such tenants) rendered it inconvenient to admit the whole, and especially those whose tenancies were sometimes only the fraction of the fraction of the fee originally granted; and that the barons and the king, through a sense of mutual convenience, agreed to dispense with the attendance of some of the smaller tenants. Others have referred the change to the latter years of the reign of King Henry III.; when the king, having broken the strength of the barons at the battle of Evesham, established a principle of selection, summoning only those among the barons whom he found most devoted to his interest. It is matter of just surprise, that points of such importance as these in the constitutional history of the country should be left to conjecture; and especially, as from time to time claims are presented to Parliament by persons who assert a right to sit there as being barons by tenure,—that is, persons who hold lands immediately of the king, and whose ancestors, it is alleged, sat by virtue of such tenure. The committee of the House of Lords, which sat during several sessions of Parliament to collect from chronicle, record, and journal everything which could be found touching the dignity of a peer of the realm, made a very voluminous and very instructive report in 1819. This has been followed by reports on the same subject by other committees. They all confess that great obscurity rests upon the original constitution of Parliament, and suppose the probability that there may still be found among the unexamined records of the realm something which may clear away at least a portion of the obscurity which rests upon it. To us it appears that the principle of selection above alluded to, which probably was admitted from the very earliest period, and from the time of Edward I. was adopted as a part of the constitutional system, is the only theory upon which the existence of an hereditary nobility, such as that presented by the House of Lords, can be explained. The right of barons by tenure to sit in the House may be justified on the assumption that upon the first institution of Parliament, as now constituted, the selection made by the king was exercised purely and solely on the ground of tenure of some particular castle or barony, whilst in other cases it was merely personal and irrespective of tenure.

We are now arrived at a time when the word *baron* acquired a sense still more restricted than that which has hitherto belonged to it. Later than the reign of Edward II. we seldom find the word *baron* used in the chronicles to designate the whole of that formidable body who were next in dignity to the king himself, who formed his army and his legislative assembly, and who forced the monarch to yield points of liberty either to themselves as a class, or to the whole community of Englishmen. The counts or earls, from this time, stand out more prominently as a distinct order. There were next introduced into that assembly persons under the denomination of dukes, marquesses, and viscounts; to all of whom was given a precedence before those barons who had not any dignity, strictly so called, annexed to the service which they had to render in Parliament. The baron became the lowest denomination in the assembly of peers, possessing the same rights of discussing and voting with any other member of the house, but remaining destitute of those honorary titles and distinctions the possession of which entitled others to step before him. The term also ceased to be applied to those persons who, possessing a tenancy in chief, were not yet summoned by the king to attend the Parliament; and the right or duty of attendance, from the time of King Edward I., has been founded, not, as anciently, upon the tenure, but on the writ which the king issued commanding their attendance.

Out of this has arisen the expression *barons by writ*. The king issued his writ to certain persons to attend in Parliament, and the production of that writ constituted their right to sit and vote there. Copies of these writs were taken, and are entered on what is called the close roll at the Tower. The earliest are in the latter part of the reign of King Henry III., in the forty-ninth of his reign, when the king was a prisoner in the hands of Simon de Montfort, who did what he pleased in the king's name. There are many such writs existing in the copies taken of them, of the reign of Edward I., and all subsequent kings, down to the present time. They are addressed to the archbishops and bishops, the prior of Saint John of Jerusalem, many abbots and priors, the earls and peers of the higher dignities as they were introduced into the peerage, and to a number of persons by their names only; as William de Vescy, Henry de Cobham, Ralph Fitzwilliam, William la Zouch, and the like; portions of the baronage whom the king chose to call to his councils. Upon this the question arises, whether when a person who was a baron by tenure received the king's writ to repair to the Parliament, the receipt of the writ, and obedience to it, created in him a dignity as a lord of Parliament which adhered to him during his life, and was transmitted to his heir. Upon this question the received opinion undoubtedly has been, that a heritable dignity was created; that once a baron, by sitting under authority of the king's writ, always a baron; and that the barony would endure as long as there were heirs of the body of the person to whom the king's writ had issued. Upon this, the received opinion, there have been many adjudications of claims to dignities, and yet the Lords' committee on this subject express very strong doubts respecting the doctrine, and contend that there are persons to whom the king's writ issued, and who took their seat accordingly, to whose heirs similar writs never went forth, though there was no bar from nonage, fatuity, or attainder. On the other hand, there is the strong fact, that we do find, by the writs of summons, that they were addressed to the several members of many of the great families of England, as they rose in successive generations to be the heads of their houses: that, when it happened that a female heiress occurred, her issue was not unfrequently set in the place in Parliament which her ancestors had occupied; and that when the new mode arose in the time of Richard II., of creating barons by patent, in which a right was acknowledged in the posterity of the person so created, the ancient barons who had sat by virtue of the king's writ to them and their ancestors did not apply for any ratification of their dignity by patent, which they would have done had they not conceived that it was a heritable dignity, as secure as that granted by the king's patent.

The doubt of the Lords' committee, however, shows that this is one of the many points touching the baron on which there is room for question. The practice, however, has been hitherto to admit that proof of the issuing of the writ, and of obedience to it, by taking a seat in Parliament, or what is technically called proof of sitting, entitles the person who is heir of the body of a person so summoned to take his seat in Parliament in the place which his ancestor occupied.

In interpreting the phrase *heir of the body*, the analogy of the descent of corporeal hereditaments in the feudal times is followed. That is, if a person die seised of the dignity of baron, and leave a brother and an only child, a daughter, the daughter shall inherit in preference to the brother, though the dignity has been transmitted from some person who is ancestor to them both. This fact clearly shows how close a connection there is between the dignity and the lands, the descent of both being regulated by the same principle. The consequence of this principle is, that through a portion of the baronage there has been an introduction of new families into the peerage without the sanction of the crown; for the heiress of one of these baronies may now bestow herself in marriage at her pleasure; and though it is not held that the husband can claim the benefit of the tenancy by courtesy principle (though doubts have been entertained on this point), yet, the issue of the husband may undoubtedly, whoever he may be, take his place in Parliament in the seat which his mother would have occupied had she been a male. Practically, the effect of this upon the composition of the House of Peers has been very small indeed.

The case of co-heiresses demands a distinct notice, because it will lead to the explanation of a phrase which is often used by persons who seem not to have very distinct notions concerning what is implied by it. Lands may be divided, but a dignity is by its very nature indivisible. Thus, if the representative of one of the ancient barons of Parliament die, leaving four daughters and no son, his lands may be divided in equal portions among them, and would be so divided according to the principle of the feudal system. But the dignity could not be divided; and as the principle of that system was against any distinction among co-heiresses (reserving the occurrence in the course of nature of persons dying leaving no son but several daughters, to be the means of preventing the too great accumulation of lands in the same person, and of breaking up from time to time the great tenancies), it made no provision that either the *caput baroniæ*, or a dignity that was indivisible, should descend to the eldest, or any daughter in preference to her sisters. It therefore fell into *abeyance*. [ABEYANCE.] It was not extinguished or destroyed, but it lay in a sort of silent partition among the sisters; and in this dormant, but not dead state, it lay among the posterity of the sisters. But if three of the four died without leaving issue, or if after a few generations the issue of three of them became utterly extinct, the barony would then revive, and the surviving sister, if alive, or the next heir of her body, would become entitled to the dignity, and might, on proof of the necessary facts, claim a writ of summons as if there had been no suspension. Again, it is a part of the royal prerogative to *determine an abeyance*; that is, the king may select one of the daughters, and give to her the place, state, and precedency which belonged to her father; and then the barony will descend to the several heirs in succession of her body, as entire as if there had never been any state of abeyance. But this does not interfere with the rights of the other co-heirs, who, and whose posterity, remain in precisely the same position in which they stood before the king determined the abeyance in favour of a particular branch. In this way the barony of Clifford, which has several times fallen into abeyance, was, in our own time, given to a co-heir. The same was the case with the baronies of Ross and Berners, and indeed it is in a great measure to the exercise of this prerogative of the crown that we owe the presence in the House of Peers of barons who take their seats at the head of the bench, and date their sittings from the 14th and 13th centuries.

The principle of the feudal law, which was favourable to the claims of females, was fraught with ruin to noble houses. The great family which springs from Hugh Capet, and a few other great families of the Continent, have had the address to escape from the operation of the principle by availing themselves of what is called the Salic law; and to this is owing that they still hold the rank in which we now see them, a thousand years after they first became illustrious. This must have been early perceived in England, and it was probably this consideration which led to the introduction of a class of barons, the descent of whose dignity should not be regulated by the principle of the feudal descent of hereditaments, but should be united inseparably with the male line of persons issuing from the stock of the original grantee. This innovation is believed to have first taken place in the reign of King Richard II., who in his eleventh year created John Beauchamp of Holt a baron, not merely by writ of summons to Parliament, but by a patent, in which it was declared that he was advanced to the state, style, and dignity of a baron, and that the same state, style, and dignity should descend to the *male heirs* of his body. Thus and at this time the class of *barons by patent* arose. The precedent thus set was, with very few exceptions, followed in the subsequent reigns; and by far the great majority of persons who now occupy the barons' bench in Parliament are the male representatives of persons on whom the dignity has been conferred, accompanied by a patent, which directs the course of its descent to be in the male heirs for the time being of the original grantee. Should it ever happen that they are exhausted, the dignity becomes extinct.

It has been reserved for our own times to settle one other very important question with respect to the baronage, namely, whether the grant of the dignity of baron *for life* only, entitles the holder to sit in the House of Peers. This was determined in the negative, in the case of Lord Wensleydale, in the session of 1855-56. It would be equally out of place here either to state the arguments in support of, or in opposition to, the view taken by the House of Lords in this case, or to express the general opinion of lawyers on the subject. The result of the decision has been to call attention to the mode of acquiring, and to the disabilities consequent on attaining, the peerage, and to raise much discussion as to the expediency of having some recognised life-peerages, similar in their nature, though different in their object, to the life baronies of the bishops. It is unnecessary to enter into any examination of the privileges of the barons, which in no respect differ from those of the other component parts of the House of Peers. [PEERS OF THE REALM.]

The principal writers upon the subject of this article are, John Selden, in his work entitled 'Titles of Honour,' first published in 1614; Sir Henry Spelman, in his work entitled 'Archæologus, in modum Glossarii,' folio, 1626; Sir William Dugdale, in his 'Baronage of England,' 3 volumes folio, 1675 and 1676; and in his 'Perfect Copy of all Summonses of the Nobility to the Great Councils and Parliament of this Realm, from the 49th of Henry III., until these present times,' folio, 1685; 'Proceedings, Precedents, and Arguments on Claims and Controversies concerning Baronies by Writ, and other Honours,' by Arthur Collins, Esq., folio, 1734; 'A Treatise on the Origin and Nature of Dignities or Titles of Honour,' by William Cruise, 8vo., 2nd edit., 1823; 'Report on the Proceedings on the Claim to the Barony of Lisle, in the House of Lords,' by Sir N. H. Nicolas, 8vo., 1829. But the most complete, though not always correct, information on this subject is contained in the printed 'Report from the Lords' Committees, appointed to search the Journals of the House, and Rolls of Parliament, and other Records and Documents, for all matters touching the Dignity of a Peer of the Realm.'

The word *Barony* is used in the preceding article only in its sense of a dignity inherent in a person: but the ancient law-writers speak of persons holding lands by *barony*, which means by the service of attending the king in his courts as barons. The research of the Lords' Committees has not enabled them to trace out any specific distinction between what is called a tenure by barony and a tenure by military and other services incident to a tenancy in chief. The Hiltons in the North, who held by barony, have been frequently called the Barons of Hilton; but whether in virtue of their territorial barony, or of their summons to Parliament, it is difficult to say. They received writs of summons to Parliament, and sittings can be shown in more than one instance under such writs. A peerage of Parliament has therefore been created, descendible to the heir general of the body of the person first summoned, namely, Robert de Hilton, temp. Edw. I., and is now in abeyance between the co-heirs of the Baron of Hilton who sat last in Parliament. Burford, in Shropshire, is also called a barony, and its former lords, the Cornwalls, who were an illegitimate branch of the royal house of England, were called, in instruments of authority, Barons of Burford, but they never had a summons to Parliament, nor privilege of peerage. *Barony* is also sometimes, but rarely, used in England for the lands which form the tenancy of a baron, and especially when the baron has any kind of territorial addition to his name taken from the place, and is not summoned merely by his christian and surname. This seems, however, to be done rather in common parlance than as if it were one of the established local designations of the country. The *head of a barony* (*caput baroniæ*) is, however, an acknowledged and well-defined term. It designates the castle or chief house of the baron, the place in which his courts were held, where the services of his tenants were rendered, and where, in fact, he resided. The castles of England were heads of baronies, and there was this peculiarity respecting them,—that they could not be put in dower, and that if it happened that the lands were to be partitioned among co-heiresses, the head of the barony was not to be dismembered, but to pass entire to some one of the sisters.

Barony is used in Ireland for a subdivision of the counties, equivalent to what is meant by hundred or wapentake in England.

It remains to notice a few peculiar uses of the word baron:—

1. The chief citizens of London, York, and of some other places in which the citizens possess peculiar franchises, are called in early charters not unfrequently by the name of '*the barons*' of the place. This may arise either from the circumstance of the persons only being intended who were the chief men of the place; or that they were, in fact, barons, homagers of the king, bound to certain suit and service to the king, as it is known the citizens of London were and still are.

2. The *Barons of the Cinque Ports* are so called, probably for the same reason that the citizens of London and of other privileged places are so called. The Cinque Ports, which were Hastings, Dover, Hythe, Romney, and Sandwich (to which afterwards Rye and Winchelsea were added), being ports opposite to France, were regarded by the early kings as places of great importance, and were consequently put under a peculiar governance, and endowed with peculiar privileges. The freemen of these ports were barons of the king, and they had the service imposed upon them of bearing the canopy over the head of the king on the day of his coronation. Here was the feudal service which marked them as persons falling within the limits of the king's barons. Those sent of themselves to Parliament, though sitting in the lower house, might be expected to retain their appellation of barons.

3. Those persons who held lands in the island of Bute, in Scotland, directly of the Marquis of Bute, the crown vassal, have long been called Barons of Bute; a designation analogous probably in its origin to the Barons of Chester.

4. The *Barons of the Exchequer*. The judges in that court are so called, one of them being the *Chief Baron*. The court was instituted immediately after the Conquest, and it is probable that the judges were so denominated from the beginning. They are called barons in the earliest Exchequer record, namely, the Pipe Roll of 31 Henry I. [EXCHEQUER.]

BA'RONAGE. This term is used, not so much to describe the collective body of the barons in the restricted sense which now belongs to the word, as signifying a component part of the hereditary nobility of England, but the whole of that nobility taken collectively, without regard to the distinction of dukes, marquesses, earls, viscounts, and barons, all of whom form what is now sometimes called the baronage.

In this sense the term is used in the title of one of the most important works in the whole range of English historical literature, for the sake of giving a short notice of which, we have introduced an article under this word. We allude to 'The Baronage of England,' by Sir William Dugdale, who was the Norroy King at Arms, and one of the last survivors of those eminent antiquarian scholars who, in the 17th century, raised so high the reputation of England for that particular species of learning.

Sir William Dugdale was the author of many other works, but his history of the baronage of England is the one to which reference is more frequently made; and there is this peculiarity belonging to his labours, that the Baronage is quoted by all subsequent writers as a book of the highest authority; and it has, in fact, proved a great reservoir of information concerning the families who, from the beginning, have formed the baronage of England, from which all later writers have drawn freely.

The first volume was published in 1675; the second and third, which form together a volume not so large as the first, in 1676. The work professes to contain an account of all the families who had been at any period barons by tenure, barons by writ of summons, or barons by patent, together with all other families who had enjoyed titles of higher dignity, beginning with the earl of the Saxon times.

It was an undertaking of infinite labour, but Dugdale was an indefatigable man. Nothing like it had before appeared. Accounts of the higher orders of the English nobility had been given before his time in the works of Milles, Brooke, and Vincent, but these accounts are excessively meagre, scarcely, in any instance, going beyond the statement of genealogical particulars, or the most prominent facts in the lives of the persons who had held those dignities. But Sir William Dugdale has collected from the chronicles, from the chartularies of religious houses, with which he became acquainted while preparing his great work on the history of the monasteries, from the rolls of Parliament, in his time only to be perused in manuscript, and from the public records, which he could consult only in the public repositories, or in the extracts made from them by his fellow-labourers in historical research, and finally from the wills in the various ecclesiastical offices throughout the kingdom, the particulars of the lives of the most eminent men of our nation. Without pretending to the graces of language, and with the introduction of less of political or moral reflection than perhaps might be desired, he has produced a work which is not only rich beyond precedent in the most authentic information, but which is read with interest and pleasure by all persons who have any tincture of the spirit of historical inquiry. But while he has thus clothed and almost animated the dry figures of the earlier writers on the higher nobility of the realm, the accounts which he has given of the persons who form the lower class, the barons, in the stricter sense, whether by tenure, writ, or patent, are entirely his own. Nothing before his time had been done to collect their names, to show their origin, or to display their illustrious achievements. This part of his work, that is, by far the larger portion of it, is pre-eminently his own; and the best tribute to its excellence is the fact to which we have alluded above, that his accounts of these illustrious persons are considered, by all subsequent writers, as genuine and authentic as if he stood in the position of a contemporary chronicler, and that so few persons have since arisen who have shown themselves able to make any addition of much value to the accounts which he has left.

Not the least merit of the work is the careful reference to authorities, which renders it a most valuable book, not only to the student in the family antiquities of the English nation,—not only to those who are delighted to read of the eminent persons of the English nation in the days of chivalry, in the times of the Crusades, and in the wars with France and Scotland,—but to the practical man, who undertakes to prosecute claims to baronies or other dignities, of which there is always one or more before Parliament, and who finds here the reference to the documents which it is necessary to produce in the prosecution of such claims.

This work contains some defects in respect of the general plan, in which we find no sound criterion by which to determine the claims to admission among those who are called barons by tenure. The arrangement also admits of much improvement, and there are occasionally mistakes and misrepresentations in the minuter details. Still nothing has yet superseded it; but he who shall undertake the work of re-modelling, correcting, improving, and continuing it to the present day, will enter on his duty with advantages which his predecessor did not enjoy. Some of the chief authorities on which Dugdale relied have been printed by the Board of Commissioners on the Public Records, and are now easily accessible to the historical inquirer, who formerly was obliged to be content with slight inspections in the offices in which the originals are deposited, or to depend on transcripts which might not always be exact.

One passage in the preface to the Baronage contains a striking truth: "As this historical discourse will afford at a distance some, though but dim, prospect of the magnificence and grandeur wherein the most ancient and noble families of England did heretofore live, so will it briefly manifest how short, uncertain, and transient earthly greatness is; for of no less than two hundred and seventy in number, touching which this first volume doth take notice, there will hardly be found above eight which do to this day continue; and of those not any whose estates, compared with what their ancestors enjoyed, are not a little diminished; nor of that number, I mean two hundred and seventy, above twenty-four who are by any younger male branch descended from them, for aught I can discover."

BARONET, an English name of dignity, which in its etymology imports a Little Baron. But we must not confound it with the lesser baron of the middle ages [BARON], with which the rank of baronet has nothing in common; nor again with the banneret of those ages [BANNERET]; though it does appear that in some printed books, and even in contemporary manuscripts, the state and dignity of a banneret is sometimes called the state and dignity of a baronet, by a mere error, as Selden asserts ('Titles of Honour,' p. 354), of the scribe.

The origin of this rank and order of persons is quite independent of any previous rank or order of English society. It originated with James I., who, being in want of money for the benefit of the province of Ulster in Ireland, hit upon the expedient of creating this new dignity, and required of all who received it the contribution of a sum of money, as much as would support thirty infantry for three years, which was estimated at 1095*l.*, to be expended in settling and improving the province of Ulster.

The principle of this new dignity was to give rank, precedence, and title without privilege. He who was made a baronet still remained a commoner. He acquired no new exemption or right to take his seat in any assembly in which he might not before have been seated. What he did acquire we can best collect from the terms of the patent which the king granted to all who accepted the honour, to them and the heirs male of their bodies for ever: 1. Precedence in all commissions, writs, companies, &c., before all knights, including knights of the bath and bannerets, except such knights banneret as were made in the field, the king being present; 2. Precedence for the wives of the baronet to follow the precedence granted to the husband; 3. Precedence to the daughters and younger sons of the baronet, before the daughters and younger sons of any other person of whom the baronet himself took precedence; 4. The style and addition of *Baronet* to be written at the end of his name with the prefix of *Sir*; 5. The wife of the baronet to be styled *Lady*, *Madam*, or *Dame*. It was stipulated on the part of the king, that the number of baronets should never exceed two hundred; and that, when the number was diminished by the natural process of extinction of families, there should be no new creations to supply the places of those extinct, but that the number should go on decreasing. Several baronets are nevertheless created every year. Further, the king bound himself not to create any new order which should lie between the baron and the baronet.

Another distinction was soon after granted to them. A question arose respecting precedency between the newly created baronets and the younger sons of viscounts and barons, which the king disposed of by his own authority, in favour of the latter; and in the same instrument in which he declared the royal pleasure in this point, he directed that the baronets might bear, either on a canton or in an escutcheon on their shield of arms, the arms of Ulster, which, symbolical it seems of the lawless character of the inhabitants of that province, as is set forth in the preamble of the baronet's patent, was a bloody hand, or in the language of heraldry, a hand gules in a field argent. And further, the king "to ampliate his favour, this dignity being of his majesty's own creation, and the work of his hands," did grant that every baronet, when he had attained the age of twenty-one years, might claim from the king the honour of knighthood (a privilege entirely obsolete); that in armies they should have place near about the royal standard; and lastly, that in their funeral pomp they should have two assistants of the body, a principal mourner, and four assistants to him, being a mean betwixt a baron and a knight.

BARONY. [BARON.]

BAROSCOPE, the *perceiver of weight*, is a term which has sometimes been applied to the barometer. It may, however, be well applied to all such barometers as, from badness in their principles or construction, show a change of the air's weight, without furnishing any good means of measuring it. Such are the conical and Hooke's barometer. The human body is sometimes, to a certain extent, a baroscope.

BARRACK, originally a hut or little lodge for soldiers in a camp from the Spanish *barracas*, meaning small cabins, such as fishermen build upon the sea-coast. Temporary constructions of this sort for the horse were formerly called *barracks*; those for the foot, *huts*; the word barrack was afterwards indifferently used for both. Barracks of this description are generally made by fixing four forked poles in the ground, and laying four others across them; the walls being afterwards built up with sods, wattles, or what the place may afford, and the top planked, thatched, or covered with turf. Modern camps, especially for winter quarters, are often formed of such barracks arranged in streets.

The word barrack does not occur in our older dictionaries, though it is found in Phillips's 'World of Words,' fol., London, 1706. Barrack, in a more enlarged sense, is now applied to the permanent, and commodious buildings, in which both officers and men are lodged in fortified towns or other places.

A writer in a periodical paper entitled 'Common Sense,' No. 105, published in 1739, speaks of permanent barracks for the lodging of troops as then just introduced. He states that a few years before, in 1720, when the plague raged at Marseille, an attempt was made to raise such buildings in London, under pretence that if we should be visited, the sick might be removed to them. But the design was seen through; the citizens took the alarm, and cried out they would have no *red-coat-nurses*.

Great opposition was made in parliament, during the French revolutionary war, to the erection of barracks on an extended scale, as inimical to the liberties of the country, as calculated to estrange the soldier from the citizen, and to render the former a fit tool to enslave the latter, should the people be called upon to submit to unpopular or arbitrary measures. Other arguments had greater weight, however, on the side of these establishments: the system of quartering was, in many instances, vexatious; the morals of a country town or village were corrupted proportionally as soldiers were quartered upon the inhabitants; and it was found that soldiers and citizens might be too much, as well as too little, intermixed.

Until the middle of the reign of George III., barracks of this last description were not numerous in Great Britain. When wanted, they were built under the direction of the Board of Ordnance, by whom they were supplied with bedding and utensils; but the articles which were extraordinary were under the management of the secretary-at-war. This system prevailed until the middle of 1792, when the situation of public affairs induced his majesty's ministers to give orders to build, with the utmost dispatch, cavalry barracks in various parts of the kingdom; and Colonel de Lancey, then deputy-adjutant-general, was requested to undertake the arrangement of the business. In January, 1793, he was appointed superintendent-general of barracks, and on the 1st of May that year the king's warrant was issued for their regulation. More extensive authority was given to him by a warrant dated May 30th, 1794, when he was appointed to the office of barrack-master-general to the forces. But as this seemed to interfere with the duties and powers of the Board of Ordnance, a new warrant was issued in 1795, defining the powers of the barrack-master-general, and those of the Board of Ordnance; under which warrant Lieutenant-General De Lancey acted in all subsequent transactions. The salaries and extra pay of the barrack-master-general and his officers amounted, in 1796, to 9524*l.* 17*s.* 2*d.* The establishment was afterwards considerably increased, in proportion as the number of barracks throughout the kingdom multiplied, and by the creation of new officers. In March, 1806, their salaries amounted to 19,329*l.* 4*s.* 10*d.*

During this year, the commissioners of military inquiry recommended that the offices of barrack-master-general and deputy barrack-master-general should be totally abolished, and that the superintendence of the barrack establishment should be vested in commissioners. This suggestion, with some others relative to the mode of transacting the business of the department, and preventing useless and extravagant expenditure, were followed, and the barrack establishment placed under the direction of four commissioners, one of whom was generally a military man.

On the late Duke of Wellington becoming Master-general of the Ordnance, and Commander-in-Chief of the Forces, forty years ago, great changes and improvements were introduced into the barrack department. It was wholly re-organised and placed under the Board of Ordnance. The barracks themselves were placed immediately under the management and care of the resident barrack-master, who had charge of all articles supplied by the barrack-office, such as beds, bedding, sheets, blankets, house and stable utensils, coals and candles, an allowance of money being made in lieu of beer which was formerly supplied by the barrack-master. The head of this barrack branch was a member of the board. The charge of execution of all barrack building and repairs, was transferred to the corps of Royal Engineers, their head, the Inspector-General of Fortifications being also a member of the board.

In 1855, the Board of Ordnance was done away with, and the civil portion of the barrack department placed under the War Office, the executive being still retained by the Royal Engineers, under the Inspector-General of Fortifications, with a particular staff for that purpose, at Whitehall.

The building and repairs are usually performed by contract, under the supervision of the Royal Engineer Department; Great Britain and Ireland being divided for this purpose into the following districts, each district under the charge of a Commanding Royal Engineer, with a staff of Royal Engineers, and civil branch of clerks and foremen of works, under him: Camp at Aldershot, Woolwich, Dover, London, Newcastle, Harwich, Chatham, Sheerness, Exeter, Portland, Pembroke, Birmingham, Manchester, York, Portsmouth, Devonport, Jersey, Guernsey, Edinburgh, Dublin, Belfast, Cork, Limerick, and Curragh Camp. Abroad, at all places where troops are stationed, these duties are performed in the same manner.

Great improvements have at various times been made in the comfort and accommodation of barracks, but more especially when the late Duke of Wellington became Master-General of the Ordnance. When the barrack departments were transferred to the Ordnance, the men were placed in wooden sloping berths ranged in two tiers, two men slept in the same bed, and the subaltern officers were placed two in a room. The first improvement was substituting single iron bedsteads for the wooden berths, and then allotting a certain number of cubical feet for each man in a room—450 to 500 feet in a temperate climate, and 600 to 700 feet for hospitals; 480 to 600 feet in a tropical climate, and 700 to 900 feet for hospitals;—and the construction of cooking and ablution rooms, with an ample supply of water for the men to cook in barracks. The second improvement was the establishment of a sergeants' mess, appropriating quarters to staff sergeants, &c., and the construction of ball courts for recreation. These were carried out at considerable expense, though, some of the barracks being old, very imperfectly. In all new barracks that were built, much more attention was paid to the comfort of the soldier. There was still, however, great room for improvement, and in 1857, a Royal Commission, of which the Right Hon. Sidney Herbert was chairman, having recommended many alterations, and obtained grants of money for experiments in ventilation, &c., they are being carried out at the present time. In the new cavalry barracks at Aldershot, each man has 1000 cubic feet of room. Great attention is being paid to the ventilation of barracks—the improvement of cooking apparatus—ablution and bath rooms with hot and cold water—the establishment of libraries and reading rooms, and all that can tend to the health and comfort of the soldier. According to the present regulation field officers are allowed two rooms and a kitchen each; captains and subalterns one room each; regimental staff, according to their relative ranks; staff-sergeants and married sergeants one room each; unmarried sergeants one room between two. Two rooms are allowed for the officers' mess, and one room for sergeants'. Separate quarters are being built for married men; and rooms set apart as reading rooms and libraries. A War Office circular of 1858 lays down 600 cubic feet as the minimum barrack space, and 1200 as the minimum hospital space for each man; also that day rooms for meals are very desirable, and to be provided in future. 24 or 12 men, as forming sections or half sections of a company, are allotted to each room.

The total expenditure in Great Britain and the islands of Guernsey, Jersey, and Alderney, on buildings for the purposes of barracks from 1793 to November 10th, 1804, was 4,115,383*l.* 6*s.* 1¾*d.* The total expenditure in Great Britain and Ireland, on buildings for the same purposes (including the artillery), from 11th November, 1804, to 24th December, 1819, was 3,220,857*l.* 17*s.* 5*d.* Expenditure from 1793 to 1819, in buildings in Great Britain for the purposes of barracks for the artillery, 735,842*l.* 3*s.* 3*d.* The estimates for barrack building and repairs were, in 1858-59,—588,370*l.* at home, and 76,959*l.* abroad. The grant to the Barrack and Hospital Improvement Commission in the same year was 57,000*l.*, and 100*l.* for each barrack in the kingdom. The estimates for 1859-60 were 726,841*l.* for barracks at home, and 70,281*l.* for barracks abroad. The above, it must be remembered, are the estimates only, large sums of which are often not expended, but revoted or not the next year according to circumstances.

(*Reports of Commissioners of Military Inquiry into Management of the Military Departments* (*Fortification and Barracks*), session 1811 (122), xlii.; *Report of Select Committee to consider the subject of Barracks*, session 54—55 (Lords), 314, 314a, xxvi.)

BARRATRY, BARATRY, or BARRETRY. The original derivation of this word is extremely uncertain: in English law it has a twofold signification, which it is difficult to trace from any account yet given of its etymology. First, barratry is a misdemeanor at common law, and consists in frequently exciting and stirring up disputes and quarrels by litigation; and secondly, it denotes a fraud committed by the master or mariners of a ship with relation to the ship or cargo, by which the owners or freighters may be injured. The Italian word *barratrare*, from which the term barratry in this latter sense is immediately derived, means *to cheat* generally; but in English law it is entirely a technical expression, and is only used to denote that particular description of knavery above described.

I. As to the misdemeanor of barratry at common law.

This offence is so indefinite in its nature, and has been so little noticed in modern times, that it would probably be found difficult at the present day to prosecute a barrator to conviction. Sir Edward Coke and other authorities state that it is not necessary, in order to constitute the offence, that the suits promoted by the barrator should be commenced in courts of record; the offence may be committed by stirring up litigation in hundred or county courts, or other inferior jurisdictions. It is also said not to be a material part of the offence that the suits or quarrels commenced should relate to a disputed title to the possession of lands, but that all kinds of disturbances of the peace and the dispersion of false rumours and calumnies which may promote discord among neighbours will amount to barratry. A single act cannot amount to barratry, as the essence of the crime consists in the frequent repetition of acts tending to stir up quarrels; nor is it necessary that an indictment for this offence should specify any particular transactions in which the person accused has promoted contention or litigation, it is said to be sufficient to state generally in the indictment that he is a *common barrator*, thus leaving the whole matter to the jury. This anomaly in criminal law, from which it would follow that a defendant might be called upon at the trial to justify fifty distinct and complicated transactions without the slightest previous notice, necessarily led to another, namely, that the prosecutor is bound to deliver to the defendant before trial a notice of the particular acts on which he means to insist, and it is, of course, a rule that none can be given in evidence but such as are stated. The punishment for this offence is fine and imprisonment, at the discretion of the court; but Mr. Serjeant Hawkins says, that "if the offender be of any profession relating to the law, he ought to be disabled from practising in future." ('Pleas of the Crown,' book i. c. 81.) At common law, it appears that a person convicted of barratry might have been sentenced to the pillory. In the case of the King against the Warden of the Fleet ('Mod. Rep.' xii. 340), the record of the punishment of a barrator by a fine being produced, Lord Holt said, "If he had had the handling of him, he had not escaped the pillory; and that he remembered Serjeant Maynard used to say that it were better for the country to be rid of one barrator than of twenty highwaymen." By stat. 12 Geo. I. c. 29, (made perpetual by 21 Geo. II. c. 3), "if any person convicted of common barratry shall practise as an attorney, solicitor, or agent in any suit or action, the court shall, upon complaint or information, examine the matter in a summary way; and if it shall appear that the person complained of has offended, shall cause the offender to be transported for seven years." There is no recorded instance of proceedings having ever been taken under this statute. Under this head may be mentioned another offence of equal magnitude, that of suing in the name of a fictitious plaintiff. This offence is a high contempt of court; and punishable in the superior courts at their discretion. In inferior courts the stat. 8 Eliz. c. 2, directs the punishment to be six months imprisonment, and treble damages to the party injured.

II. Barratry by masters or mariners of ships.

This offence is not an object of the criminal law of England; and in this country is only a subject of importance with reference to maritime insurances. From the earliest times, a loss by the barratry of the master or mariners has formed a subject of indemnity by underwriters in British policies of insurance. The absurdity and impolicy of inserting this species of loss in marine policies have often been pointed out by high authority. "It is somewhat extraordinary," says Lord Mansfield in the case of *Nutt* v. *Bourdein* ('Term Rep.' i. 330), "that this term should have crept into insurances, and still more that it should have continued in them so long, for the underwriter insures the conduct of the captain (whom he does not appoint, and cannot dismiss) to the owner, who can do either." Lord Ellenborough makes the same remark, and also points out the impolitic tendency of this kind of insurance, as enabling the master and owners, by a fraudulent and secret understanding, to throw upon the underwriters the failure of an illegal adventure, of which the benefit, if successful, would have belonged solely to themselves. (*Earle* v. *Rowcroft*, East's 'Rep.,' viii. 134.) Upon this it may, however, be observed, that merchants are always desirous to limit the number of their risks as much as possible; and if they are willing to pay for their indemnity from the fraudulent acts of their own servants, there seems to be nothing unreasonable in such a contract; while, on the other hand, it is the whole business of underwriters to insure against risks, and it is quite indifferent to them what the nature of that risk is, provided they clearly understand the nature of it, and receive a proportionate premium.

The legal meaning of the term barratry thus inserted in policies of insurance has frequently become a subject of discussion in courts of justice. Its original and verbal signification is framed in the most general sense, and is defined in Dufresne's 'Glossary' as "fraus, dolus, qui fit in contractibus et venditionibus," without being limited to marine contracts, or to any particular class of contracting parties. In English law, however, it is certainly understood only in the limited sense mentioned in the commencement of this article. It means every species of fraud or knavery in the master or mariners of the ship by which the freighters or owners are injured. Barratry may therefore be committed either by a wilful deviation tending to defraud the owner, by smuggling, by running away with the ship, by sinking or deserting her, or by delaying the voyage by any means, or for any length of time, with a fraudulent intent. It follows, that in all cases where the underwriter has insured against barratry, the assured will be entitled to recover the amount of a loss which he may have sustained in consequence of any of the acts above enumerated. There must, however, be always a fraud or breach of trust in order to constitute barratry; and therefore a mere deviation in consequence of the ignorance of the master will not amount to barratry, though it would avoid the policy as being a variation from the voyage insured. It must also be an act done tending to defraud the owner, unless in itself criminal; and therefore where the owner consents to the acts done by the master, though they may amount to a gross fraud upon the underwriter, they will not constitute the technical offence of barratry; and, for the same reason, where the master of a ship is also the owner, there can be no barratry committed by him, because he cannot defraud himself. (Arnould, on 'Marine Insurance,' 2nd ed. vol. ii. p. 843.)

BARREL. The word barrel, or something equivalent, is found in several European languages, as denoting a large vessel for holding liquors. In the old English measures it was used to denote 31½ old gallons of wine, 32 of ale, or 36 of beer. The ale and beer barrels were equalized for every part of England except London, by a statute of the 1st of Will. & Mary, and 34 gallons were made the barrel of beer or ale. But the complexity still remained very great; for there were barrels containing diverse number of gallons, and gallons of diverse sizes. Thus, the wine gallon, by a statute of Anne, was declared to be 231 cubic inches, and the beer gallon (which did not differ from the ale gallon) was usually reckoned as 282 cubic inches; consequently the dimensions of the four barrels were as follow:—

	Gallons.	Cubic inches.
Wine barrel	31½	7316½
Ale ditto (London)	32	9024
Ale and beer ditto (England)	34	9518
Beer ditto (London)	36	10152

In imperial gallons of 277·274 cubic inches, now in use [GALLON], these measures are as follow:—

	Imp. gallons.
Old Wine barrel	26¼
„ Ale ditto (London)	32[illegible]
„ Ale and beer ditto (England)	34[illegible]
„ Beer ditto (London)	36[illegible]

Many other *barrels* were in use to denote certain quantities of goods usually sold in barrels; thus the barrel of salmon or eels was 42 gallons, that of soap 256 pounds, &c.

The measurement of the content of a barrel or ordinary cask may be done with sufficient exactness as follows, in which the curve of the staves is considered as a parabola:—Measure the diameter of the widest part (allowing for thickness) and that at the ends, which call the greater and smaller diameters: also measure the length from end to end. To the larger diameter add one-fourth of the smaller, and multiply this sum by itself. Multiply one-fourth of the smaller diameter by itself, and take the result five times. Add together the last two results; multiply the sum by the length of the barrel, and that product by ·41888. The product is the number of cubic *inches* in the barrel, if the lengths were measured in *inches*.

The word barrel is often applied, in common use, to any hollow cylinder, such as the barrel of a gun, a jack, or a hand-organ.

BARREL-DRAIN. [DRAIN.]

BARREL-ORGAN. [ORGAN.]

BARREN LAND, in agriculture, is that in which the plants generally cultivated do not prosper or arrive at maturity. This barrenness may arise from various causes. The texture of the soil may be such, that the moisture essential to vegetation cannot be retained, or that the fibres of the roots cannot penetrate in search of food. The first is the case in loose siliceous sands, the second in rocks and indurated clays. It is seldom that either of these soils can be rendered productive, so as to repay the expense of cultivation, unless under particular circumstances. The most barren sands will become productive by irrigation, and in that case the labour applied to improve their texture, by the admixture of more tenacious earth, may be fully repaid. The vine may be made to grow in the fissures of the hardest rocks, where the climate is favourable; and terraces may be formed, by which the soil brought on may be retained; but in general loose sands and rocks ought to be left to their natural state of barrenness.

There are, however, in all countries tracts of land which are barren and waste in their present state, and which, for want of better soils to employ and feed an increasing population, are well worth improving, and will ultimately repay the labour bestowed on them.

In 1829, it appears that the soil in the British dominions may be divided as follows: Taking the total surface of England, Wales, Scotland, Ireland, and the British islands, at 77,394,433 acres, only 46,522,970 acres were in cultivation, leaving 30,871,463 acres uncultivated, or nearly so. Some part of this, no doubt, consists of high sheep-walks, mountains, bogs, and water; but a large portion is capable of improvement, by the application of capital and industry.

Since that date, exact information has been obtained of many particulars regarding the average of the different conditions of land in the United Kingdom. [AGRICULTURAL STATISTICS.] Sheep-walks and drives, and waste lands attached to farms, amount, according to the figures for England, to nearly 3,000,000 of acres, and there are 3,800,000 acres unaccounted for. The statistics for Scotland, as ascertained by Mr. Hall Maxwell for the Highland Society, do not refer to sheep-walks, woods, and water. In Ireland, the unenclosed pastures amount to at least 8,000,000 acres, in addition to 4,000,000 or 5,000,000 capable of improvement.

Looking at these figures, it is impossible not to ask whether so very large a proportion of the surface of the British dominions in Europe may not remain uncultivated more from want of industry and skill than from insuperable barrenness.

We shall endeavour to give, as briefly as possible, an outline of the various means by which even the poorest soils may be rendered capable of adding something to the general stock of food necessary for a large and increasing population. The question as to the policy of cultivating such lands in preference to importing supplies of foreign grain, is not here considered. Our object is to show how barren lands may be improved, whenever such improvement may be deemed expedient.

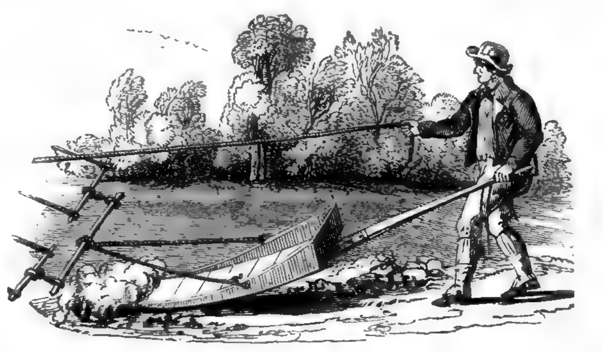
Some lands are barren in consequence of noxious ingredients in the soil, which by their chemical action on the food of plants, or on their minute fibres, prevent their growth and render them sickly and abortive. These, having been ascertained by careful analysis, must be deprived of their noxious qualities by chemical means, one of the most obvious of which is burning or baking. Nature has supplied a general and complete antidote to acid combinations, in lime, one of the most abundant of mineral productions. There are few bad soils which lime will not improve. The most common substances found in barren soils are different combinations of metals, principally iron, with sulphur and acids; quick-lime either decomposes all these or renders them innocuous. Another substance is *tannin*, or the astringent principle, which is of vegetable origin, and, by preventing the solubility of vegetable fibres, transforms them into an inflammable substance well known by the name of peat or moss. This, likewise, is readily corrected by the same means, and experience has proved that of all substances which can be obtained in sufficient quantities lime is the most valuable as an improver of bad soils. But the different substances of which a soil is composed may be perfectly innocuous to vegetation, and yet the barrenness may not be the less, if the supply or circulation of moisture be deficient or excessive. This must therefore be the first consideration, before any improvement is attempted; and if sufficient moisture cannot be supplied, or superfluous removed, all other attempts will only be lost labour. In tropical climates, irrigation is the chief source of fertility, and the most expensive works have been constructed, both in ancient and modern times, to supply the land with water as occasion requires. In northern and moister climates, the foundation of all improvements in the soil is a proper outlet to superfluous water. These two subjects will be treated in the articles IRRIGATION and DRAINING.

Supposing, then, that the moisture has been regulated, and that the land is to be brought into cultivation, the first thing to be done is to remove obstructions and impediments, whether they be rocks, stones, trees, or shrubs, or only the heath and coarse grasses which generally cover waste lands. Rocks may be quarried or blown, and so may stones too large to be removed whole, and the fragments will often be useful in building the necessary farm offices, or making fences to divide the land into fields of convenient dimensions, and especially to keep off animals from destroying the crops. A simple method of getting rid of large stones is to dig a deep hole by the side of them, as near as possible, and roll them in, so that they may be buried at least two feet below the surface. If they can be removed, this may be done by means of a common triangle with a windlass and pulley, raising them on a low carriage with broad wheels, such as is used for heavy timber. If the nature of the stones is lamellated, and they will split, wedges of soft iron driven into holes made in the direction of the layers readily divide them into flat pieces extremely convenient for use. A very powerful wedge for this purpose is an iron cylinder cut through the axis into two pieces, between which a thin iron or steel wedge is inserted: a hole is bored in the stone of a diameter equal to that of the cylinder, and when this cylinder and wedge are put into it, the wedge is driven in with repeated smart strokes of a hammer. Several such wedges, placed in a line, will split large masses of the hardest granite, and, next to gunpowder, are the most efficacious instruments for that purpose. Trees must be grubbed up by the roots, and it saves labour to cut the roots below the ground while the tree is standing, and draw the tree over by means of ropes fixed to the top; the stem becomes a lever, by which the roots are more easily drawn out. Useless shrubs are readily cut down, and serve for fuel; their roots are seldom difficult to grub up; a simple and powerful

instrument for this purpose is a very strong iron three-pronged fork, having the prongs 20 inches long, and a strong ashen handle, 20 feet long, fixed firmly into it, to the end of which a rope is fastened; this is driven obliquely under the roots, and by means of a log as a fulcrum it forms a lever when pulled down by the ropes.

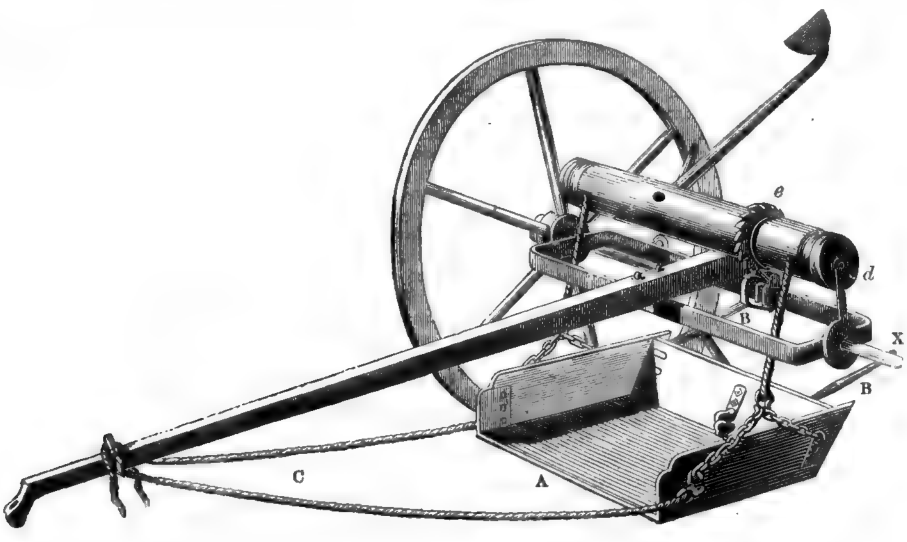
There are two methods by which the heath and grass of the surface may be got rid of, by mowing them close to the ground, and ploughing in the roots, or by paring the surface and burning it. Each mode has had its strenuous advocates, and has been alternately praised and reprobated. A little consideration will soon settle this point. If the soil consists of clay or loam containing yellow ferruginous earth, and if the ashes, after the sods have been burned in heaps, are of a bright red colour, the effect of burning the surface will be generally advantageous, even where the soil is already deficient in vegetable matter; for the fire will do more good in correcting the crude qualities of the soil, than the small quantity of vegetable matter which is dispersed would have done, had it been decomposed in the most favourable manner, and the tough roots of the heath which are reduced to ashes would have taken a very long time to decay, and would have been a constant impediment to the plough. But if the soil is a sharp sand, and the ashes are white and loose, burning destroys the small portion of clay and vegetable matter in the soil, without compensating the loss by any advantage, and in this case burning the surface is inexpedient. The roots of the heath must be grubbed up by spades and mattocks, or by means of a strong plough; they may then be gathered and burned, but the grass must be ploughed in, and not too deep at first that it may soon rot; a coating of lime ploughed in will accelerate the decay of the grass. This kind of soil requires the addition of vegetable and animal matter, and the principal attention must be directed to this object.

When the surface is very uneven, so as to form hillocks and hollows, in which the water is apt to stagnate, levelling is a necessary process. The most effectual way of doing this is by the wheelbarrow and shovel, provided the distance to which the earth is to be wheeled does not exceed a hundred yards. The surface should be first pared off, and put in heaps or rows, to be replaced when the operation of levelling has been performed, in order that the best earth, impregnated more or less with vegetable matter, may not be buried under the poorer subsoil. If the soil is loose and sandy, it may be very expeditiously levelled by an instrument in use in Flanders, which they call a *mollebart*. It is a large wooden shovel, shod with iron, having a long handle: about the middle of this shovel, which is convex at the bottom, are two hooks, one on each side, to which chains are fixed which unite at the bar to which the traces of a horse or horses are to be attached: a rope fixed to the end of the handle completes the instrument. A man accustomed to the use of it raises the handle, and the shovel enters the ground, and is filled by the horse going on. By depressing the handle, the load is made to slide on the rounded bottom of the shovel, till it arrives at the place where it is to be deposited. By letting the handle go, retaining the rope, the whole is upset instantly, turning over on the edge; the handle strikes on the bar, and the load is left behind in a heap. By pulling the rope, the whole



instrument resumes its original position, and is brought back to the place from which the earth is to be taken again, without any loss of time, or the slightest stoppage of the horses. About 5 cwts. of loose earth may be thus moved at each time. By means of this machine the small fields in Flanders are raised about two feet or more in the centre, and the ground laid convex, sloping in every direction to let the water run off. Thus also the soil of the headlands, which accumulates by the repeated turnings of the plough in our fields, might be carried back to the middle, or spread evenly over the ground. A patent has been lately obtained in France for an improved instrument of this kind, which has two large wheels for such grounds as will not readily allow the *mollebart* to slide over it. It is more complicated, but as it may afford useful suggestions, and be improved and simplified, we give a drawing and description of it.

A is the box or shovel to contain the earth, the bottom of which



opens to release the load; B B two handles; C ropes to keep the box steady; *d* a windlass, with *e* a ratched wheel to raise the box when full; X is the axle on which the second wheel runs, which has been taken off to show the construction of the instrument. It is not yet brought into general use, but the experiments made with it are said to have been quite satisfactory.

The land being now enclosed, fenced, and drained where requisite, obstacles to the plough removed, and in a tolerably level state, it remains only to consider how it may be most advantageously cultivated, so as in the end to repay the first and great outlay. Some lands which have lain waste for ages for want of a proper spirit of enterprise, are found to consist of a tolerable depth of moderately fertile earth. These must be treated like a garden newly formed, and trenched as deep as possible; mere exposure to the air and frost will often make them highly productive, and in this case the only caution necessary is not to exhaust them at first; on the contrary, their fertility should be increased by such crops and manuring as will always restore more humus than has been consumed by vegetation. It is too common an error with those who have made a great outlay, to be impatient, and expect too rapid a replacement of the capital laid out. This makes them sow white crops in preference to roots and legumes; and as fresh earth is generally very productive, especially in straw, they imagine the land to be of a better quality than it really is, and soon exhaust it, by which they lose infinitely more in the end than if they began with roots and green crops, and raised a quantity of manure by the stock fed on them. Lime excites new land wonderfully, and no manure is more active, provided there be vegetable matter in the soil or added at the same time. The lime renders the natural humus soluble and active, and, if put on injudiciously, will soon leave none for future crops. Bone-dust will raise a better crop of turnips than lime alone; but bone-dust, or, what is better, coarsely-bruised bones, are chiefly of use in raising the first crop of turnips. They should therefore be used sparingly, unless they can be obtained very cheap, and only on light loams or sands. Mixed with ashes in a heap, and allowed to heat, they become much more efficacious.

But after all the expense of clearing the land and preparing it for cultivation, it may yet be of such a quality as to dishearten the improver. We shall take an example from two kinds of soil very common in all the northern parts of Europe. The one is generally called sandy heath soil, the other is peat or moor, both quite unproductive till they are improved; and yet vast tracts of both have been brought into cultivation, and are covered with a rich harvest, in spite of their natural barrenness. Sir Humphry Davy declared, on analysis, that the soil of Bagshot Heath, in its natural state, was the most barren soil in England; yet great portions of this barren soil are now covered with thriving plantations, interspersed with green fields. The methods used to bring this land into cultivation will serve as an example for all similar soils. The surface soil of the heath consists of sand, gravel, and light loam, strongly impregnated with a yellow carbonate and sulphate of iron; the subsoil is generally a stiffer loam. The water which percolates the upper stratum dissolves a portion of the iron by means of the carbonic acid which rain water contains, and this iron, mixed with earth, is slowly deposited in a thin layer on the impervious subsoil, where it takes a hard crystallised form, called the *iron pan*, absolutely impervious to moisture; and until this pan be broken, no cultivation can take place. Trenching is, therefore, absolutely necessary wherever this pan exists at a small depth under the surface. A part of the subsoil being brought to the surface greatly improves the texture of the sand, and then the salts of iron must be decomposed and the acid neutralised by lime or chalk. Manure is now the principal object, and, if it cannot be obtained from neighbouring towns, or from old cultivated lands near at hand, the progress will be very slow. Planting trees, especially the fir and the larch, is then the only resource; but where manure and calcareous earth, either in the form of chalk, marl, or lime, can be obtained, the land may be cultivated and improved in the following manner: Lay on a good coating of chalk or marl before winter, and plough it in with a shallow furrow. In spring, plough again deeper, mixing the calcareous earth as much as possible with the soil by frequent harrowings: all the dung that can have been collected must be laid on and ploughed in by the end of May. In June, drill turnip-seed with bone-dust, if possible, in rows not too distant; say twelve inches, if the soil is very poor, but wider in proportion as it is of better quality. These, as soon as they are in the rough leaf, must be carefully hoed till they nearly cover the ground. They must be fed off by sheep in the following winter and spring: the dung of the sheep must be ploughed in with a shallow furrow as soon as possible after the sheep are removed. The quality of the first crop will decide whether a crop of corn may be ventured on in the second year, in which case tartarian oats are found the best suited to such land: but, if the turnips were not a very good crop, a second crop of the same, or of cole, for the sake of variety, to be again fed off, will be much better husbandry; and, until the soil shows an evident improvement in colour and texture, the most that can be expected is a crop of turnips and oats alternately. As soon as the ground has, by frequent tillage and manuring, become of a uniform and somewhat mellow texture, the first opportunity must be taken to lay it down with white clover and perennial grasses, and let it remain in pasture two or three years without mowing. When it is next broken up, it may be treated as the old cultivated lands of a similar quality usually are.

If a well-cultivated farm is near, and a sufficient supply of manure can be raised upon it, by converting a portion of it into artificial meadows, or keeping it under green crops, so that an increased quantity of stock may be maintained, the land to be improved may be soon brought into a productive state, without robbing the old land to make the new, as is too often done. Nothing has so rapid an effect in removing sterility as the free use of the urine of cattle, and the draining of dung-hills, collected and allowed to ferment in covered tanks; but this can only be obtained by keeping cattle stalled and fed with provender brought to them. This is the great secret of the fertility of the once poor barren heaths of Flanders. In different situations it may not be practicable to procure sufficient manure, at least at first, and the progress will be much slower. In this case the seeds of rye, tares, beans, buck-wheat, and other succulent plants, must be sown, and the crop ploughed in when in blossom; potatoes and other roots may be raised, to be consumed by cattle and swine, in sheds built for the purpose near at hand, and every means that ingenuity can devise must be resorted to in order to make as much manure as possible. This is not to be applied to the land at once, but mixed up in heaps with sods and parings of the surface, with the ashes of roots burned, and with lime, and when thoroughly incorporated by frequent turning, mixing, and repeated watering with liquid manure, a good coat should be put on the land at once, as far as it will go: for one acre brought into a tolerably fertile state will repay the cost better than many imperfectly improved; and by proceeding gradually in this way, more land will be brought into a state fit for cultivation at the end of a few years, and at less expense, than could have been done by beginning with too much at first.

When an attempt is made to bring a large extent of very poor sandy soil into cultivation at once, as may be the case where labour is cheap, it would be impossible to procure the requisite quantity of manure to ensure any return for the outlay. In that case there is a simple remedy, which, in the end, is very advantageous; it is, to sow the seeds of broom and furze, which will readily come up, and, in the course of two or three years, not only be of some value to cut for fuel for bakers, but in the mean time have greatly improved the nature of the soil, especially that which has been trenched, by the quantity of vegetable substance contained in the roots and their fibres, and also in the leaves and tender stems which have decayed and dropped during the three years that the land has been covered with these plants. This, at all events, will more than repay the interest of the money expended in trenching, and the future improvement will go on much more rapidly than if the ground had been treated as recommended above when first broken up. This practice also is taken from our sagacious and industrious neighbours the Flemish.

What has been said of a poor heath, or sandy loam, is applicable to every kind of unproductive soil, difference of composition and texture being kept in view. Poor, wet, stiff lands must be divided by deep ditches, ploughed in high ridges, and be as much as possible exposed to the wind and frost: instead of turnips, grasses must be sown, such as suit the soil. Paring and burning the surface are here generally useful in the first instance, and may sometimes be repeated with advantage. Such soils, in the end, are best calculated for permanent meadows; but it is essential to get them into a sound and fertile state by tillage and manuring, and by clearing them of all the roots and seeds of weeds before they be laid down with grass-seeds, which must therefore be done with a first crop after a clean fallow, or, which is still better, without any crop of corn at all, and kept free from coarser grasses by hand-weeding. [Grass.]

There is another kind of barren soil, which extends over large tracts in northern climates, well known by the name of peat, or moor. This, being chiefly composed of vegetable matter, is too loose in its texture for any vigorous vegetation. But, besides, it is of an insoluble, astringent nature, highly unfit for the increase and nourishment of plants. Moors being generally situated in valleys between mountains, draining off the superfluous water is the first and indispensable operation before any improvement of them can be thought of. The next thing is to compress the soft soil into a more solid state; and for this purpose any kind of earth or gravel is useful by its mere mechanical pressure. The surface may be burned in sods, and the ashes will greatly improve the remainder. Lime, chalk, marl, and shells are the specific correctors of the quality and texture. By the help of these, the soft mass, which can only be stirred with a spade by men standing on boards, is made to produce abundant crops of potatoes and oats; and, gradually condensing, a more compact soil is formed, which soon bears the tread of men and even cattle, and then, properly speaking, the cultivation may be said to begin. The great object is to prevent the absorption of too much moisture by the still unconsolidated mass, which is effected by cutting numerous and deep ditches in every direction, with proper outlets kept carefully open; at the same time guarding against the opposite extreme of drying this spongy substance too much. If it is dry at top, and moist, but not boggy, a foot below the surface, it will be in the best state to improve and consolidate. It is surprising how soon a peat moss, of little more solidity than a bog, can be rendered perfectly firm, and bear even loaded waggons on its surface. It often happens, where there is a command of good water which can be brought above the level of the old peat moss, that it may be converted into a most productive water-meadow. All that is required is, that the upper soil, artificially produced, be not broken through, and that the bottom be well drained.

We have only given brief hints and outlines to those who may be inclined to render lands productive which have hitherto been barren. The certain cost and probable improvement must be well calculated and compared to avoid disappointment and loss. As these depend on the peculiar circumstances of each case, it is impossible to give any general idea of them. But, by beginning on a small and experimental scale at first, and proceeding cautiously, new modes of lessening the expense of many of the operations will be suggested, errors will be avoided, and some certain practical ground of calculation will be obtained.

That there is a great pleasure in the pursuit no one can doubt, who sees at what expense favourite barren spots are improved; and a scanty harvest on land created, as it were, by art, pleases the proprietor more than the most abundant which his richest lands can produce.

Many a fortune, no doubt, has been impaired by rash speculations and too sanguine hopes; but, without this spirit of improvement, few soils, except the very richest, would ever have been cultivated, until the wants of a population greater than the richest lands could feed had forced the cultivation of those of inferior quality. It is in the tillage of very poor soils, chiefly, that those improvements in the utensils and operations of husbandry have been suggested and invented, without which a great portion of the soil of the British dominions, and of a considerable part of Europe, could never be cultivated to any advantage, much less afford rent to a proprietor, or contributions to the expenses of the nation.

The unproductive state of waste lands in many populous countries has suggested the employment of the poor and friendless on their improvement, and it has been thought a more enlightened charity to expend the money, which would otherwise be given in simple temporary relief, in such a manner as to make the labour of paupers available to their future comfort and independence. In some places portions of land have been given absolutely, or at a nominal rent, to paupers, in order that they might cultivate and gradually improve them; and where the soil is naturally good, and requires only to be worked and tilled, the plan has been attended with great success. But where a barren waste can only be improved by artificial manures and expensive operations, it is folly to expect this to be done by labour alone, without considerable capital; and neither the judicious managers of public funds nor prudent speculators on their own account will venture to lay out much capital on the chance and with the hope that a naturally indolent and idle class of men shall make it productive either to themselves or those who have advanced the funds.

A portion of good land, let at a fair rent to a poor family, with a little pecuniary assistance at first, in the purchase of a cow or pigs, and provisions, until the land produces food for the family, to be repaid by instalments, will occasion much less expense, and will in general be attended with less loss and fewer casualties than the improvement of poor sands and heaths, however judicious may be the management; and the ground converted into a garden will increase much more rapidly in value, than an equal quantity, originally worth nothing, can ever be made worth by three times the labour bestowed. Let the rich then be the improvers of wastes, and the poor lay out their surplus labour on more grateful soils.

It is near increasing manufactories, where land acquires a greater value, that barren land is soon converted into fertile fields. It is there, also, that the improvement of waste lands is most profitable, and the neighbourhoods of Aberdeen, Birmingham, Manchester, and Sheffield, among many others, furnish examples of the greatest industry and perseverance in overcoming the natural barrenness of the soil. Even Chat Moss, between Liverpool and Manchester, which was a few years back nothing but a quaking body of peat to a great depth, is covered with green fields and farm buildings.

BARRICADE. A military term, derived most probably from the verb to *bar*—its origin has been attributed to the French word *barriqué*, in allusion to the defences of the streets of Paris during the disturbances of the League, &c. It is applied either to the temporary obstruction to attack, made by the occupation and conversion of buildings into defensive posts in the field, or to the defences thrown up by either party during insurrectionary movements in towns; or occasionally to the barriers [BARRIER] which close the entrances of a fortress.

When of a permanent character, barricades are made with heavy pales or stakes, shod with iron. [STOCKADE.] Those of a temporary nature are constructed of anything that may happen to be at hand; carts and waggons, with their wheels taken off and filled with stones, baskets full of earth, trees, furniture, woolpacks, bales of cotton, have all been used. In Paris where, during the revolutionary outbreaks, barricades have played a most important part, the pavement of the street has generally furnished the material for them. The present Emperor of the French has had the whole of the pavement removed from the Boulevards and principal thoroughfares of Paris, the roadways macadamised, and the footpaths laid down in asphalte. Some years ago, in making arrangements for defence, in Ireland, moveable portions of palisading were constructed, which could be carried to any place where a barricade was required, put up in a few minutes, and made musket proof by a wall of sandbags on the inside.

(See *Royal Engineer's Aide-Mémoire*, art. 'Barricade.')

BARRIER, from the verb to *bar*, in a general sense, means any piece of wood-work or other construction which presents an obstacle to passing through the place where it is fixed: hence it comes to signify a fortification, or strong place, on the frontiers of a country. Thus we used formerly to speak of the barrier-fortresses of Flanders. It is likewise a kind of fence composed of stakes and transoms, or athwart rafters, erected to defend the entrance of a fortress or intrenchment, which, when musket proof, is called a stockade [STOCKADE], when simply obstructive, a palisade. In the middle of the barrier there is generally a very strong gate made of vertical wooden bars, about five feet long, kept together by two long bars across, and another diagonally. In field works the barrier is made of the strongest material procurable, but in permanent fortifications it is generally made with stockades and a heavy gate such as that described above. (*Royal Engineer's Aide-Mémoire*, art. 'Barrier and Gate.')

BARRIER TREATY. [TREATIES, CHRONOLOGICAL TABLE OF.]

BARRING-OUT, a practice formerly common in schools. Dr. Johnson, in his 'Life of Addison,' says, that in 1683, in the beginning of Addison's twelfth year, "his father being made dean of Lichfield, naturally carried his family to his new residence, and I believe placed him for some time, probably not long, under Mr. Shaw, then master of the school at Lichfield, father of the late Dr. Peter Shaw. Of this interval his biographers have given no account, and I know it only from a story of a *barring-out*, told me when I was a boy, by Andrew Corbet, of Shropshire, who had heard it from Mr. Pigot, his uncle. The practice of barring-out," he adds, "was a savage licence practised in many schools at the end of the last century, by which the boys, when the periodical vacation drew near, growing petulant at the approach of liberty, some days before the time of regular recess, took possession of the school, of which they barred the doors, and bade their master defiance from the windows. It is not easy to suppose that on such occasions the master would do more than laugh; yet, if tradition may be credited, he often struggled hard to force or surprise the garrison. The master, when Pigot was a schoolboy, was barred out at Lichfield, and the whole operation, as he said, was planned and conducted by Addison."

Brand, in his 'Popular Antiquities,' vol. i. pp. 346, 347, speaks of the custom as still existing in the grammar-school of the city of Durham, and at the school at Houghton-le-Spring. It no longer exists.

In the statutes of Witton School, near Northwich, in Cheshire, founded by Sir John Deane in 1558, the observance of this practice by the scholars is directed. (See Carlisle's 'Description of Endowed Grammar Schools,' vol. i. p. 133.) It prevailed long also at Rothbury, near Alnwick, in Northumberland. (Ibid. vol. ii. p. 259.) An entertaining story of a barring-out is given in vol. vi. of Miss Edgeworth's 'Parent's Assistant,' 12mo. Lond. 1813. Hutchinson, in his 'History of Cumberland,' vol. ii. p. 322, says this custom was used by the scholars of the free-school of Bromfield in that county, about the beginning of Lent, or, in the more expressive phraseology of the country, at Fasting's even.

BARRISTER. The etymology of this word has been variously given by different authors, and it would be unprofitable to enumerate the fanciful derivations which have been assigned to it. But, though the precise etymology of the term is uncertain, there is little doubt that it arose from the local arrangement of the halls of the different Inns of Court, which for several centuries have composed in England a kind of university for the education of advocates. [INNS OF COURT.] The benchers and readers, being the superiors of each house, occupied on public occasions of assembly the upper end of the hall, which was raised on a *dais*, and separated from the rest of the building by a bar. The next in degree were the *utter* barristers, who, after they had attained a certain standing, were called from the body of the hall to the bar (that is, to the first place outside the bar), for the purpose of taking a principal part in the mootings or exercises of the house; and hence they probably derived the name of *utter* or outer barristers. The other members of the Inn, consisting of students of the law under the degree of utter barristers, took their places nearer to the centre of the hall and farther from the bar, and from this manner of distribution appear to have been called *inner* barristers. The distinction between utter and inner barristers is at the present day wholly abolished, the former being called barristers generally, and the latter falling under the denomination of students.

The degree of utter barrister, though it gave rank and precedence in the Inn of Court, and placed the individual in a class from which advocates were always taken, did not originally communicate any authority to plead in courts of justice. In the old reports of the proceedings of courts, the term is wholly unknown; serjeants and apprentices at law, who are supposed by Dugdale to be the same persons, being the only pleaders or advocates mentioned in the earlier year-books. (Case of the Duchy of Lancaster, 4 Eliz., Plowden's 'Reports,' vol. i. p. 213; 'Chronica Judicialia,' p. 165.) In the time of Stow, however, who wrote in the latter part of Elizabeth's reign, it is clear that utter barristers were entitled to act as advocates, as he expressly says that persons called to that degree are "so enabled to be common councellors, and to practice the law both in their chambers and at the barres." The exact course of legal education pursued at the Inns of Court before the Commonwealth is extremely uncertain, but it appears to have consisted almost entirely of the exercises called *readings* and *mootings*, which have been described by several ancient writers. The *readings* in the superior or larger houses were thus conducted: The benchers annually chose from their own body two readers, whose duty it was to read openly to the society in their public hall, at least twice in the year. On these occasions, which were observed with great solemnity, the reader selected some statute, which he made the subject of formal examination and discussion. He first recited the doubts and questions which had arisen, or which might by possibility arise, upon the several clauses of the statute, and then briefly declared his own judgment upon them. The questions thus stated were then debated by the utter barristers present with the reader, after which the judges and serjeants, several of whom were usually present, pronounced their opinion *seriatim* upon the points which had been raised. Readings of this kind were often published, and it is to this practice of the Inns of Court that we are indebted for some of the most profound juridical arguments in our language, such as Callis's reading on the Statute of Sewers, and Lord Bacon's on the Statute of Uses.

The process of *mooting* in the Inns of Court differed considerably from *reading*, though the general object of both was the same. On these occasions, the reader of the Inn for the time being, with two or more benchers, presided in the open hall. On each side of the bench table were two inner barristers, who declared in law French some kind of action, previously devised by them, and which always contained some nice and doubtful points of law, the one stating the case for the plaintiff, and the other the case for the defendant. The points of law arising in this fictitious case were then argued by two utter barristers, after which the reader and the benchers closed the proceeding by declaring their opinions *seriatim*. These exercises appear to have lost much of their utility in the time of Lord Coke, who, in the 'First Institute,' p. 280 *a*, praises the ancient readings, but says that the modern performances were of no authority. Roger North says that Lord Keeper Guildford was one of the last persons who read in the Temple according to the ancient spirit of the institution. It is, however, beyond all doubt, that, as far back as we have any distinct memorials, all advocates must have passed through the mode of preparation adopted in the Inns of Court.

The serjeants, who, before the allowance of utter barristers to plead in courts, appear to have been the only advocates, were called by writ from the Inns of Court, the writ commanding the person to whom it was addressed to take on himself the dignity of the coif, being only issued at the discretion of the crown, and generally as a matter of favour. This continues to be the case at the present day, although practically the nomination of serjeants is in the hands of the Chief Justice of the Court of Common Pleas. In process of time it became convenient and necessary to enable utter barristers to practise; but some time after they began to act as advocates in the superior courts, the terms upon which they were called to the bar, and allowed to plead, were prescribed by the Privy Council. Thus an order of council regulating the proceedings of all the Inns of Court in this respect, dated Easter Term, 1574, and signed by Sir Nicholas Bacon as lord keeper, and several lords of council, directs that "none be called to the utter bar but by the ordinary council of the house (that is, the Inn), in their general ordinary councils in term time; also, that none shall be utter barristers without having performed a certain number of mootings; also, that none shall be admitted to plead in any of the courts at Westminster, or to sign pleadings, unless he be a reader, bencher, or five years' utter barrister, and continuing that time in exercises of learning; also, that none shall plead before justices of assize unless allowed in the courts of Westminster, or allowed by the justices of assize." (Dugdale's 'Origines Juridiciales.') This appears to be the last instance of the immediate interference of the Privy Council with the arrangements of the Inns of Court respecting calls to the bar. In the reigns of James I. and Charles I., the judges and benchers of the several Inns conjointly made orders on this subject, and, since the Commonwealth, the authority to call persons to the degree of barrister-at-law has been tacitly relinquished to the benchers of the different societies, and is now considered to be delegated to them from the judges of the superior courts. In conformity with this view of the subject, the practice has been, in the several cases of a rejection of applications to be called to the bar which have lately happened, to appeal to the judges, who either confirm or reverse the decision of the benchers. From the history of the system, however, it would appear as if the judges themselves possessed only a delegated authority from the crown.

Previously to a general arrangement made by all the Inns of Court in 1762, the qualifications required for being called to the bar varied extremely, and no uniform rule was observed at the different houses. In the first year of the reign of James I. it was solemnly ordered by a regulation, signed by Sir Edward Coke, Sir Francis Bacon, and other distinguished names, that no person should be admitted into any of the Inns of Court *who was not a gentleman by descent*. Other regulations were occasionally made, as to the length of standing required, and the number of persons to be called at each time, which were often absurd and inconsistent with each other. The greatest inconvenience, however, arose from the absence of uniformity in the practice of the different Inns, as to the qualifications which they respectively required. To remedy this evil, it was determined, in 1762, by the concurrence of all the Inns of Court, to adopt a common set of rules for their guidance in this respect; and under these rules, which were slightly modified by the different Inns of Court from time to time, the only qualifications required, until quite recently, were, that a person should be twenty-one years of age, and have kept twelve terms, by eating the number of dinners *during term* necessary to constitute *keeping* that term. The candidate must thus have been *three years* a member of the society to which he belonged, and during that time he was required to go through certain formalities, called *keeping exercises*, which meant nothing. No knowledge of law was required; but the candidate must have been able to write his name, and either to read writing or to recollect some words of his exercise. By an order made by the benchers of the Inner Temple, in Trinity Term, 1829, every person proposed for admission to that house must, previously to his admission, have undergone an examination by two barristers appointed by the bench, who were required to certify whether the individual was proficient in 'classical attainments and the general subjects of a liberal education.' This regulation was never adopted at any of the other three Inns of Court; it was felt, or supposed to operate, as a restraint upon the resort of students to the Inner Temple, and to create a consequent diminution of its funds. The rule was abandoned in 1847.

In 1852, the four societies agreed upon a new set of rules, by which the previous rules were almost entirely re-enacted. A student is now compelled to attend two of the five courses of lectures delivered at the halls of the Inns of Court, during one whole year; the year being divided for this purpose into three educational terms. He may, however, avoid this attendance by submitting himself to an examination in law. Lectures have been instituted and lecturers appointed, and a body called a 'Council of Legal Education' created. One studentship of fifty guineas per annum, tenable for three years, may be conferred by this council on the student who passes the best examination, at the general examinations, which are held at the beginning of every educational term. As the examination is voluntary, this is the inducement held out to students to offer themselves; besides which, two of the terms of successful students may be dispensed with, and they may thus, and not otherwise, take precedence at the bar of men otherwise of their own standing. Students, it may be added, are now charged an extra five guineas at their admission, one guinea being paid over to each lecturer.

The opinions of the bar are very much divided as to the utility of these lectures and studentships. The *keeping of terms* at an Inn of Court constituted the merely formal part of the preparation for the bar. It was not unusual for a student to pass three years in the chambers of a gentleman in practice, and in this way to obtain an actual knowledge of law, and qualify himself for the actual practice of his intended profession. If three years were not always given to study, a lesser period must have been passed *in statu pupillari*, there being no other mode of acquiring the practical knowledge thus obtained. It is admitted universally that the lectures are not intended or expected to give this practical knowledge of the profession, and it is contended by those who have had the most ample means and opportunity of forming an opinion, that a knowledge of the law is only to be gained by a close, continuous, and uninterrupted study, and that lectures can be of little, if of any use, in directing the student in his course. As yet, no practical good is known to have resulted from the new system, which, however, must still be considered experimental.

The expense of being called to the bar amounts to between 80*l.* and 90*l.*, exclusive of the three years' commons and the admission fees *supra*. In order to qualify a person for the bar in Ireland, it is necessary that he should have kept six terms at one of the four Inns of Court in London, and six terms at the King's Inn in Dublin. After a student has kept the necessary number of terms, he may be admitted to practise *under the bar*, as it is termed. Persons thus practising the common law are termed *special pleaders;* those following a similar course in the courts of Chancery, *equity draftsmen*. They must take out an annual certificate, like attorneys, and are generally paid much smaller fees than barristers; but they can charge their fees and recover them by action, which a barrister is unable to do. Some of these practisers *under the bar*, as well as members of the bar, devote themselves to one branch of practice in chambers, and are thence called *conveyancers*. [COUNSEL; INNS OF COURT.]

BARRISTER. In Scotland, there was (if we except public *Notaries*) till modern times but one order of law practitioners. They had various names,—procurator, advocate, prolocutor, forespeaker: of which the two former were the most frequent, and the first is to this day the judicial style of the advocates of the college of justice, the advocate of the church of Scotland, and the fiscals and practitioners of the local courts. They were at once the chamber-counsel, the barrister, and the attorney of their clients; and, in the common law courts at least, all pleaded *within* the bar. This continued to be the case till the institution of the Court of Session in 1532, when it was enacted "that nane advocat nor procuratour within the bar stand to pley, bot passe outwith with the partie, except the king's advocat:"—an enactment which, being limited to the Court of Session and inferior courts, is unknown in the Court of Justiciary, where to this day, both at Edinburgh, and on the circuit, all plead as of old *within* the bar. We soon afterwards find in the records a new class of law practitioners under the name of *writers*, acting below the bar; but against them the censures of the court were constantly proclaimed, and they were ordered to be *extruded* from the court; and we also find that, by the Secretary of State's injunctions in 1594, the *writers to the signet* were forbidden to act as agents, that is, attorneys or solicitors in court. The *writers*, however, had taught division of labour in the legal profession; and the business of the Court of Session accordingly was soon divided between the advocates and their clerks—all except whom were, by act of Sederunt, 13th July, 1596, prohibited to act as agents, and this order was renewed by statute 1672, c. 16, s. 31, and by act of Sederunt, 26th February, 1678. By a bye-law of the writers to the signet, also, December, 1676, any member of that body who should act as an agent was made liable to be prosecuted. Nevertheless, the writers to the signet came ultimately to act as agents; and in the course of last century, a third class of agents was established under the name of solicitors before the supreme courts. These several classes of agents can act in court only below the bar, whereas the advocates are not confined to the bar, but remain undivested (except by usage) of their ancient right to act both as counsel and attorney.

Thus far as to the Court of Session. In regard to the local courts, the resident practitioners are styled *procurators*, except at Aberdeen, where, agreeably to an act of court passed by Mr. Sheriff Crombie in 1633 (perhaps the first local-court regulation in Scotland subsequently to the establishment of the Court of Session), the practitioners are admitted to practise (as in the Court of Session) as "advocates and procurators," and are usually styled advocates in Aberdeen. These, and the procurators of the other local courts, act, as of old, in every branch of juridical business. They are admitted by the court before which they intend to practise, and cannot act before any other county court.

The advocates of the College of Justice, who form the Bar of Scotland, are not restricted to the Court of Session, but are entitled to act in every court in the kingdom (except where specially excluded by statute), and they go on circuit with the superior criminal court; but no practising member of the bar is permanently resident in any of the provincial towns; and there is not yet, therefore, any *provincial bar* in Scotland, as in England.

The advocates of the College of Justice form an incorporation called the Faculty of Advocates. All matters relating to the body are regulated by the vote of the whole members, and there is no governing council resembling that of the benchers of the English Inns of Court. The president of the body is called the Dean of Faculty, and is elected by general vote. He has precedence in court after the Lord Advocate for the time being, and before the Solicitor-General. No other precedence is recognised, except that of seniority. But by a recent resolution the Faculty has resolved of courtesy to permit those who have held the offices of Lord Advocate and Solicitor-General to have precedence next after the Lord Advocate, Dean of Faculty, and Solicitor-General for the time. But only the actual Lord Advocate and Solicitor-General plead within the bar. The Faculty regulates all matters connected with admission to the bar.

Till the institution of the Court of Session in the beginning of the 16th century, no course or exhibition of legal learning appears to have been required to qualify for the legal profession in Scotland. At first indeed no legal qualification was necessary even for the Scottish bench. The first advocates were mostly, if not all, ecclesiastics, conversant with the canon and civil laws; and, till the Union with England, a knowledge of these laws was the chief requisite to admission to the Scottish bar. Indeed, till the above era, there was no provision for the study of the law in Scotland, except the canon and civil law chairs of the universities; and accordingly it was usual till our own day to prepare for the Scottish bar at some one of the foreign colleges; of which those of France and Italy were the most frequented, till the lustre of the Cujacian school in the Low Countries, aiding the connection which arose between Scotland and them at the Reformation, drew the student thither. In 1722, however, a chair of *Scots Law* was erected at Edinburgh; and there are now several law professorships in the different universities of Scotland.

From the year 1610, it has been imperative on all candidates for admission to the bar in Scotland to pass an examination in law. In the year 1750 it was required that this examination should be both upon the civil law and the law of Scotland. A further extension of the course of study was made in 1854, when an examination, or the production of other evidence of proficiency in several branches of general learning, was directed, prior to the examination in law. These preliminary qualifications are as follows:

The degree of M.A. of any Scottish university, of the University of London, or of the Queen's University in Ireland, or the degree of B.A. of the English universities, or such degree of a foreign university as may be evidence of the same amount of scholarship as the degree of M.A. in Scotland.

In the event of the candidate not having graduated as above, he must undergo an examination on the following subjects and books,—

1. Latin.—'Cicero de Oratore,' and the 'Odes' of Horace, or in place of Horace, the first six books of the 'Æneid.'
2. Greek.—First six books of the 'Iliad,' or Herodotus's 'History.'
   In place of the Greek, the candidate may select any two of the modern languages subjoined:
   German.—Schiller's 'Geschichte des Abfalls des Vereinigten Niederlande, &c.,' and Schiller's 'Historical Dramas.'
   French.—Guizot's 'Histoire de la Civilisation en Europe,' and a Satire of Boileau.
   Italian.—Beccaria, 'Dei Delittie e delle Pene,' and a Tragedy of Alfieri.
   Spanish.—Cervantes, 'Don Quixote,' and Yriarte, 'Fabulas Literarias.'
3. Logic.—Whately's 'Logic.'
   In place of Logic the candidate may select
   Mathematics.—First six books of Euclid.
4. Ethical and Metaphysical Philosophy.—Reid's Works by Hamilton, and Sir J. Mackintosh's 'Dissertation on Progress of Ethical Philosophy.'

A year after passing this examination, the candidate may present himself for examination in law. But for a year prior to the examination in law, he must not have engaged in any trade, business, or profession, either on his own account or in the employment of another. And he must have attended, during at least one session, a class of civil law in a university, and during another session a class of Scots law in a university; and attended during one session a class of conveyancing, or during a second session, either of the classes first mentioned; and lastly, he must have attended a course of lectures on medical jurisprudence.

The examination on civil law is appointed to be on the 'Institutes of Justinian,' with Warnkœnig 'Inst. Jus. Rom. Privat.;' and the title of the Pandects 'De div. reg. juris' (lib. l. tit. vii.) with the Commentary contained in the 45th title of the 4th book of Bankton's 'Institute of the Law of Scotland.' The examination on the Scottish law is appointed to be on Bell's 'Principles.'

If the examination is successfully passed, a title of the Pandects is assigned to the candidate as the subject of a thesis in Latin. Unfortunately it is not required that the thesis should be actually, as it is nominally, of the candidate's own composition, and this is consequently, what no other part of the examination is, a mere formality. When the thesis has been approved, the candidate is presented to the Court of Session, by which he is formally admitted as an advocate. The fees on admission amount to about 350*l.*; the greater part of which goes to the support of the magnificent library belonging to the Faculty.

Among the curious trifles of which the memory is still preserved by antiquaries, is the right claimed by the Scottish bar to remain covered in the presence of the court. Thus we find that Alexander Seton, afterwards Lord Chancellor of Scotland, "made his public lesson of the law before James VI., the Senators of the College of Justice, and Advocates present, in the Chapel Royal of Holyrood House, in his lawyer-gown and four-nooked cap (as lawyers used to pass their tryals in the Universities abroad), to the great applause of the king and all present; after which he was received by the College of Justice as ane lawyer." And so, when King Charles removed Oliphant, King's Advocate, from the bench, and issued an ordinance that no officer of state should for the future have the place of an ordinary lord there, the Court of Session passed an act of Sederunt, acknowledging the right of his assistant and successor, Hope, King's Advocate, to plead covered. This, it is indeed said, was a privilege granted to Hope personally, in consideration of his having a son, or as some say two sons, and others, who not content with *one* or *two*, roundly assert *three* sons on the bench, who like the other judges sat with the hat on. But the fact is, Hope had *no* son on the bench when the act of Sederunt referred to was passed, nor for six years afterwards; and the acknowledgment then made was renewed to Sir Thomas Nicholson, King's Advocate, with other known privileges of the office of King's Advocate. We therefore take the act of Sederunt to contain recognition of a right common to the whole faculty, and made to the King's Advocate as the head of the body under the bench. That the judges wore their hats on the bench till recent times is certain; and at admissions to the bar the hat is to this day placed on the bar of the court in assertion of the right of the candidate. A general parity indeed prevails between the bench and bar: the King's Advocate and others were long members of both bench and bar; and in former times, when the judges were removable at pleasure, if a judge was removed from the bench he resumed his practice at the bar. This, for example, President Balfour did, on his removal from the chair.

BARROW. [TUMULUS.]

BARTER, a rule of Arithmetic, introduced into books which teach rules without principles, but which, though a very necessary and usual application of arithmetic, would be too obvious a consequence to be introduced into any system of demonstrative arithmetic. It means the exchanging of goods against goods, not against money, and, as might be supposed, the rule is the following:—

"Find the value of that commodity whose quantity is given; then find what quantity of the other at the rate proposed you may have for the same money, and it will be the answer required." (Bonnycastle's 'Arithmetic.') Thus, to find how many oranges at 2 a penny should be given for 150 apples at 3 a penny, find how much money 150 apples cost at 3 a penny, namely 50 pence, and find how many oranges can be bought for 50 pence at 2 a penny, namely 100.

BARTER. When one commodity is exchanged directly for another, without the employment of any instrument of exchange which shall determine the value of the merchandise, the transaction is called Barter. All trade resolves itself into an exchange of commodities; but the commercial exchangers of one commodity for another effect their exchanges by a money-payment, determined by a market-value. This is a Sale. Swift, in his attack upon Wood's halfpence, which he considered as destructive of the money-standard of value, says, "I see nothing left us but to *barter* our goods, like the wild Indians, with each other." The general evils of such a state are obvious; and they create dishonest attempts in one exchanger to cheat the other. The North American Indians obtain a few of the comforts and luxuries of civilised life by exchanging skins for manufactured articles. The Indians meet the traders: each man divides his skins into lots, which have a relative value to each other, as that two otter skins are equal to one beaver. For one lot he wants a gun, or a looking-glass, or a blanket, or an axe. The trader has the articles to give the Indian in exchange. Twenty beaver-skins are given for a gun; the gun costs a pound in Birmingham; the beaver-skins are worth more than twenty times the amount in London. If the Indians were brought into more general contact with the exchangers of civilised life, they would regulate their exchanges by a money-standard, and would obtain a fairer value for their skins.

The term *barter* seems to have been derived from the languages of southern Europe: *baratar*, Spanish; *barattáre*, Italian,—which signify to cheat as well as to barter; hence, also, our word Barratry. The want of a standard of value in all transactions of barter gives occasion to that species of overreaching which prevails from an ignorance of the real principles of trade, by which all exchangers are benefited through an exchange. The examples of barter, however, without any reference to some standard of value, become more and more uncommon, as the commercial intercourse of mankind advances. A skin of corn, or a stone vessel of corn, among some of the Indian tribes, is established as a standard of value; councils are held to determine the rate of exchange; and a beaver-skin is thus held to be worth so many more skins of corn than a blanket. This is an approach to a standard of value which almost takes the transaction out of the condition of being a barter. In the trade carried on between Russia and China, the exchanges of merchandise are directly effected, but the comparative value of the merchandise is determined by a money-standard. This is clearly not barter. The Indian corn measure of value is something like the animal measure which formerly existed in this country, when certain values being affixed to cattle and slaves, they became an instrument of exchange, under the name of *living* money. Amongst the northern nations skins used to be a standard of value: the word *rāha*, which signifies money in the Esthonian language, has not lost its primitive signification of skins amongst the Laplanders. When nations come to use any standard of value, whether skins, as in northern Europe, or dhourra (pounded millet, *Sorghum vulgare*), as in Nubia, or shells, as in parts of India, their transactions gradually lose the character of barter. If wages are paid in articles of consumption, as in some mining districts of England, the transaction is called *truck;* —*troc* is the French for barter.

The exchanges of a civilised people amongst themselves, or with other countries, are principally carried on by bills of exchange: the actual money-payment in a country by no means represents the amount of its commercial transactions. If any sudden convulsion arise which interrupts the confidence upon which credit is founded, bills of exchange cease to be negotiable, and exchangers demand money-payments. The coin of a commercial country being insufficient to represent its transactions, barter would be the natural consequence if such a disastrous state of things were to continue. Thus, when Mr. Huskisson declared in 1825 that the panic of that year placed this country "within forty-eight hours of barter," he meant that the credit of the state would have been so reduced, that its notes would not have been received, or its coin, except for its intrinsic value as an article of exchange; and that the bills of individuals would have been in the same case. Barter, in this case, would be a backward movement toward uncivilisation.

BARTHOLOMEW, HOSPITAL OF ST. [HOSPITALS.]

BARYTA, BARYTES. [BARIUM.]

BA'RYTON, or BARITONE, from βαρὺς, heavy, grave, and τονὸς, tone, the male voice, the compass of which is between that of the tenor and the base. Dr. Bennati, in his 'Recherches sur la Mécanisme de la Voix Humaine,' applies a new term, *baritenor*, to this voice, which is much to be preferred to the above, for that, according to its etymological meaning, would seem to imply a low rather than a high base.

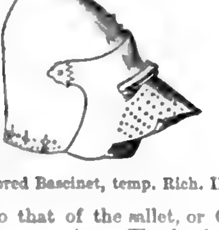
BARYTON is the name of an instrument similar to the viol da Gamba [VIOL DA GAMBA], invented in 1700, but now entirely disused. Haydn composed no less than 163 pieces for the baryton, or *baritono*, which was the favourite instrument of his patron, Prince Nicola Esterhazy.

BASCINET, BASINET, or BASNET, was a light helmet, so called from its resemblance to a basin. It was introduced about the time of Edward I. and replaced the chapet-de-fer, being worn commonly with the nasal, which however disappears after this reign.

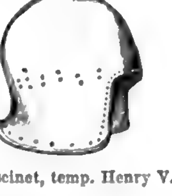
Finchet, says Grose (it should be Fauchet, 'Origines des Chevaliers, Armoiries, et Héraux,' 8vo, Paris, 1606, p. 42 b.), supposes the bascinet to have been a lighter sort of helmet that did not cover the face, and says he finds that the knights often exchanged their helmets for bascinets when much fatigued, and wishing to ease and refresh themselves, at a time when they could not with propriety go unarmed. An example of this kind, copied from a brass in Minster Church, Sheppey, of the time of Edward II. is appended.

Bascinets were worn in the reigns of Edwards II. and III. and Richard II. by most of the English infantry, as may be repeatedly seen in the rolls of Parliament and other public records.

In the reign of Richard II. a novelty in the form of the bascinet was introduced: it was then furnished with a species of moveable visor, a ventaille, bavière, or visière, as it was indifferently called, of which an example, copied from Sir S. Meyrick's 'Engraved Illustrations of Ancient Arms and Armour,' is given below, together with one when it had resumed its simpler form, of the time of Henry V. copied from one in Sir S. Meyrick's collection. The form is



Visored Bascinet, temp. Rich. II.



Bascinet, temp. Henry V.

tending to that of the sallet, or German headpiece, which came into use in the next reign. The knob on the top is intended to hold the panache or plume, which was introduced as a crest in the time of Henry V.

(Grose, *Treatise on Ancient Armour;* Meyrick, *Critical Inquiry into Ancient Armour;* Planché, *History of British Costume.*)

BASE. The name base is applied in chemistry to those elements or groups of elements which combine with halogens or with acids to form, in inorganic chemistry, salts, or, in organic chemistry, bodies analogous to salts.

As it appears that every two elements may combine together, it follows that the basicity of an element is nothing absolute, but wholly relative to the other element or elements present. Thus, in one binary compound an element may be basic to another element, while in another compound the first element may be halogenous to a third. This being the case even with binary compounds, bodies which contain more than two elements show this ambiguity to a greater extent; for in such cases a body which is basic to a second may, when combined with a third, form a compound which is halogenous to a fourth. There are no separate terms for compound bases and simple or elementary ones, corresponding to the terms halogen and acid, employed in distinguishing simple and complex base-combiners.

But although no absolute line of demarcation between basic bodies and acids or halogens exists, yet in compounds resulting from the union of the two, it is generally possible to determine which function is exercised by each of the elements or groups of elements. This can only be done by analogy: by comparing such compounds with others, the functions of whose constituents are assumed as known. Thus, if in hydrochloric acid (HCl) we admit the hydrogen to be basic, then when zinc dissolves in hydrochloric acid, the zinc, in the chloride of zinc formed, must occupy the same position and perform the same function towards the chlorine, as did the hydrogen which it has expelled—that is, it must be basic. Again, on treating nitrate of silver with the so-formed chloride of zinc, the silver displaces the zinc to form chloride of silver, and the zinc the silver to form nitrate of zinc. Hence, the silver of chloride of silver stands in the same relation to the chlorine as that which was maintained by the zinc, and therefore also by the hydrogen; it is therefore basic. Moreover, the formation of nitrate of zinc shows that in this latter body the zinc and nitric acid are related to one another in the same manner as the silver and chlorine in the chloride of silver, the two metals having simply changed places.

By insisting upon the symmetry of the recompositions which occur in analogous interchanges, some chemists have been led to the symbolisations $AgNO_6$ and $ZnNO_6$ (*mutatis mutandis* for other oxygen salts), instead of those usually employed, $AgONO_5$ and $ZnONO_5$. [SALT.]

The electrolysis of compound bodies by a voltaic current furnishes us with a comparison between the unknown functions of the constituents of one compound, and those of another in which such functions are admitted as known. If a piece of zinc and one of copper be immersed in a vessel (1) of hydrochloric acid, the zinc alone decomposes the acid, evolving hydrogen. On attaching by metallic wires the two plates in (1) with two platinum plates immersed in a second vessel (2) of hydrochloric acid, chlorine is liberated at the platinum plate connected with the copper, hydrogen at that connected with the zinc. If now, instead of hydrochloric acid, we place in vessel (2) another compound liquid and find that it is decomposed, it is clear that the constituents which appear at the two platinum plates are related to one another, as are the chlorine and hydrogen of the hydrochloric acid. On the electrolysis of a compound body, therefore, the substance which separates at the plate in connection with the copper is halogenous or acid, that at the plate connected with the zinc, basic. Since now the plate connected with the zinc is the negative, and the one connected with the copper the positive pole, the terms electro-positive and electro-negative may, from the voltaic point of view, be substituted for basic, and halogenous or acid. Since dilute sulphuric acid is the acid most usually employed to be decomposed in the exciting cell, the products of decomposition in the decomposing cell are strictly the analogues of the products of the decomposition of dilute sulphuric acid when placed in the same decomposing cell; these are hydrogen and oxygen. But whatever acid be employed in the exciting cell, the same electrolytical products appear at the two poles in the decomposition cell, when the same substance is decomposed.

The determination by electrolysis of the relative basicity of the elements of a compound, is sometimes complicated by secondary recompositions effected by the re-actions of those separated elements upon the original body decomposed, sometimes wholly frustrated by the resistance to the passage of the current.

If metallic copper be placed in a cold solution of chloride of gold, the whole of the gold may be deposited in the metallic state, and its place be taken by the copper, chloride of copper being formed. If metallic iron be placed in the so-formed chloride of copper, copper is deposited and chloride of iron produced. Hence under these conditions copper is more basic than gold, and iron more basic than copper towards chlorine. When metals are compared in this way with one another in regard to their basicity, almost the same order is found to prevail whatever electro-negative constituent is present, and it is therefore possible to construct a list of the metals arranged according to their basicity. Thus in the following table the most strongly basic metals are placed first, and the basic power gradually diminishes towards the end of the list:

Potassium.	Nickel.	Silver.
Sodium.	Cobalt.	Palladium.
Magnesium.	Aluminium.	Platinum.
Manganese.	Lead.	Rhodium.
Zinc.	Tin.	Iridium.
Cadmium.	Bismuth.	Gold.
Iron.	Copper.	

Such a list, however, does not give the relative basic positions of these elements with infallibility. The physical conditions under which the elements are present, and the nature of the possible compounds which may result, influence their order. Thus, although sodium may decompose the oxide of iron at one temperature, iron decomposes the oxide of sodium at a higher one. For further information on this subject, see CHEMICAL AFFINITY.

Those salts which do not result from the direct combination of a halogen with a metal, but from the union of compounds of the non-metallic elements with metals, are usually supposed to contain the metals in combination with a portion of the non-metallic constituents of the salt. In such cases the group containing the metal is the base. The bases resulting from the union of oxygen with the metals have been most fully examined. Sulphur, selenium, and a few other non-metallic elements, also form bases when combined with metals.

According to the solubility of the metallic oxides in water the metals which they contain are called the metals of the alkalies, of the alkaline earths, and of the heavy metals. The oxides of potassium and sodium are accordingly alkalis; those of barium, strontium, calcium, magnesium, the alkaline earths; while the remaining oxides, those of the heavy metals are almost absolutely insoluble. Metals may be basic when in combination with a certain proportion of oxygen, and acid when combined with a larger quantity. This is the case with iron, manganese, chromium, and others. Sometimes one and the same stage of oxidation of a metal may be basic to an acid, and acid towards a base: such are the oxides of aluminium, zinc, and tin. Antimony and arsenic, which occupy an intermediate position between the metallic and non-metallic elements, combine directly with chlorine as bases, while their oxides form well defined acids.

The same two semi-metals in combination with sulphur play the part of acids, not only to the oxides but to the sulphides of the alkalies, giving rise thereby to the salts of sulphur bases alluded to above. Thus the ter- and penta-sulphides of arsenic and antimony combine with the sulphides of potassium, sodium, and ammonium, giving rise to sulphur salts, of which sulpharseniate of sulphide of potassium may be taken as an example. Gold, platinum, and tin, in combination with sulphur, also act as sulphur acids towards the oxides and sulphides of the alkalis.

A metallic chloride may be regarded as playing the part of a base, as for instance, the potassio-chloride of platinum, $KCl\ Pt\ Cl_2$, in which the chloride of potassium is the base, and the chloride of platinum the acid.

In all cases of double salts, indeed, whether resulting from the union of two binary compounds, or of two oxygen salts, we may consider the one salt as the base, and the other as the acid, as seen in the following formulæ:

$$KCl\ Mg\ Cl;\ KOSO_3\ HOSO_3;\ KOSO_3\ MOSO_3.$$

Different quantities of the same base may combine with the same acid, and form well defined salts. The phosphates furnish the most complete example of this. If the phosphate of soda and ammonia ($2NH_4O$, $Na\ OPO_5$), be heated to redness, all the ammonia is expelled, and monobasic phosphate of soda ($NaO\ PO_5$) is left. If ordinary phosphate of soda ($HO\ 2NaO\ PO_5$) be heated, water is expelled and bibasic phosphate of soda remains. If ordinary phosphate of soda be treated with caustic soda, tribasic phosphate of soda ($3\,NaO$, PO_5) separates out on evaporation. Hence phosphoric acid may combine with soda, or soda with phosphoric acid in these proportions, related to one another by weights, as 1, 2, and 3. Phosphoric acid is on this account called polybasic. Antimonic and arsenic acids have also the power of combining with bases in different proportions. Some other acids combine with two, and others again with one or two proportions of base. Among the oxides of the heavy metals, oxide of lead is pre-eminent in possessing the power of uniting in various quantities with acids to form salts which contain more than one basic molecule for every acid one present. [ACIDS, SALTS.]

The non-metallic group ammonia (NH_3), in combination with water as the oxide of the quasi metal ammonium (NH_4), combines with oxygen acids to form salts, in the same manner as do the oxides of the metals proper. Moreover, not only do the hydrochlorate of ammonia, or chloride of ammonium, iodide of ammonium, sulphide of ammonium, &c., present the strongest analogies to the chlorides, iodides, &c., of the metals proper, but such binary salts of ammonium as combine with salts of the metals either binary or oxygen, exhibit the same analogies; thus:

	Analogous to
NH_4O.	KO.
NH_4ONO_5.	$KONO_5$.
NH_4OSO_3, $MOSO_3$.	$KOSO_3$, $MOSO_3$.
NH_4Cl, $PtCl_2$.	KCl, $PtCl_2$.
etc.	etc.

In those hydrogen salts which are called acids (hydrochloric acid, sulphuric acid, &c.), we have seen that zinc and other metals may take the place of hydrogen, and the like substitution may occur in ammonia itself; bodies being formed having the composition

$$\left.\begin{matrix}M\\H\\H\end{matrix}\right\}N,\ \left.\begin{matrix}M\\M\\H\end{matrix}\right\}N,\ \left.\begin{matrix}M\\M\\M\end{matrix}\right\}N.$$

At present however, the basic nature of such inorganic substitution-ammonias has not been sufficiently studied to be discussed here.

Descriptions of the organic representatives of these substitution products of ammonia, where organic molecules replace one or more atoms of hydrogen, will be found under the heads ORGANIC BASE, AMIDES.

BASE, or BASS, a name sometimes given to the violoncello.

BASE, in *music*, from Βάσις (basis), the base or foundation, the lowest part, whether vocal or instrumental. This word is frequently written *bass*, but the etymology, and more especially the pronunciation, are decidedly in favour of the orthography here adopted, which is sanctioned by Dr. Johnson and other high authorities. "The *base*," says Rousseau, "is the most important of parts—the whole harmony is founded on it: hence it is a maxim with musicians, that when the base is good the harmony is rarely otherwise." M. Subzer adopts this opinion; and we do not differ from two such able writers, without having duly considered the question. But if by the words *most important* is meant that which can least be dispensed with, then both assuredly are in error, for the highest part, or melody, is unquestionably the most essential. It is the theme, the subject, without which the other parts, however numerous, are unintelligible. It being understood that we are not speaking of instrumental accompaniments, such as violin, flute, &c., which, in the score, are frequently above the highest voice part or melody. In composition in two parts, the tyro finds it more difficult to write a correct base than a tolerable melody, but to the sound musician the subject and intermediate parts require more thought than the base.

BASE IN ARCHITECTURE. [COLUMN.]

BASE CLEFT. [CLEFT.]

BASE, CONTINUED. [CONTINUED BASE.]

BASE, DOUBLE. [DOUBLE BASE.]

BASE FEE. [ESTATE; RECOVERY; TENANT-IN-TAIL.]

BASE, FIGURED. [FIGURED BASE.]

BASE, FUNDAMENTAL. [FUNDAMENTAL BASE.]

BASE, GROUND. [GROUND BASE.]

BASE LINE. [GEODESY.]

BASE, THOROUGH. [THOROUGH BASE.]

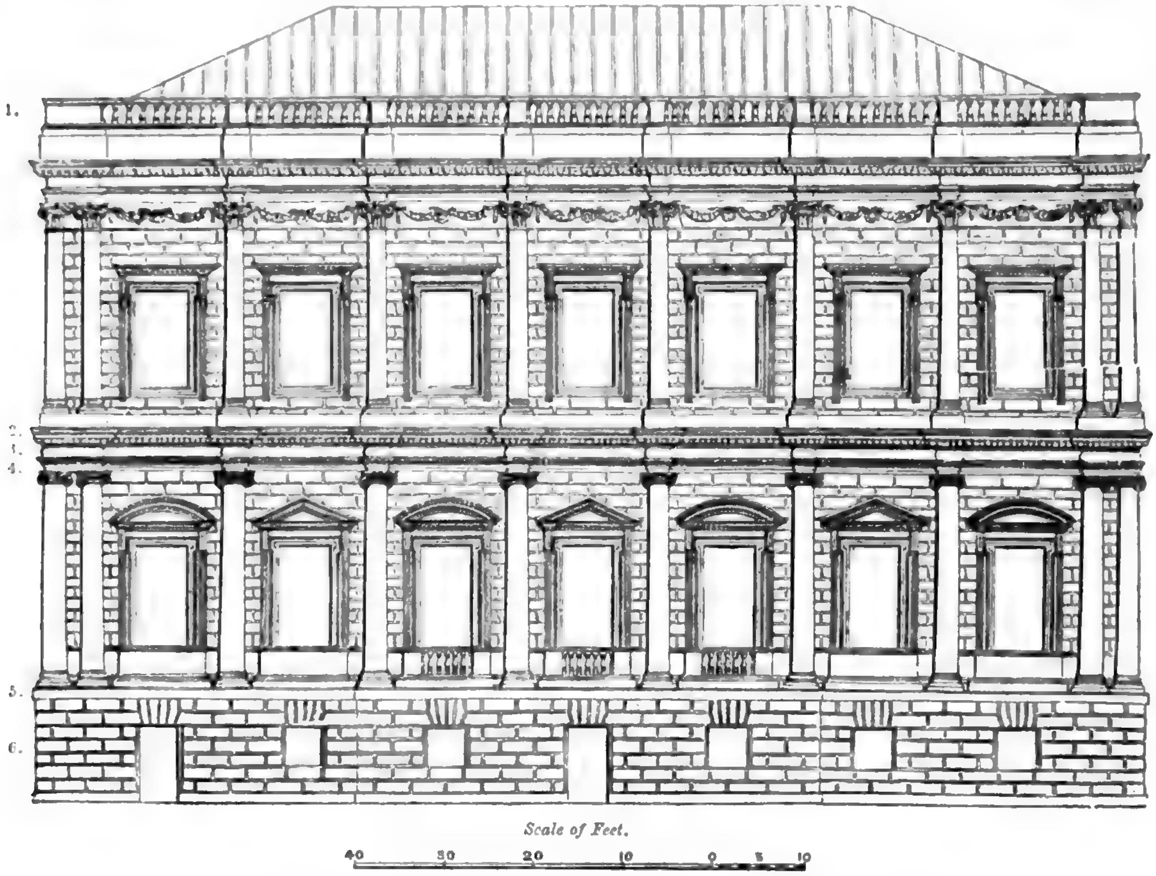
BASE VOICE, the lowest male voice, the usual compass of which is from G or F below the base staff to D or E above it; but some few voices exceed the limits here assigned, and must be considered as exceptions to the rule. Handel, in the aria 'Fra l'ombre,' in his opera of 'Sosarmes,' exacts from the singer a compass of two octaves—from F above the staff to F below; and Purcell, in his anthem 'They that go *down* to the sea in ships,' altogether mistaking the meaning of the word 'down,' and in a wretched endeavour to express descent, writes for the base a run of notes from D above to D below the staff.

BASEL, COUNCIL OF. [COUNCILS.]

BASEMENT, in Architecture, is the lowest story of a building, forming the base of a private house or public edifice. This feature of a building should possess externally the character of strength; and, accordingly, in the designs of Palladio, and the other great masters of the Italian school, we find that the basement has a massive appearance, capable of sustaining the order or orders which are often placed above it. In edifices used as dwellings the basement is high; but in churches and other public buildings it is usually kept low. Some basements are as high in proportion as the floor or story placed above it, while others are not more than a third or a half of the height. The proportions of basements vary according to the conveniences required in the lower story, or to the importance attached to the floor or floors which they may support. Sir William Chambers, in his 'Treatise on Civil Architecture,' gives rules for the proportions of the parts forming the characteristic features of the basement, but at the same time he admits that "the proportions of these basements are not fixed," but depend chiefly on the nature of the apartments forming the ground-floor. "In Italy," he says, "where the summer habitations are very frequently on that floor, the basements are sometimes very high. At the palace of the Porti, in Vicenza, the height is equal to that of the order placed thereon; and at the Thiene, in the same city, its height exceeds two-thirds of that of the order, although it be almost of a sufficient elevation to contain two stories; but at the Villa Capra and at the Loco Arsieri, both near Vicenza, the basement is only half the height of the order, because in both these the ground-floor consists of nothing but offices." These four works enumerated present different proportions, and are all from the designs of Palladio. The true principle is that the proportions of a basement should not be regulated by any rigid rule, but that it be made higher or lower according to the purpose it is intended to subserve in the general design. In the edifices of antiquity the basement is usually low, and intended to support an order of columns. The monuments of Lysicrates and Philopappus at

Athens are, however, examples of high basements. The edifice at Whitehall, to which we have frequently referred, and the Cathedral of St. Paul's, London, have both a low basement.

In basements the masonry is usually rusticated and set upon a plinth, on which there is sometimes a moulded base; the upper part of the basement is surmounted with a broad band, under which, at



Whitehall, London, from a drawing measured and delineated, by Mr. William Barnes, architect.
1. Balustrade. 2. Cornice. 3. Frieze. 4. Architrave. 5. Band. 6. Basement.

times, mouldings are employed. A cornice is also used occasionally instead of the band.

In the beautiful palaces of Rome and Florence the basements are finely proportioned. For geometrical representations of these buildings we refer to the architectural work of MM. Percier et Lafontaine, entitled 'Palais de Rome et de Florence.' The published designs of Palladio, Vignola, and Scamozzi, may also be consulted with advantage by the student in architecture.

BASHA. [Pasha.]

BASIL, MONKS OF ST. When St. Basil, bishop of Cæsarea, retired into Pontus, about the year 358, for the convenience of himself and his followers, he founded a monastery, to which he gave a written rule for its regulation, the first of the kind that had appeared, and which was soon adopted in numerous other monasteries. This rule shortly spread itself over the East, and, according to the generality of writers, was not very long in passing to the West. Those who adopted it styled themselves of the order of St. Basil; and St. Basil's Rule was, in fact, the parent of that which was afterwards framed by St. Benedict. (See Schlosser's remarks on Basil, 'Universalhistorische Uebersicht,' &c., 3 th. 3 abth.)

Dom Alphonso Clavel, the Spanish annalist of this order ('Antiguedad de la Relig. y Regl. de S. Basilio,' c. viii. § 2), says that Basil's Rule was approved and confirmed by Pope Liberius in the same year in which it was written and published, A.D. 363; afterwards by several other popes; and was, in a later age of the Church, revised by Pope Gregory XIII., who, about 1573, united the religious of this order in Italy, Spain, and Sicily into one congregation. The abridgment of this Rule made by Cardinal Bessarion, during the pontificate of Eugene IV., and approved by Gregory XIII., was also confirmed by Popes Clement VIII. Paul V. and Alexander VII.

Moréri gives 1057 as the date when the order was introduced in the West. St. Saviour, at Messina, is now considered as its chief monastery in the West. The monks of St. Basil in Spain follow the Greek, those of Italy the Latin ritual. The Greek monks are chiefly of this order, which exists to a great extent in Russia; though in that country, if we may rely on Dr. King, the monks have deviated from their original Rule. He says, "Basil is generally looked upon as the founder of the order of monks which exists in Russia, though, in truth their Rules, at least those they observe at present, are taken from several different persons; as Ephraim of Edessa, Gregory, Chrysostom," &c. (See 'Hist. des Ordres Monastiques,' 4to, Par. 1714, tom. i. pp. 175–238, where engravings will be found of the dresses worn by both monks and nuns of this order in the respective countries; Moréri, 'Dictionnaire Historique,' fol. Par. 1759, tom. ii. p. 154; King, 'Rites and Ceremonies of the Greek Church in Russia,' 4to, Lond. 1772, p. 365; Rodolph, 'Hospiniani de Monach,' lib. iii.)

The order of St. Basil was never, that we know of, introduced into England; though Sir Roger Twysden, in his 'Rise of the Monastic State,' p. 5 (as quoted by Tanner, Pref. to 'Notit. Monast.' p. li.), says, "The monks of Bangor were not unlike the order of Basil, if not of it." The genuine history of the monastery of Bangor, however, in its earliest period, cannot now be traced upon authority which can be relied on.

BASI'LICA (*βασιλικὰ, βασιλικὸς νόμος*). This term denotes a collection or digest of the 'Corpus Juris' of Justinian, translated from the original Latin into the Greek language. This work was commenced and brought to its present state during the latter part of the 9th and the beginning of the 10th centuries, under the superintendence of the Greek emperors of Constantinople. The design of reducing the laws of Justinian into one Greek book from the several Latin collections in which they were known in the Western Empire, is said to have been originally formed, and was certainly in part executed, by Basil I., called the Macedonian, whose reign commenced A.D. 867, and ended in 886, and from whom the book derives its name. Basil's death occurred before the completion of the work; and all that was effected in his time was a kind of Preface, or Introduction, which was called *Πρόχειρον τῶν νόμων*, and consisted of forty heads, or titles. Leo VI., surnamed the Philosopher, who succeeded his father Basil as emperor of Constantinople, brought the collection considerably nearer to its present form. Under his direction it was distributed into six general heads, each of which was subdivided into ten titles; from which circumstance it is entitled in some manuscripts Ἑξάβιβλος (the Six-Book), and in others Ἑξηκοντάβιβλος (the Sixty-Book). The Basilica were however finally reduced into their present form by Constantine VII., commonly called Constantine Porphyrogeneta, the son of Leo the Philosopher, in the early part of the 10th century, and were published under the title ‘Basilica repetitæ prælectionis.’ From that time the book was commonly used as a code of jurisprudence in the Eastern Empire, whilst it still retains its value in our own day, as a treatise explanatory of Justinian's collection of law.

The Basilica contains the code, digests, institutes, and novellæ of the ‘Corpus Juris;’ and in the latter divisions are inserted some of the later edicts of Justinian himself, of the subsequent emperors of Constantinople, and of Basil the Macedonian in particular; and also a few extracts from the fathers, and decrees of early councils of the Church.

The Greek translation of the Roman law was, in all probability, not made expressly for this work, as the four books containing the institutions of Justinian are known to have been in existence in the Greek language previous to the time of Basil the Macedonian.

Hervetus first published, in Latin only, in 1557, four complete books of the Basilica (lib. 45–48), and two books (28, 29) incomplete. A splendid edition of the Basilica, accompanied by a Latin translation and several valuable scholia, and prepared from a collation of various manuscripts in the Vatican and the Bibliothèque du Roi, was published at Paris by Fabrot, in 1647, 7 vols. fol., to which is prefixed a Report to Pope Urban VIII. upon the history of the Basilica, by Joseph Maria Suarez; but this edition only contains thirty-three books complete, and ten others incomplete. Reitz, in 1752, added four books (49–52), following those of Hervetus; but both editions together only contain thirty-six books complete, and seven with considerable lacunæ in them. Cujacius undoubtedly possessed the Greek text of Book 53–59 inclusive; and the manuscript is possibly still extant, or it must have been lost a long time ago. [CUJACIUS, BIOG. DIV.] A new edition has been published since 1835, at Leipzig, by Professor Heimbach of Jena, in which are comprehended the various readings obtained by the collation of several manuscripts not examined by Fabrot. For a history of the Basilica, see Heimbach's treatise ‘De Basilicorum origine fontibus, scholiis, atque nova editione adornandâ;’ see also ‘Thémis ou Bibliothèque du Juris Consulte,’ vols. viii., ix., and x., for some observations upon the use made by Cujacius of the Basilica. Those readers of the Post Justinianean Law who may be prosecuting inquiries into the history and text of the Basilica, will do well to refer to Haubold's ‘Manuale Basilicorum,’ which, in addition to an accurate enumeration of the books and titles, contains abundant references to parallel passages, as well as to the works of modern civilians.

BASI′LICA, from the Greek *βασιλικὴ*, literally signifies a royal residence: but we have no account of any royal residence being specially called by that name; nor have we any description of Greek edifices called Basilicæ, which may be supposed to have furnished the model of the Roman basilica. The name, indeed, is Greek, and it is highly probable that the building itself was framed on a Greek model, though the fact does not appear to be capable of direct proof. The building at Athens, called the Βασίλειος Στοὰ, or Royal Portico, seems to have been pretty much like a Roman Basilica, as to the purposes for which it was used. This edifice, which is mentioned by Demosthenes (‘Against Aristogeiton,’ chap. 6), contained the court of the Archon Basileus [ARCHON]; and the Areopagus occasionally held their sittings there. (See also Pausanias, i. 3.)

The Romans gave the name of Basilicæ to those public buildings with spacious halls, often surrounded with wide porticoes, many of which were built at different times in the various fora of Rome. They were usually called after the person who caused them to be built, as the Basilica Æmiliana, Porcia, &c. (Livy, xxxix. 44.) At the time of the conflagration recorded in Livy (xxvi. 27), B.C. 210, there were no basilicæ then built. We read in the ‘Bellum Alexandrinum’ (cap. 52) that the basilica was used in the Spanish provinces at the date (B.C. 47) to which that work refers.

Copper Coin of Trajan, from the British Museum, representing on the reverse the façade of the Basilica Ulpia.

The principal feature of the Basilica was a large roofed building, supported on columns. The roof, which was called the *testudo*, rose high above the other part of the structure, which consisted of two galleries, called *porticus*, placed one above the other, and round the internal sides of the central building. The porticus was covered with a lean-to roof, the upper part of which commenced below the capitals of the columns which supported the testudo. The light was admitted between the spaces formed by the under line of the architrave of the testudo, the upper line of the lean-to roof, and the perpendicular lines

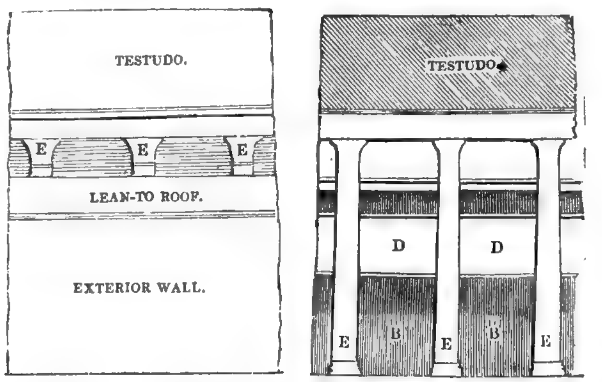
of the columns. At the end of the central part of the interior a raised platform formed the tribunal for a magistrate. The term testudo, as its name implies, is strictly the roof of the central part; but the term is also extended to signify the whole of the central space, which corresponds to what we call the nave of a church; the porticoes correspond to the aisles.

The basilica was not only used as a hall for the administration of justice, but afforded also convenient shelter to the merchants who transacted business there. Vitruvius, who constructed a basilica at the Julian colony at Fanum, informs us that it ought to be built “on the warmest side of the forum, that those whose affairs called them there might confer together without being incommoded by the weather.” “The breadth,” he says, “is not to be made less than the third, nor more than half, the length, unless the nature of the place opposes the proportion, and obliges the symmetry to be different; but if the basilica has too much length, chalcidica are made at the ends [CHALCIDICUM], as in the basilica of Julia Aquiliana.” (Newton's ‘Translation.’)

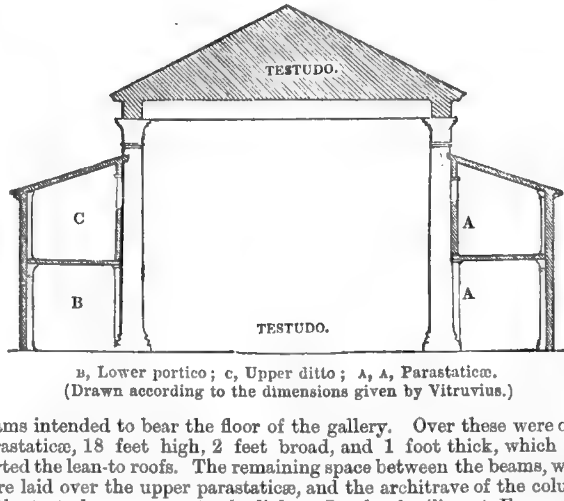
The size and proportions of these edifices varied according to circumstances. The following proportions are given by Vitruvius for the various parts of this structure. The columns of the basilica (by which Vitruvius means the columns engaged in the wall) are to be made as high as the porticus is broad; the porticus is to be as wide as the third part of the space in the middle. The columns of the upper gallery must be one-fourth less than the lower. The pluteum (continued pedestal) must be made one-fourth less in height than the upper columns, and be placed between the upper and lower columns, that those who walk above may not be seen by the merchants; from which circumstance it would appear that the upper gallery was intended for a purpose distinct from the uses of the lower gallery. It is probable that in the upper gallery some kinds of handicraft were carried on.

The dimensions of the basilica built by Vitruvius at Fanum were as follow: the testudo 120 Roman feet long, and 60 broad; the porticus between the walls and columns of the testudo, 20 feet broad; the height of the columns of the testudo, including their capitals, 50 feet, and the diameter 5 feet. Behind these were parastaticæ, or small piers, 20 feet high, $2\frac{1}{2}$ feet broad, and $1\frac{1}{2}$ foot thick, to sustain the

1. 2.



1. Elevation of part of the basilica, showing the columns of the testudo above the lean-to roof of the porticus.
2. Longitudinal section through the testudo. D, D, pluteum; E, E, columns of the testudo.

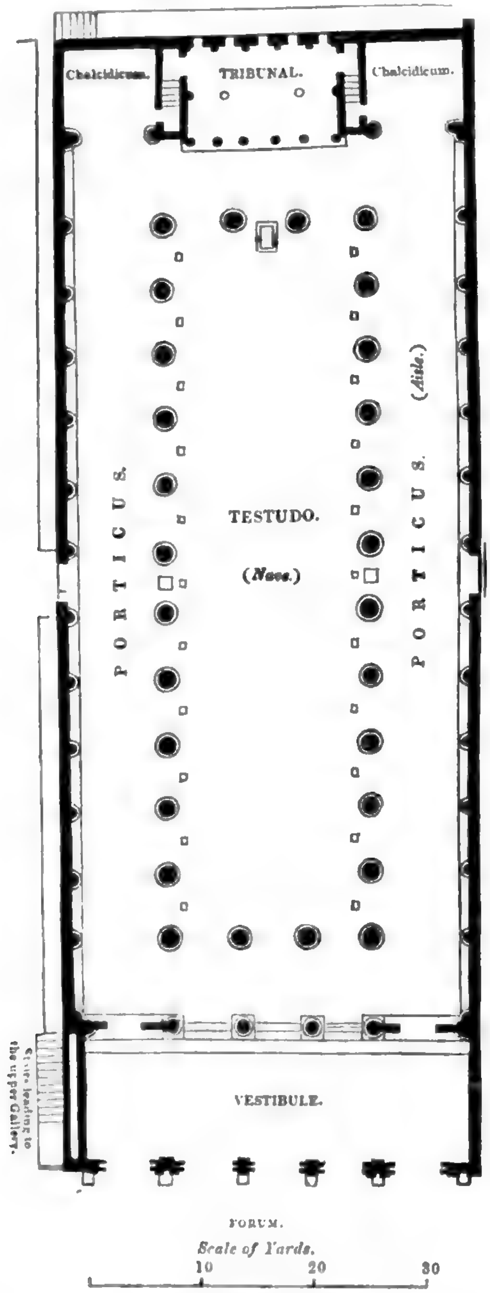


B, Lower portico; C, Upper ditto; A, A, Parastaticæ.
(Drawn according to the dimensions given by Vitruvius.)

beams intended to bear the floor of the gallery. Over these were other parastaticæ, 18 feet high, 2 feet broad, and 1 foot thick, which supported the lean-to roofs. The remaining space between the beams, which were laid over the upper parastaticæ, and the architrave of the columns of the testudo, was open to the light. In the basilica at Fanum, the testudo was supported by eighteen columns, four at each end, six on one side, and four on the other, the two centre columns being omitted on this side, that the view of the pronaos of a temple to Augustus might be seen. The tribunal in this building was in the form of a curved recess, 46 feet wide, and 15 feet deep. To this information Vitruvius adds the proportions of the timbers of the roof.

It is probable that Rome possessed basilicæ in all the different fora of the city. Of these the Basilica of Trajan, which formed a part of the Forum Trajanum [FORUM], is the only one of which there are considerable remains left. Its width was about 180 feet, its length at least double the width. It is represented on the reverse of the medal which we have given above. Another basilica, of the Corinthian order, was discovered on the Palatine Hill. A large edifice in the Forum, called the Temple of Peace, has also been named the basilica of Constantine.

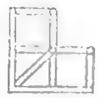
The Emperors Gordian, in their magnificent country residences built on the Via Prænestina, had three basilicæ, 100 feet in length. Two famous basilicæ, Æmilia and Fulvia, were built at Præneste



Plan of the Basilica at Pompeii.

(*Palestrina*), between which Sylla caused a magnificent sun-dial to be placed. The marble fragments of the plan of Rome, now preserved in the Capitol at Rome, which was made during the reign of Septimius Severus, show a part of the Basilica Æmiliana; from which it appears that, unlike the other basilicæ, it had no external wall. In this last respect, it may be compared to a very ancient Greek edifice at Pæstum, which has been generally considered a basilica. This building is an inclosure of columns, without any internal or external walls, and divided in the centre by an order of columns, with another above it. A basilica which was discovered some years since at Otricoli, had a curvilinear recess or hemicycle adorned with statues, which were removed to the museum of the Vatican.

The most perfect basilica of antiquity, and which best corresponds with the building described by Vitruvius, exists in Pompeii, constructed on the south-west, and consequently the warm side of the Forum. This edifice is 220 feet by 80. The testudo rose to the height of about 60 feet, judging from the diameter of the portions of the columns still remaining. These columns are twenty-eight in number, four of which are placed at each end, and the rest on each side of the testudo; they are curiously constructed of brick, and covered with stucco. At the farthest end is the tribunal, raised on a platform, to which the ascent on each side is by a flight of stairs. Under the platform are rooms, conjectured to have been used as temporary prisons for criminals; and in the floor of this platform are circular holes, communicating with the rooms below. On each side of the tribunal are two small square rooms, which, as the Basilica is very long in its proportion, may be considered a part cut off to form Chalcidica. Small engaged columns are attached to the walls inclosing the porticus, on which one end of the beams of the floor were placed, the other being either inserted in the shafts of the brick-columns, or supported on wooden parastaticæ set against their backs, in the manner described by Vitruvius. In the angles the small columns are clustered thus after the manner of Gothic shafts. This arose probably from the circumstance of the beams of the floor of the upper porticus being placed diagonally at the angles, in this manner—



and it is most likely that the under side of the floor was left exposed, as is still the case in the dwellings of Italy, and not covered with lath and plaster, as is the custom in England. The columns being clustered in the angles gave an appearance of strength.

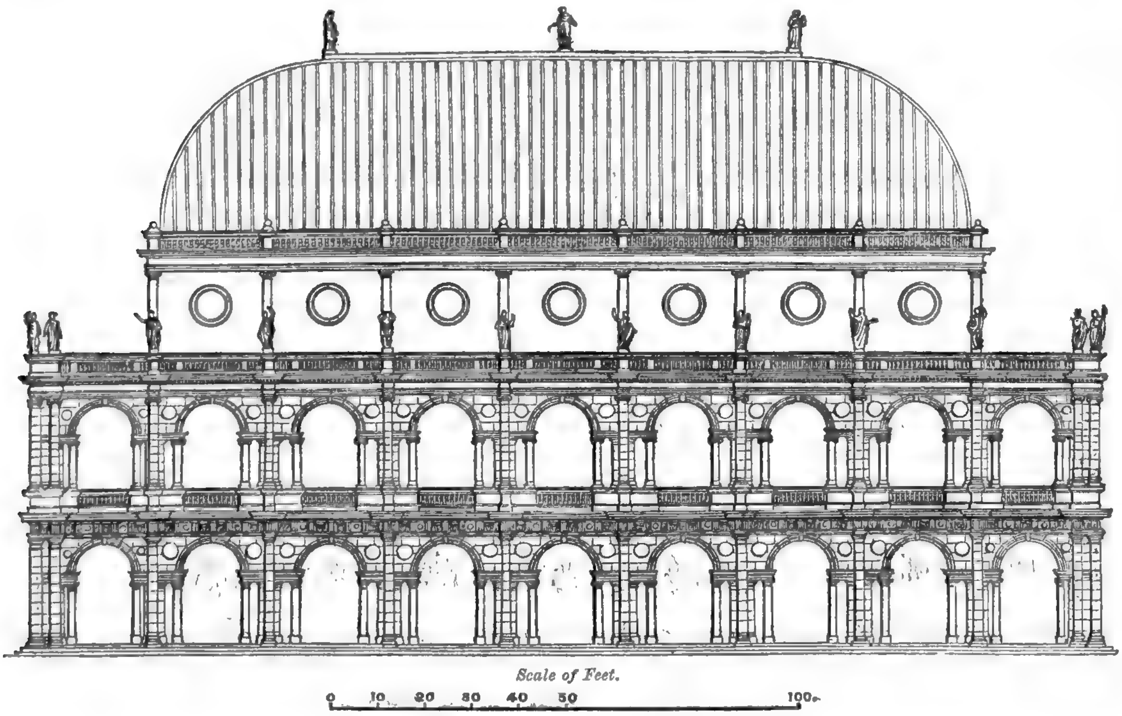
The light, most probably, was admitted in the manner mentioned by Vitruvius; but, in addition, there were windows at the back of the tribunal, which perhaps were at one time glazed, as glass for windows was in common use at Pompeii. The stone door-jambs are remarkable for a large groove, in which we may conjecture that the wooden door-frames were fixed. The doors appear to have folded, as the marks left on the sill from the opening and shutting still remain. The order of the small engaged columns is Corinthian, and the style very similar to that of the Temple of Vesta at Tivoli, and, like that edifice, this Basilica was covered with a fine marble stucco. The most singular decoration is observed in the rusticated plastering of the interior, where the rustics are painted in every variety of colour. The order of the testudo is unknown, as there are no remains of the capitals. It is probable that the columns, from their height, were never covered with the ashes of Vesuvius, which circumstance enabled the inhabitants to remove them.

The early Christian churches of Rome may be considered as the best resemblances of the Roman Basilicæ. In some of them are still found many of the characteristics of the ancient Basilicæ. We give the following list of existing Basilican churches, or parts of churches, at Rome, with their dates (some known, others conjectural), from Bunsen's work on the Basilicæ of Rome, referred to below.—S. Pietro, about 330; S. Paolo, 386; Sta. Sabina, 425; Sta. Maria Maggiore, 432; S. Pietro ad Vincula, 442; S. Lorenzo, 580; Sta. Balbina, 600; St. 'Agnese, 625; Quattro Coronati, 625; S. Giorgio in Velabro, 682; S. Chrisogogno, 730; S. Giovanni a Porta Latina, Sta. Maria in Cosmedin, S. Vicenzo alle Tre Fontane, S. Lorenzo (the nave), SS. Nereo ed Achille,—all about the close of the 8th century; Sta. Prassede, and Sta. Maria in Dominica, in the first quarter of the 9th century; S. Martino ai Monti, 850; Sta. Clemente, 870; S. Nicolo in Carcere, and S. Bartolomeo in Isola, end of 9th century; S. Giovanni in Laterano, 910; Sta. Maria in Trastevere, 1135; Sta. Croce in Gerusalemme, 1144; Sta. Maria in Ara Coeli; Sta. Maria sopra Minerva (noteworthy as a Gothic basilica), 1370; S. Agostino, 1480.

The Marquess Galiani remarks, that the first churches were looked upon as tribunals in which the bishops, &c., administered penance to the guilty and the Eucharist to the absolved. We may therefore observe, in accounting for the resemblance which the early Christian churches bear to the ancient Basilicæ, that nothing could appear at first sight more appropriate than the idea of imitating a tribunal of justice in the construction of the new churches, in which the bishops and priests were to administer a kind of spiritual justice. This remark is well supported by the fact of the bishop's throne being placed in the apsis, or arched recess corresponding to the curved recess or hemicycle, as it was called, of the ancient Basilica. [APSE.] It would seem, in fact, that the obvious convenience of the Basilicæ led the early Christians to convert the ancient Basilicæ into churches, and in their new churches to adopt the principles of that form of building, as these edifices were both light and spacious, and better adapted to the ceremonies of the new religion than the temples of the Pagans.

Constantine has the reputation of having erected the first of these Christian Basilicæ, which was built on the site of his own palace of Lateran, on Mount Cælius. Shortly afterwards he built the Basilica of St. Peter, on the site of the Circus of Nero; and finally commenced a

Interior View of the Basilica of St. 'Agnese at Rome, from a work on Roman Church Basilicæ by I. G. G., Roma, 1823 and 1824.



Elevation of the Basilica at Vicenza, built by Palladio.

third, that of St. Paul, without the walls of Rome. This church was finished fifty years afterwards by Theodosius, who, if we may trust Procopius, built a continuous portico from the city to the Basilica, covered with a copper roof. St. Peter's was decorated with one hundred columns of white marble; it is however now replaced by a more modern structure, the largest of the kind in the world. The external part of the Basilica of S. Giovanni Laterano is of modern construction. St. Paul's without the walls was burnt down some years since, but was afterwards partly restored upon the old plan. The section of this edifice, across the nave, shows the form of the testudo with the inclined roofs of the porticus; and in the spaces between the under side of the roof of the testudo and the upper line of the roof of the porticus, are formed the windows of the church. The other Basilicæ we have not space to notice; but the church of St. 'Agnese exemplifies the peculiar character of the ancient Basilica in so striking a manner, that we give a representation of it, which will illustrate the description of Vitruvius.

In this view will be easily recognised the galleries (porticus) running round three sides of the building, and interrupted by the recess forming the tribunal. In the upper gallery is the pluteum, or continued pedestal, inclosing the same. The nave corresponds to the testudo; the apsis of the church to the hemicycle of the ancient buildings: the only difference is in the manner of piercing the walls for windows, and in the omission of the large columns of the testudo, the two orders of columns standing in the places of the ancient parastaticæ. It is probable that the construction of the roof of the ancient Basilica was exposed, as it is shown here, and as was the invariable practice in almost all the church Basilicæ of Rome. These Basilicæ are built from the old materials of other edifices, and the parts are put together without much regard to symmetry, so that there are often Ionic, Corinthian, and Composite capitals, placed on shafts of columns of various diameters, with portions of entablatures above them, which originally belonged to dissimilar edifices. Santa Maria in Trastevere is an example of these incongruities: here also the throne in the apsis has an antique form, very similar to the hemicycles of the Street of Tombs at Pompeii. The Roman church Basilicæ in their complete form consisted of an atrium, or entrance-court, in the centre of which was the baptismal basin or font; a colonnade, called the narthex, devoted to the use of penitents or catechumen; a nave (*navis*, or *gremium*), where the people assembled to worship; a choir, or chancel, appropriated to the singers and inferior clergy, and in which were the ambones or pulpits; and a sanctuary, or bema, in the centre of which was placed the high altar under a canopy, or baldachin [BALDACHIN], and at the back of which was the apsis [APSIS], in which was the throne of the bishop.

The Roman church Basilicæ are remarkable for their mosaic decorations. [MOSAIC.] The pavements of many of them are enriched with the most elaborate patterns made of the hardest marbles. The arched head of the apsis is often decorated with the figures of saints or apostles upon a gold ground, the whole mosaic being formed of glass tesseræ; but the most sumptuous mosaics are those of St. Peter's, of modern execution, which represent so truly the great works of the best Italian painters, that none but a practised eye can detect the difference.

The general form of the nave, aisles, and apsis of our ancient cathedrals and churches, as well as in those of the Continent, is evidently borrowed from the Italian church Basilica. The nave corresponds to the testudo, and the side aisles to the porticus; the windows of the nave, which externally are seen above the lean-to roof of the aisles, correspond to the opening between the upper part of the columns of the testudo.

Modern Basilicæ exist at the present day in Italy, applied, as the ancient were, to civil purposes. Palladio gives the name of Basilicæ to such public buildings, many of which are found in the Italian towns. Part of the Basilicæ of the present day serve as the palaces of the magistrates, and in them they administer justice, while the lower parts are occupied by merchants, &c. Speaking of these edifices, Palladio says, "Our modern basilicæ differ from the ancient in this, that while theirs were on the ground-floor, ours are elevated on arches, and the parts beneath the arches are used as shops, prisons, and for other public purposes. Another difference is, that the ancient had porticoes only in the interior; the moderns, on the contrary, either have none, or have them on the exterior." There is an example of such a Basilica at Padua, and another at Brescia; but the most celebrated is that at Vicenza, the exterior of which is after the design of Palladio. The body of the building is supposed by Vincenzio Scamozzi to have been erected during the reign and by the command of Theodoric the Goth. This Basilica is 162 feet long by 63 wide; the curved roof is of wood, covered with lead; the great hall is 25 feet 10 inches above the ground-floor, and is supported on piers. This edifice, which reflects great credit on the skill of Palladio, is called at Vicenza "Il Palazzo della Ragione." The architect himself, though a modest man, was so well satisfied with his own performance, that he expressed an opinion that this construction was equal to any Basilica of antiquity.

In England the town-hall, and in France the Palais de Justice, correspond, in some respects, to the modern Italian Basilicæ.

(Vitruvius; Nardini's *Rome*; Nolli's *Plan of Rome, with the Fragments of the Ancient Plan; A Series of Geometrical Plans and Sections, and Perspective Views of the Roman Church Basilicæ*, by I. G. G., Roma, 1823-24; Eustace's *Class. Tour; Plan of Pompeii*, by the Society for the Diffusion of Useful Knowledge; Marquess Galiani's *Translation of Vitruvius; Life of Palladio*, by M. Quatremère de Quincy; *Notizie sulla Antichità e Belle Arti*, Roma; Bunsen, *Die Basiliken des Christlichen Roms* (with the Illustrations of Gutensohn and Knapp); Mazois, *Pompeii*, vol. iii.; Ferguson, *Handbook of Architecture*.)

BASKETS. Baskets have been made from the earliest ages, in most countries where pliant willows, reeds, or grasses are to be met with. In England the osier or willow is chiefly used for this purpose; and many of the specimens produced are exceedingly elegant. The willow twigs or other materials are prepared in various ways, according to the costliness of the basket to be made; and the manufacture consists in a kind of interlacing, very simple in its character, and requiring the aid of but few tools. Any of our excellent blind asylums, where industrial pursuits are carried on, will afford a pleasing exemplification of the ease with which basket-making can be carried on by blind persons.

A very large per-centage of the baskets bought by the middle and working classes in London, are made by poor persons, whose wives and children hawk them about the streets for sale. It is precisely one of those trades likely to put on such a commercial aspect—easy to learn, and requiring little or no capital to carry it on.

Foreign baskets are imported to the value of 30,000*l.* to 40,000*l.* annually. Since the period of the Great Exhibition in 1851, Swiss baskets of very light construction, carved in white wood, have become well known in this country.

BASQUE LANGUAGE. This language, Léngua Bascongáda, called also by the Spaniards Bascuence and Vizcaino, and by the French Basque, is spoken by the people who inhabit the Basque provinces, and part of Spanish and French Navarre. The people call themselves Euscaldunac, their country Euscalerria, and their language Euscara, or Escuara. The latter word is derived, according to Larramendi, from *escuco*, free, and *era*, mode or manner. But this is perhaps hardly satisfactory. The elementary syllable in all these words is *Eusc* or *Esc*, which appears in the forms *Vesc* and *Osc* in such names of places as Vesci and Osca, &c.: the true meaning of this element seems doubtful. Balbi, in his 'Atlas Ethnographique,' places the Euscara in the first family of the European languages, and classes it with the Celtic; which opinion, however, few philologists have hitherto adopted. The Jesuit Beovide, quoted by Abate Hervas, says, that having examined the Celtic Dictionary of Leibnitz, he found only two words common to both languages. But upon this we may remark, that the Jesuit must have looked very carelessly not to have found a larger number: if he had carried his inquiries no farther than the numerals to 20 inclusive, he ought to have arrived at a different result. The Basque language is certainly generally supposed to be totally different from all the European languages; an assertion from which entire assent may be reasonably withheld for the present. It is also loosely said to bear some affinity, if not in its roots, at least in its construction, to some of the Asiatic tongues. We may consider the Celtæ and Iberi as two historically distinct nations, without at the same time assuming, what we can never prove, that they do not descend from one common stock. If we are to believe the Basque grammarians, their language existed before the building of the Tower of Babel, and was brought to Spain by Tubal. Setting aside such extravagances, it may be remarked that the testimonies adduced to prove that the Basque language was spoken by all, or nearly all, the primitive inhabitants of the peninsula, are so numerous and conclusive as to amount almost to a demonstration. The etymology of the words denoting the ancient names of mountains, rivers, and towns in almost every part of the peninsula, is one of the strongest proofs. The word España is purely Basque, according to Astarloa, and means lip or extremity: W. Humboldt, however, disputes this explanation, and apparently with good reason. The river Ebro may be derived from *ibai-ero*, a foamy river, or from *urbero*, a warm river; Carpetania is derived from *gara-be*, with the Latin termination *tania*, and means the place at the foot of the hills. The examples of words in which the first element appears to be Basque are perhaps the most striking: such is *acha, aitza*, a rock, which in names of places assumes the form *asta*. Modern names which contain the element are, Asteguieta, Astobeza, Astorga, &c. In Spanish names mentioned by Roman writers the element *asta* also occurs, as in Asta, Astigi, Asta-pa (a dwelling at the foot of a rock), Astures, Asturica, and the river Ast-ura (rock-water). (See Humboldt's 'Inquiries respecting the first Inhabitants of Spain,' p. 23.) The word *briga*, which occurs at the termination of some ancient Spanish names of places, but which appears much more frequently in Gaul, is considered by Humboldt not to be a Basque word. The explanation of this word by Astarloa may serve to show how cautious we should be in following those who have written on this language. *Bri, vri* and *uri*, he says, mean a peopled place; the termination *ga* is negative, so that *briga* means a place without inhabitants, or a place without a town, or a wild population: hence the words *bergante* in Spanish, and *brigand* in French; but as *briga* is always the termination of the name of a town or inhabited place, we must suppose that the word *briga*, in course of time, got a meaning exactly contrary to its primary meaning. Such an hypothesis, as Humboldt remarks, scarcely needs confutation.

All the radicals in the language are significative, even the names of the letters of the alphabet. The Basques write as they speak, and the sound of their letters, whether vowels or consonants, is fixed. It is said that aspirated and guttural sounds did not exist originally in the language. Even at the present day the Basque people give to the *z* a much softer sound than the rest of the Spaniards. According to d'Iharce Bidassouet, quoted by Balbi, the names of the alphabetical characters, nouns, pronouns, and adverbs, may be converted into verbs. The Basque language possesses a great variety of terminations.

Besides terminations equivalent to all those existing in English, it has frequentative, diminutive, and argumentative terminations, like the Spanish and Italian. Verbal nouns are formed with the termination *ari* or *arija*, to denote a physical actor, and *lia*, to denote a moral one: as *gudarija*, a warrior, *iracuslia*, a teacher or doctor. For the abstract substantives it has likewise two terminations, *tassuna* and *querija;* the former denotes a natural and the latter a moral quality, defect, or perfection. Thus, *zoratassuna* denotes madness, as a physical derangement of the mind; *zoraquerija*, an inclination to madness from a strong passion. The possessive terminations are three, *cua*, to denote something contained in the thing expressed by the word; *arena*, to denote the possessor; and *ez* or *ezco*, to express the matter of which it is formed: as *echecua*, contained in or belonging to the house; *guizonarena*, of the man; *olezcua*, made of wood. From the last the Castilians have formed their patronymic, and perhaps their abstract nouns; as *Fernandez*, Ferdinandson; *amarillez*, paleness. The Basque substantives have no sign to express the relation of gender. There is but one article, which is *a* for the singular, and *ac* for the plural. This sign forms the characteristic of nouns as to number, and is in all cases affixed to the substantive: as, *guizona*, *man-the;* *guizonac*, *men-the*.

According to Astarloa, there are but six cases in the declension of the Basque words; but Bidassouet marks eleven. As the preposition is always affixed to the noun, there may be said to exist as many cases as there are prepositions. The verbs are divided into simple, or those expressing a single action, as *icassi*, to learn by one's self; double, as *i-ra-cassi*, to learn by the assistance of another; simple active, as *iltendot*, to kill; and active transitive, as *iltendeutzat*, to kill another. The moods are eleven, and the tenses, according to some Basque grammarians, amount to forty-six. Every verb can be conjugated in twenty-six forms, showing the different relations of the agent to the action and to the object which it affects.

The relation of the speaker to the person spoken to is also expressed by particular terminations. These relations are with regard to sex and dignity. Thus there are five different terminations; namely, masculine and feminine, from an inferior to a superior, and *vice versâ*, and also between equals.

The syntax is very simple, and subject to fixed rules. In every sentence the substantive is placed first, next the article, then the adjective, next the adverb, followed by the verb, and lastly the object, with the preposition affixed to it. Example: *Seme oquer bat-ec emon-d-eus-cuz ardura-one ec;* the literal meaning—"son-crooked-one, given-us-has-to, cares-these;" which means, a bad son has caused these troubles to us. This order is that in which, generally speaking, an illiterate Basque places the words when he attempts to speak Spanish, for which reason the Spaniards call *concordancia Vizcaina* a bad construction.

The Basque is divided into three dialects, not much differing from one another; namely, the Guipuzcoan, the Vizcaino, and the Labortan. The first is the purest, and is spoken in Guipuzcoa; the second, in Vizcaya and Alava; and the Labortan in the French and Spanish Navarre. The only Basque books are grammars and dictionaries, the Bible, books of devotion, proverbs, and songs. In 1824, a very interesting work appeared at Donostian (San Sebastian), upon the ancient usages, dances, games, and songs (of which many still exist, most of them possessing a slow and monotonous character, but with considerable power) of the Guipuzcoans, published by Iztueta, the title of which is 'Guipuzcoaco dantza, gogoangarrien, condaira, edo istoria beren,' &c. The same author published, in 1826, another work, entitled 'The very Ancient Melodies of Viscaya,' &c. This work contains thirty-six airs to as many dances, with their respective words. M. Duhalde, a learned philologist of the Basque nation, has published a work in which he has compared and contrasted the variations found in the different literary productions of the Basque provinces. Le Compte Garat also published, in 1835, 'Fragments inédit. de Littérature Basque,' collected by him.

The best grammars are those of Lécluse in French, and Larramendi in Spanish. The latter author published also a dictionary in Spanish, Latin, and Basque, which is considered the best. Whoever wishes to investigate the very curious structure of the Basque language will derive great assistance from the labours of Lécluse, professor of Greek and Hebrew literature at Toulouse, who published a short dissertation upon the language in 1826, and also his grammar in the same year. Lécluse, in 1828, put forth a proposal for publishing a dictionary of the Basque, Spanish, and French, which it is much to be regretted did not meet with the encouragement which such a work merited.

The following are among the recent works on the Basque language which may be serviceable to the student: the new editions of Larramendi's Dictionary (2 vols. fol., San Sebastian, 1853-4), and Grammar (8vo, San Seb., 1853); S. H. Blanc's 'Grammaire de la Langue Basque, d'apres celle du P. M. de Larramendi,' 8vo, Lyon, 1854; J. B. Archer's 'Grammaire Basque-Française, à l'usage du Pays-Basques,' 12mo, Bayonne, 1854; A. Oihenart's 'Proverbes Basques, suivies des Poésiès Basques,' 2nd ed., Bord., 1847; and the 'Histories of the Early Usages, Language, &c., of the Basque People' (founded on the work of Iztueta), by Chaho (Bayonne, 1850) and Baudrimont, 8vo, Paris, 1854.

BASSET-HORN, a musical instrument, which, notwithstanding its name, is a clarinet [CLARINET] of enlarged dimensions and extended scale, said to have been invented in Germany in 1770, but known to have been produced in an improved state twelve years later by M. Lotz of Presburg; and subsequently, in its present perfect condition, by the brothers, Anthony and John Stadler, of the imperial Austrian chapel. The basset-horn is longer than the clarinet, and the bell end is wider. On account of its length, the tube, which consists of five pieces, is bent inwards, forming a very obtuse angle. The scale of this instrument embraces nearly four octaves,—from C the second space in the base, to G in altissimo, including every semitone; but its real notes, in relation to its use in the orchestra, are from F below the base staff,  to C, the second leger line above the treble, 

The basset-horn takes an intermediate place between the clarinet and bassoon, and, on account of its vast compass, may perform the functions of both. Its capabilities and beauty are strikingly displayed in Mozart's 'Requiem'; and in the aria, 'Non più di fiore,' in his 'Clemenza di Tito'; as well as in other works of the same great composer, who well understood its value.

The Italian name for this instrument, and that by which it is generally designated in scores, is *corno bassetto*, or *rather low horn*, the termination *etto* being a diminutive. The unfitness of this term must at once be obvious: but, unhappily, musical nomenclature abounds in obscurities and contradictions.

BASSIC ACID. [STEARIC ACID.]

BASSO DI CA'MERA, a double-base, or *contrabasso*, reduced in size and power, but not in compass, and thus adapted to small or private rooms.

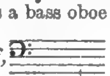
The dimensions of the body of this instrument are as follows:—

Length	3	feet.
Width above	16	inches.
Width below	21	„
Depth under the bridge	7½	„
Length of strings from bridge to nut	31	„

It has four strings; two of gut and two covered with silver wire, all proportionably thicker than those of the violoncello, and tuned in 5ths, to the same literal notes as the violin, but two octaves lower than the latter. Example:

Hence, and by referring to the article DOUBLE-BASE, it will be seen that this new instrument has a great advantage, in respect to compass, over the other; and in quality of tone it is far superior in chamber music, though neither powerful enough nor designed to supersede, or even to be used as a substitute for, the double-base in the full orchestra.

BASSO-RILIEVO. [ALTO-RILIEVO.]

BASSOON, a musical instrument of the pneumatic kind, blown through a reed. It consists of four pieces, or tubes of wood, bound together, and pierced for ventages, of a brass craned neck, in which the reed is inserted, and of several keys. The whole length of the tubes is 6½ feet, but by doubling up, this is reduced to four. It may be considered as a bass oboe [OBOE]; and its compass is from B flat below the base staff,  to B flat in the treble staff. 

This instrument is used in every kind of music, the richness of its tone and the extent of its scale rendering it invaluable to the composer. Handel seems to have been the first who gave importance to it, and in the air 'Thou didst blow,' in the oratorio of 'Israel in Egypt,' exhibited its qualities in so advantageous a manner, that it immediately afterwards began to assume a rank in the orchestra which it has ever since retained.

The bassoon was invented as early as the year 1539, three years after Luscinius had published his 'Musurgia,' who consequently does not mention the instrument. Mersenne describes it and all its varieties; but a long time elapsed before it came into use. The word is derived from the Italian *bassone*, which is now rarely used. The common Italian term is *fagotto*, a fagot, or bundle of sticks, because the tubes of which the instrument is composed are bound together. The Italian word *fagotto* is always employed in musical scores.

The brass bassoon, with a new system of holes and keys, which excited some attention at the time of the Great Exhibition of 1851, as the invention of M. Sax, was claimed by Mr. Cornelius Ward of London, who had previously taken out a patent for it in France.

BASSOON, DOUBLE, a bassoon of increased dimensions, the scale of which is an octave below that of the ordinary bassoon. The double-bassoon was introduced at the commemoration of Handel in 1784, but not having been found to answer the intended purpose, it fell into disuse, the serpent [SERPENT] well supplying its place.

BASSORIN. [GUM.]

BASTARD. The conjectures of etymologists on the origin of this word are various and unsatisfactory. Its root has been sought in several languages—the Greek, Saxon, German, Welsh, Icelandic, and Persian. For the grounds on which the pretensions of all these languages are respectively supported, we refer the curious to the glossaries of Ducange and Spelman, the more recent one of Boucher, and to the notes on the title 'Bastard' in Bacon's 'Abridgment.'

Among English writers it is applied to a child not born in lawful wedlock, and as such he is technically distinguished from a *mulier* (*filius mulicratus*), who is the legitimate offspring of a *mulier* or married woman.

Our ancestors very early adopted strict notions on the subject of legitimacy; and when the prelates of the 13th century were desirous of establishing in this country the rule of the canon law, by which children born bastards are legitimated upon the subsequent intermarriage of their parents, the barons assembled at Merton (1235) replied by the celebrated declaration, "that they would not consent to change the laws of England hitherto used and approved."

It has been observed, that this sturdy repugnance to innovation was the more disinterested, inasmuch as the lax morality of those days must probably have made the proposition not altogether unpalatable to many to whom it was addressed. The opposition therefore seems to have been prompted by a jealousy of ecclesiastical influence, which was at that time ever watchful to extend the authority of the church by engrafting on our jurisprudence the principles of the canon law.

On another point our ancestors were less reasonable; for it was very early received for law, not only that the fact of birth after marriage was essential to legitimacy, but that it was conclusive of it. Hence it was long a maxim that nothing but physical or natural impossibility, such as the continued absence of the husband beyond seas, &c., could prevent the child so born from being held legitimate, or justify an inquiry into the real paternity.

Their liberality in the case of posthumous children was also remarkable; for in the case of the Countess of Gloucester, in the reign of Edward II., a child born one year and seven months after the death of the duke was pronounced legitimate; a degree of indulgence only exceeded by the complaisance of Mr. Sergeant Rolfe, in the reign of Henry VI., who was of opinion that a widow might give birth to a child at the distance of seven years after her husband's decease without wrong to her reputation. (Coke upon Littleton, 123, b. note by Mr. Hargrave; Rolle's 'Abridgment'—Bastard; Le Marchant's 'Preface to the case of the Banbury Peerage.')

The law now stands on a more reasonable footing, and the fact of birth during marriage, or within a competent time after the husband's death, is now held to be only a strong presumption of legitimacy, capable of being repelled by satisfactory evidence to the contrary.

Another curious position of doubtful authority is also found in our old text writers; namely, that where a widow marries again so soon after her husband's decease that a child born afterwards may reasonably be supposed to be the child of either husband, then the child, upon attaining to years of discretion, shall be at liberty to choose which of the two shall be accounted his father. It was to obviate this embarrassing state of things, that the civil law prescribed an '*annum luctûs*,' or year of grief, during which the widow was prohibited from contracting a second marriage; and our own law provided the now obsolete proceeding on a writ *de ventre inspiciendo*.

The legal incapacities under which an illegitimate child labours by the law of England are few, and are chiefly confined to the cases of inheritance and succession. He is regarded for most purposes as the son of nobody, and is therefore heir-at-law to none of his reputed ancestors. He is entitled to no distributive share of the personal property of his parents, if they die intestate; and even under a will he can only take where he is distinctly pointed out in it as an object of the testator's bounty, and not under the general description of 'son,' 'daughter,' or 'child,' by which legitimate children alone are presumed to be designated. He may however acquire property himself, and thus become the founder of a fresh inheritance, though none of his lineal descendants can claim through him the property of his reputed relations. If he dies without wife, issue, or will, his lands and goods escheat to the crown, or lord of the fee. In the former event, it is usual for the crown to resign its claim to the greater part of the property on the petition of some of his nearest *quasi* kindred.

Strictly speaking, a bastard has no surname until he has acquired one by reputation, and in the meantime he is properly called by that of his mother.

The first English statute which provides for the maintenance of illegitimate children is the 18th of Elizabeth, cap. 3, which confers on justices of the peace the power of punishing the parents, and of requiring from one or both of them a weekly or other payment for their support. Under this and later Acts of Parliament, the usual practice was for the mother to apply for relief to the parish officers, by whom she was carried before certain magistrates to be interrogated respecting the paternity of the child. An order of filiation was then made, and the male adjudged to be the reputed father, and ordered to contribute a weekly payment, or to indemnify the parish against the future expenses of maintenance. (Blackst. 'Com.,' Mr. Kerr's ed., vol. i. p. 480, *et seq.*)

The commissioners appointed in 1832 to inquire into the administration of the Poor-Laws, recommended the exemption of the reputed father from all liability to the support of the child. The proposal was supported by arguments not devoid of plausibility, and is said to be sanctioned by the favourable experience of other countries; it was however strenuously opposed in both Houses of Parliament, and was eventually so modified as to leave the law nearly as it stood before. ('Report of the Commissioners,' pp. 165, 343, 8vo. ed.; stat. 4 & 5 Will. IV. c. 76; 2 & 3 Vict. c. 85.)

The proceedings to affiliate a child are now, except in certain cases, exclusively at the instance of the mother (7 & 8 Vict. c. 101; 8 Vict. c. 10), who is bound in any case to maintain the child, and in case of neglect to do so, may be punished as a rogue and a vagabond. (5 Geo. IV. c. 83.)

The civilians and canonists distinguish illegitimate children into four or five classes not recognised in the English law; it may however be worth while to remark, that the familiar term *natural*, applied by us to all children born out of wedlock, is in that classification confined to those only who are the offspring of unmarried parents living in concubinage, and who labour under no legal impediment to intermarriage. Children of the last-mentioned class are, by the civil and canon law, capable of legitimation by the subsequent union of the parents, or by other acts which it is needless here to particularise. (Heineccius, 'Syntag.' v. i., p. 159; Ridley's 'View,' &c., p. 350, ed. 1675; Godolphin's 'Repertorium Canonicum,' cap. 35.)

By the Athenian law (passed in the archonship of Eucleides, B.C. 403), as quoted by Demosthenes ('Against Macartatus,' cap. 12), illegitimate children were cut out from all inheritance and succession; nor could a man who had legitimate male offspring leave his property to other persons, and consequently not to his illegitimate children. A previous law of Pericles ('Life' by Plutarch, cap. 37) declared that those only were legitimate and Athenian citizens who were born of two Athenian parents. This law, which was repealed or violated in favour of a son of Pericles, was re-enacted in the archonship of Eucleides. (Athenæus, xiii. 577; Demosthenes 'Against Eubulides,' cap. 10.)

The repute in which spurious children have been held has varied in different ages and countries. In some they have been subjected to a degree of opprobrium which was inconsistent with justice; in others, the distinction between base and legitimate birth appears to have been but faintly recognised, and the child of unlicensed love has avowed his origin with an indifference which argued neither a sense of shame nor a feeling of inferiority. When the Conqueror commenced his missive to the Earl of Bretagne by the words, "I, William, surnamed the Bastard," he can have felt no desire to conceal the obliquity of his descent, and little fear that his title would be defeated by it. Accordingly, history presents us with many instances in which the succession not only to property, but to kingdoms, has been successfully claimed by the spurious issue of the ancestor. It is however very improbable that, in any state of society where the institution of marriage has prevailed, children born in concubinage and in lawful wedlock should ever have been regarded by the law with exactly equal favour. (Ducange, 'Glossary,' tit. 'Bastardus.')

Those who may be curious to learn what fanciful writers have urged in proof of the superior mental and physical endowments of illegitimate issue, may refer to Burton's 'Anatomy of Melancholy,' vol. ii. p. 16 (ed. 1821); Pasquier 'Recherches,' chap. 'De quelques memorables bâtards;' and Pontus Heuterus 'de Liberâ Hominis Nativitate.' See also Shakspere's 'King Lear,' act. 1, scene 2; and the observations of Dr. Elliotson in his edition of Blumenbach's 'Physiology,' in notes to chap. 40.

BASTARDY. Under the act of Elizabeth and later acts of parliament, down to the passing of the Poor Law Amendment Act in 1834, the usual practice was for the mother to apply for relief to the parish officers, by whom she was carried before the magistrates in petty session to be interrogated respecting the paternity of the child. An order of affiliation was then made, and the reputed father was ordered to contribute a weekly payment, or was bound to indemnify the parish against the future expenses of maintenance. "In form, the proceeding was against the putative father for the indemnification of the parish; but in substance it was a proceeding of the mother against the putative father, the benefit of which accrued to her, and to which the parish was little more than a nominal party, except when it made good the father's default. It was in truth an action of the mother against the putative father, for a contribution towards the expenses of their common child, in which by a fiction of law, the parish was plaintiff." ('On the law concerning the maintenance of bastards, by the Poor Law Commissioners,' Parl. paper, No. 31, session 1834.) In this state of things the Commissioners of Poor Law Inquiry (1834) recommended that the mother of a bastard should be rendered liable for its maintenance, but that she should be exempted from the punishment under 30th Geo. III. c. 51, and that all enactments charging the putative father should be repealed. The Bill for amending the Poor Law, brought in in 1834, as it ultimately passed (4 & 5 Will. IV. c. 76, ss. 72–76), enacted that the parish might still apply for an order upon the putative father, but this was to be done at the quarter sessions instead of the petty sessions; and corroborative evidence was required; and other difficulties and onerous conditions were thrown in the way, which showed that "the object of the legislature was to impede rather than encourage the applications to quarter sessions." The number of bastards affiliated in England and Wales, in the years ending respectively 25th of March, 1835 and 1836, was 12,381 and 9686. The practice of affiliation was therefore rapidly diminishing under the Poor Law Amendment Act, but it was alleged that the putative father was not punished, while the consequences fell solely upon the woman. In 1839, therefore, an act was passed (2 & 3 Vict. c. 85) which transferred the power of making orders in bastardy from the quarter sessions to any two justices in petty sessions, and facilitated instead of discouraged affiliations. Payments by putative fathers under orders in bastardy, were, under 2 & 3 Vict. c. 85, "limited to the cost of the relief actually given; they have been made bonâ fide to the parish, and therefore the parish has not been a purely formal party to the proceeding, and a mere screen to the woman." (Report of Poor Law Commissioners, Jan. 31st, 1844.) The law respecting bastardy has been still more recently the subject of legislation, and by 7 & 8 Vict. c. 101, the principle of charging the putative father is totally different from that of any previous law on the subject. "Formerly the remedy was intended exclusively for the parish: now the mother alone can obtain it. . . . . . Formerly the chargeability of the child, either in fact or in prospect, was the ground of the remedy: now the actual or probable chargeability of the child is made wholly immaterial." ('Official Circular,' No. 39, Oct. 1, 1844.) The officers of all parishes and unions are deprived of the power of applying for orders of affiliation with regard to illegitimate children, and the mother alone is entitled to apply, at the petty sessions, for such order; but in case of the death or incapacity of the mother, the guardians of unions, or if there are no guardians the overseers, may enforce an order although they cannot apply for one, and payments are to be made to some person appointed by the justices to have the custody of the child, and not to the parish officers; and such person is to receive the child on the condition that it is not to be chargeable. Parish officers are guilty of misdemeanour for endeavouring to promote the marriage of a mother of a bastard, by threats or promises respecting any application to be made for maintenance. The mother of a bastard may summon the putative father before the petty sessions within twelve months after the birth of the child, for the purpose of affiliation, or at any time on proof of money having been paid to her in respect of such child. The justices may then make an order on the putative father for maintenance of the child and other costs, and enforce the same by distress and commitment; but not more than thirteen weeks' arrears can be claimed. The sum paid for maintenance is to be paid to the mother, and if she neglect or desert her offspring she may be punished under the Vagrant Act (5 Geo. IV. c. 83). While unmarried or a widow, the mother is liable for the maintenance of the child until it is sixteen. Any person having the care of a bastard child under an order of maintenance, who maltreats it, or misapplies moneys paid by the putative father for its support, is liable to a penalty of 10*l.* on conviction before two justices. The putative father may appeal to the quarter sessions, as under the old law. The stat. 8 & 9 Vict. c. 10, contains forms, and regulates the proceedings at petty sessions and on appeal. All orders for the maintenance of a bastard cease after it has attained the age of thirteen, or on the marriage of the mother.

In the Savings Bank Act (7 & 8 Vict. c. 83) there is a clause under which the deposits of illegitimate persons who die intestate may be paid to their heirs, as if they had been legitimate; but in other respects the law relating to the succession and inheritance of bastards remains the same. By 6 Will. IV. c. 22, the incapacity of bastards in England to dispose of their moveable estates by will was removed.

The late Mr. Rickman was the first who attempted to ascertain the number of illegitimate births in England. During the progress of the census of 1831, he obtained from the ministers of churches and chapels the number of bastards born in their parishes or chapelries in 1830. The number returned was 20,039. Under the Registration Act (6 & 7 Will. IV. c. 86) no specific reference is made to illegitimate children, but the penalty for making a false statement combined with the local knowledge of the registrars, in most cases prevents such children being registered as born in wedlock. Still there is no doubt that the registrar's returns will give something less than the real number of illegitimate children born. Of the births which escape the vigilance of the registrars, it is most probable that the proportion of those which are illegitimate is greater than in the total registered births. Still-born children are not registered in England, and here again the proportion is higher for illegitimate births than for births in wedlock. In Saxony the proportion of still-born children to 10,000 illegitimate births is 616, in 10,000 other births 464. Whatever may be the number of illegitimate births as they appear on the face of the register, it may safely be assumed that they are below the actual number. If the mortality of illegitimate children were the same as that of children born in wedlock, the number of illegitimate persons living would exceed one million for England and Wales. It is both a social and political evil when so large a proportion of persons exist in any society with ties of a different nature from those of the majority of the population. The condition of an illegitimate child is very frequently a hard one from the moment of its birth.

BASTARDY. The Scottish law of bastardy differs considerably from the English, chiefly in consequence of its having adopted much of the Roman and pontifical doctrines of marriage and legitimacy.

Thus, in England, in the case of a sentence of nullity of a marriage, the issue born during the cohabitation are bastards. But agreeably to the judgment of the canons, 'Decret. Greg.,' lib. iv. tit. 17, c. 14, the Scottish writers, having regard to the *bona fides* of the parties, incline to a different opinion, *in favorem prolis;* and it will be recollected that when Secretary Lethington proposed to Mary Queen of Scots a divorce from Darnley, James Earl of Bothwell, to quiet her fears for her son, "allegit the exampill of himself, that he ceissit not to succeid to his father's heritage, without any difficultie, albeit thair was divorce betwixt him and his mother." The point has not, however, received a judicial determination, and cannot therefore be regarded as settled, though of the tendency of the law there can be little doubt. Even in the case of a marriage where one of the parties is, unknown to the other, already married to another person, still in life, the weight of authority inclines strongly to the side of the legitimacy of the offspring, in favour of the *bona fides* of one of the parents. Of course, the issue of every legal marriage is lawful, and therefore the children not only of marriages regularly solemnised, but also of every union acknowledged by the law as a marriage, are alike legitimate. The same may be said of children legitimated by the subsequent intermarriage of their parents; but the situation of these is, as we shall immediately see, somewhat anomalous.

The Scottish law has adopted two species of legitimation, which, in the language of the civil law, it calls legitimation *per subsequens matrimonium*, and legitimation *per rescriptum principis.*

The former of these was introduced into the Roman jurisprudence by a constitution of the Emperor Constantine the Great, but did not become a permanent method of legitimation till the time of Justinian. It was afterwards adopted by the Roman pontiffs and disseminated by the ecclesiastics throughout Europe. At the parliament of Merton, however, the doctrine met with a repulse from the barons of England; but though the English law was preserved inviolate, yet the ecclesiastics did not cease to press the point among the people, and to this day we may remark traces of the custom in some of the remoter districts of the island.

The doctrine was certainly no part of the ancient common law of Scotland any more than of England; but it is now settled law there, and its rise and establishment are unquestionably to be referred to the influence of the canon and civil laws in that country. The principle on which the doctrine rests was once supposed to be a fiction of law, that the marriage of the parents related back to their child's birth. If the parents could not then have legally married, or if a *mid impediment* intervened between the birth and the marriage, it was thought that the fiction was excluded, and that the previous issue would not be legitimated by marriage. But in one of these cases this theory has been overruled, and it has been decided that an intervening marriage of one of the parties to another person does not prevent the subsequent marriage of the two parents from legitimating their children born previously in bastardy. The sole restriction now admitted is that which was established simultaneously with the first introduction of the principle in the civil law, namely, that the parents must have been capable of contracting marriage with each other at the time of the birth of the offspring. It is not, however, decided whether, in the case of an intervening marriage of the father to another woman, by whom he has issue, the subsequent legitimation of bastards whom he had prior to that marriage will give them the rights of primogeniture over its issue. It is thought it would not, although, in the general case, a child legitimated takes precedence of its full brothers and sisters born in subsequent wedlock. If the father is domiciled in a country which does not admit the doctrine, legitimation will not follow from subsequent marriage; but the circumstance of the marriage taking place in such a country will not prevent legitimation from taking effect, if the father is domiciled in Scotland. In England the judges have held, that a child born in Scotland before marriage, and legitimated in Scotland by subsequent marriage, though in point of fact the first-born son, and in status and condition, by comity, legitimate in England, will not succeed to land in England.

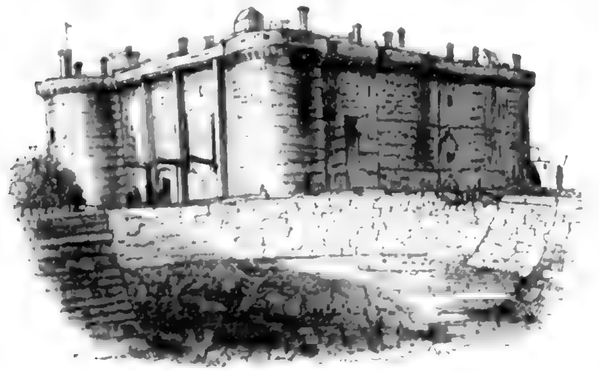
Legitimation *per rescriptum principis* proceeds on a less abstract and more generally-acknowledged principle than the preceding. Though, therefore, it is said to have been invented by Justinian, and copied by one of the popes of Rome, yet concessions in the nature of letters of legitimation are not peculiar to the Roman law. The form of these letters seems to have been borrowed by the Scots immediately from the old French jurisprudence: their clauses are usually very ample, capacitating the grantee for all honours and offices whatsoever, and to do all acts in judgment or outwith, and, in short, imparting to him all the public rights of lawful children and natural-born subjects, together with a cession of the crown's rights by reason of bastardy; but as the crown cannot affect the rights of third persons without their consent, letters of legitimation do not carry a right of inheritance to the prejudice of lawful issue.

As, in the Mosaic law, a bastard was debarred from the congregation, so, according to the canons, he is, in strictness, incapable of holy orders; and, indeed, it has been the policy of most nations to incapacitate bastards in divers ways, that if men will not be deterred from immorality by a sense of the injury accruing to themselves, they may by a consideration of the evils resulting to their offspring. But whatever may be the operation of those incapacities, they are felt by all to be wrongs inflicted on the innocent; and as Justinian properly observed, when he made legitimation *per subsequens matrimonium* a perpetual ordinance, 'indigni non sunt qui alieno vitio laborant.' Accordingly, such doctrines are now obsolete in Scotland. There is no distinction between a bastard and another man, in respect of power to dispose of his property in life or after death, and he may succeed to any estate, real or personal, by special destination. To his lawful children, also, he may appoint testamentary guardians; and his widow has her provisions like other relicts. It is to be noted, however, that in the eye of law a bastard is *nullius filius;* and being thus of kin to nobody, he cannot be heir-at-law to any one, neither can he have such heirs save his own lawful issue. Where a bastard dies, leaving no heir, the crown, as *ultimus hæres,* succeeds both to his personal and real estate, but commonly makes a gift of it to the person who would have been his heir if he had not been a bastard. As regards land held of a subject superior, the grantee must obtain from the Court of Session a decree declaring the bastardy, and thereupon he is presented by the king to the superior as his vassal.

But though bastards are legally *nullius filii,* yet the law takes notice of their natural relationship for several purposes, and particularly to enforce the natural duties of their parents. These duties are comprised under the term *aliment,* which here, as in the civil law, comprehends both maintenance and education; including under this latter term, as Lord Stair says (b. l. tit. 5, sec. 6), "the breeding of them for some calling and employment according to their capacity and condition." In determining who is the father of a bastard, the Scottish courts again proceed on the principles of the civil law. In Scotland there must first be semi-plenary evidence of the paternity, and then, when such circumstantial or other proof of that fact is adduced as will amount to *semiplena probatio,* the mother is admitted to her *oath in supplement.* The whole aliment is not due from one parent, but from both parents; and therefore, in determining what shall be payable by the father, the ability of the mother to contribute is also considered. The absolute amount of aliment, however, is in the discretion of the court, as is likewise its duration.

The mother of a bastard is entitled to its custody during its infancy; but afterwards the father may take the rearing of the child into his own hand, and may also nominate to it *tutors* in the event of his death.

BASTILE, or BASTILLE, the name used in France to denote a fortress or state-prison. There have been three of that name at Paris, the Bastile du Temple, the Bastile of St. Denis, and that of the Rue St. Antoine. We shall only treat of the last, which has obtained historical celebrity, and is usually denominated The Bastile. This fortress stood at the east end of Paris, on the north side of the Seine. It was originally intended for the protection of the city, but afterwards was used as a state-prison. Hugues d'Aubriot, Prevost des Marchands in the reign of Charles V., laid the first stone on the 22nd of April, 1369, by the order of that king. There had previously been a fortified entrance to Paris on the same spot, on a small scale, which was built by Etienne Marcel, the predecessor in office of Hugues d'Aubriot. The Bastile consisted at first of two round towers, with an entrance between them; afterwards, to render it stronger, two additional towers, parallel to the two first, were built, and the whole connected by walls. The building, however, was not completed till 1383, in the reign of Charles VI., when four more towers were added, of the same dimensions, and at equal distances from the first four, and the whole eight were united by masonry of great thickness, in which were constructed a great number of apartments and offices. The entrance to the city by the original gate was closed, and the road carried without the



View of the Bastile, from a Print in the British Museum.

building. In 1634 a fosse was dug round it, 120 feet wide and 25 feet deep; and beyond that a stone wall, 36 feet high, was built all round. Thus the Bastile became, from a fortified gate, one of the strongest fortresses of the kind in Europe. The towers contained several octagonal rooms one above the other, each having one window pierced in the walls, which were rather more than six feet thick. This window was without any glazing, was wide internally, but narrow like a loop-hole on the outside: in the centre was a perpendicular bar of iron, and two cross-barred gratings between that and the internal part. The entrance to each of these rooms was secured by double doors eight inches thick, strapped with iron, and placed at the distance of the thickness of the walls from each other. There were no fire-places or chimneys in these rooms. The only article of furniture, if it may be so called, was an iron grating, raised about six inches from the floor, to receive the prisoner's mattress, and prevent its decay from the damp of the stone floor. To each tower there was a way by a narrow winding staircase. The apartments constructed in the walls, connecting the towers, were larger and more commodious than the others, and were provided with fire-places and chimneys, but with similar precautions for preventing the escape of prisoners. They were usually assigned to persons of some importance, or to those who were treated with indulgence. The rest of the Bastile consisted of two open courts: the larger, 102 feet by 72, called the Great Court; the smaller, 72 by 42 feet, French measure, called the Court of the Well, was separated from the first by a range of buildings and offices, having a passage through them. The height of the building within was 73 feet, but greater on the outside next the fosse. (See the Plan in the British Museum.)

In modern times the establishment of the Bastile consisted of a governor, a deputy-governor or lieutenant du roi, a major, an aide-major, a physician and surgeons, a certain number (usually about 100) of invalid soldiers and Swiss in the pay of France to perform the military duty of the fortress, with turnkeys to watch over the prisoners, and cooks and other domestics. The office of governor was very lucrative; the pay and perquisites being supposed to amount to 60,000 francs per annum. Prisoners were almost always taken to the Bastile by an exempt of police and two or three armed men in a hackney coach, to avoid observation, and were conducted direct to the governor at his house, to whom the exempt delivered the *lettre de cachet* and took a receipt for it. The prisoner was then led into the body of the fortress, a sign being first made to all the soldiers on duty to cover their faces with their hats during his passage. This was invariably done whenever a prisoner entered or left the Bastile. The prisoners were subjected to frequent and minute interrogations, with a view to extort from them their secret, if they had any, the names of their accomplices, &c. Their treatment depended entirely on the will of the governor, who was interested in their being detained, as he contracted with the government for their maintenance, and derived a profit from it; and he being the only channel by which the prisoners could communicate with their friends or with the government, he could suppress their applications if he thought fit. We have the concurrent testimony of almost all the prisoners who have written their memoirs, that the food was bad and scantily supplied, and that all other necessaries were of the worst description. The duration of a prisoner's detention was arbitrary. No term was ever specified. The longest we have been able to discover, from the registers published after the taking of the Bastile, is that of Isaac Armet de la Motte, who was removed to Charenton (a lunatic asylum and prison), after a confinement in the Bastile of fifty-four years and five months. In this registry there are several others of thirty years and upwards. The first historical mention of any imprisonment in this fortress is that of Hugues d'Aubriot himself, who having given offence to the clergy, and being accused by them of blasphemy and impiety, was sentenced to be imprisoned for life, but being transferred to another prison, he regained his liberty in the insurrection of a faction called the Mailliotins. The only prisoners who ever effected their escape from the Bastile were two persons of the name of De la Tude and D'Aligre. They were confined together in one of the apartments constructed in the walls of the Bastile. By unravelling their linen, stockings, and other parts of their clothes, and by saving from time to time the billets of wood allowed for their firing, they contrived to make two ladders, one a rope-ladder, near 180 feet long, with rounds of wood covered with flannel to prevent any rattling noise against the walls; the other a wooden ladder, about 30 feet long, consisting of a centre piece, in joints to be fastened by tenons and mortices, and through which passed wooden pegs to hold it together. The first was to enable them to descend from the platform, or the top of the Bastile, into the fosse; the second to ascend the rampart into the garden of the governor. The ladders, as well as the tools they had formed for making them, were concealed, when the turnkeys visited them, under the floor of their apartment. They cut through the iron gratings in the chimney, which they ascended, and taking advantage of a dark night, got upon the platform. Having first lowered their wooden ladder, they fastened that of rope to one of the cannons of the fortress and descended into the fosse. Finding a patrole with a light in the governor's garden, they altered their plan, and with a handspike formed of one of the iron bars of the chimney grating, made a hole in the wall next the Rue St. Antoine, through which they effected their escape on the 26th of February, 1756. After the revolution of 1789 La Tude claimed and received these ladders, and they were publicly exhibited at Paris in the autumn of that year.

The Bastile was besieged and taken three times: in 1418, by the Bourgignons; in 1594, by Henry IV.; and on the 14th July, 1789, by the Parisians, from which day the French Revolution may be dated. Its demolition was decreed by the Permanent Committee of Paris on the 16th, and carried into immediate effect. The materials were employed in the construction of a new bridge, called the Bridge of Louis XVI., and there is not now remaining the smallest vestige of this edifice.

(Dulaure, *Histoire de Paris*; *Remarques Historiques sur la Bastille*; *La Bastille dévoilée*; *Mémoires de Linguet*; *Mémoires de la Tude*: and the various histories of the French Revolution.)

BASTINA'DO is derived from the Italian *bastone*, a stick, *bastonare*, to beat with a stick, &c. The word would have been more correct in the form bastonáta, but long use has confirmed our etymological error.

The bastinado is the chief governing instrument of a great part of the world, from Corea and China to Turkey, Persia, and Russia. It is administered in different ways, and called by different names, as the bamboo in China, the knout in Russia, &c.

According to our modern acceptation, the term bastinado does not include all these methods of stick-beating, but is confined to the Turkish and Persian method, which is to beat the soles of the feet with sticks. This excessively painful punishment is thus inflicted: Two men support between them a strong pole which is kept in a horizontal position; about the middle of the pole are some cords with two running knots or nooses; through these the naked feet of the sufferer are forced, and then made tight in such a manner that the soles are fairly exposed; the sufferer is then thrown on his back, or left to rest on his neck and shoulders with his feet inverted, which are forthwith beaten by a third man with a heavy tough stick. When the presiding officer or magistrate gives the word, the heavy blows cease, the maimed feet are cast loose from the cords and pole, and the victim is left to crawl away and cure himself as best he can.

In the Koran, stripes are prescribed as a punishment for some offences; murder was to be punished by death, and theft by the cutting off of the hand; but the bastinado became an early substitute, except in the case of highway robbery, when the offender is beheaded. By the letter of the penal code of the Ottoman empire, this punishment can only be inflicted on the *men* of the fourth and last class of society, which comprises the slaves, and the rayahs or tributary subjects of the empire, as Jews, Armenians, Greeks, &c. The other three classes, namely: 1. The Emirs, or issue of the race of the prophet Mohammed, and the Oulemas, or men of the law; 2. Public functionaries, civil and military; 3. Free citizens and private individuals who live on their rents or the proceeds of their industry, were all exempted by law from this cruel and degrading punishment; but the distinction was not very rigorously observed. By the original code the number of blows to be given was from three to thirty-nine; but a later clause permitted them, in certain cases, to be carried to seventy-five, and in practice, when the passions are inflamed, the Turks seem to dispense with the ceremony of keeping any account of the blows, and the men lay on till they are tired and the sufferer's feet reduced to an unsightly jelly.

The punishment, called *zarb* in Turkish, was generally inflicted in a summary manner, without examination or any form of trial, at the will or caprice of the sultan, his representatives, and the officers of justice and police. The most frequent dispensers of it were probably the Meuhtessibs, or the commissaries of police at Constantinople, each of whom, from time to time, and always unexpectedly, made the round of the quarter of the city assigned him, to see that the provisions were sold at the exact prices despotically and most absurdly fixed by the government, and to ascertain whether the weights and measures in use by the dealers were all just. This officer generally went on horseback, followed by an armed mob of irregular soldiers, and preceded by his bastinado-men (*falacadjis*), whose office was to execute the sentence the moment it was uttered. If the offending dealer were absent, then his shopman or journeyman was punished as his substitute, the commissary only requiring a victim *ad terrorem*, and not having patience to await the return or arrest of the master. The punishment was always inflicted on the spot, in front of the shop in the open street. Mr. W. J. Hamilton, in his 'Researches in Asia Minor, Pontus, and Armenia,' 1842, describes the punishment thus: "At Ispir" (not far from Kars) he says, "I was treated with a novel kind of entertainment, being roused by loud shouts and cries, and, looking round, I saw an unfortunate wretch lying on his back, with his heels up in the air, tied to a log of wood held up by two men, whilst others were inflicting the bastinado on his naked soles with great rapidity. On appealing to the governor to know the meaning of this proceeding, he was pleased to say that, in consequence of my presence, he would let the man off with a slight punishment, although he richly deserved more for his turbulent and quarrelsome behaviour, and ordered him to be set at liberty. On being released he could hardly move, and was roughly pushed out of the way into the house. He had been quarrelling with and striking an old woman; but the aggravation of his crime was having used indecorous language to a woman." Sometimes, instead of being bastinadoed, the offender or his journeyman (accomplice or not as it might be) was nailed by the ear to the door-post of his shop, and so exposed till sun-set; at other times there was substituted the punishment of the portable pillory, called a khang or cang by the Chinese (who make great use of it as well as of the bamboo), and styled tahtakulah by the Turks, who probably derived the instrument from the Tartars, who may either have borrowed the invention from or given it to the Chinese. [CANG.]

Under the old system the greatest violence, caprice, injustice, and corruption prevailed in the administration of justice. The man with money in his hands, could always save the soles of his feet by bribing the authorities, and the pain of the bastinado was seldom inflicted except on the very poorest of the *baccals*, or shop-keepers, and destitute and unprotected rayah subjects of the Porte. Sultan Mahmoud introduced some improvements; but under a despotic government, like that of Turkey, a summary and rapid mode of proceeding will always obtain more or less.

Although the privileges of the free Turks, or Osmanlis, civil and military, were not always respected, yet their pashas and men of authority or dignity were never subjected to the bastinado like the khans, begs, and others in Persia, where the shah would frequently have his vizir, or prime-minister, cudgelled on the feet in his presence, and the vizir would do the like with the highest of the ministers and officers under him. The Osmanlis were always a more sturdy and proud-spirited people than the Persians, and thought that only Jews, Christians, and other tributary subjects could be beaten with propriety. It appears, however, that in the time of Busbequius the Janissaries were "basted with clubs." That excellent old traveller says: "Their lighter offences are chastised by the club. . . . . And here let me acquaint you with the patience of the Turks in receiving that punishment: they will receive sometimes a hundred blows on their legs, their feet, and buttocks, so that divers clubs are broken, and the executioner cries out, '*Give me another!*' Yea, sometimes the chastisement is so severe, that several pieces of torn flesh must be cut off from the wounded parts before anything can be applied to cure them. Yet, for all this, they must go to the officer who commanded them to be punished; they must kiss his hand, and give him thanks; nay, they must also give the executioner a reward for beating them. . . . . . As some relief to their misery, they count those parts wounded with the rod or club to be free from any purgations and expiations after this life."

BA'STION. This term is applied to a species of tower, or rather to what has taken the place of the flanking towers in old fortresses, and which constitutes the principal member of the fortifications immediately surrounding a town, or position to be defended. The rampart by which it is formed is disposed on four sides of a pentagon, two of which, technically called the *faces*, meet in an angle whose vertex projects towards the country; the other two, denominated the *flanks*, connect the opposite extremities of the faces with the *curtain*, or that part of the rampart which coincides in direction with the sides of a polygon supposed to inclose the town; the fifth side of the pentagon is generally unoccupied by a rampart, and is called the *gorge* of the bastion.

From the infancy of the art of war the defenders of a fortress must have felt the necessity of having the walls disposed so as to afford means of observing the enemy when very near their foot; for, when these means were wanting, the enemy was enabled to plant his scaling-ladders against, or even to make a breach in the wall itself, with almost perfect security. This was inevitably the case when the ground-plan of the *enceinte*, or inclosing rampart, was a simple polygon, since the men stationed on the rampart for its defence, behind the parapet by which they were protected, were incapable of seeing the exterior ground which lay near the base of the walls. Thus, according to the old story in Pausanias (iv. 20), when the Messenians were besieged in their hastily erected fort on Mount Ira, the guards being driven from their posts by violent rains, and there being no towers or projections from the walls to shelter them, the Spartans gained possession of the parapets by escalade. To avoid such a surprise, it was the practice of the ancient engineers to construct either *machicoulis* on the top of, or projecting towers at certain intervals along the walls of fortresses, that from thence the besieged might get a view of and be able to annoy the enemy, when at the latest and most critical period of the siege the latter should have gained the otherwise undefended ground. The walls of Messene, built by Epaminondas (Paus. iv. 31), which were all of stone, and furnished with battlements and towers, were reckoned by Pausanias among the best specimens of Grecian fortification.

From the accounts given by ancient writers of their fortified places, and particularly from the precepts of Vitruvius ('Architectura,' lib. i. cap. 5), we learn that the projecting towers were sometimes square or polygonal, but generally circular, and that their distance from each other along the walls was regulated by the range of the weapons employed in the defence. In the fortifications of cities this distance seems to have varied from 80 to 100 paces, according to local circumstances, and the power of annoying the enemy by the arrows and javelins discharged from the towers; but, from the greater distance at which modern arms will take effect, the bastions, measuring from the vertices of their projecting or salient angles, are now generally, and agreeably to the rules of Vauban, placed at 360 yards from each other. It was a maxim with the ancient engineers that the projecting quoins of walls were detrimental to the defence, from the facility with which they might be destroyed by the battering-ram; and it is on this account that Vitruvius recommends the towers to be circular, or to have faces forming with each other obtuse angles. These towers were placed indifferently at the angles, or at any part of the line of the inclosing rampart: in the latter case, when they were of a square form, one side was parallel to the length of the rampart, and in the former, one face was almost always perpendicular to a line bisecting the angle between two adjacent sides of the polygon surrounding the town; that is, to what would be now called the *capital* of the bastion. It must have frequently happened, therefore, that this face was nearly unseen from any other part of the rampart, and that the enemy made his assault against it in order to avoid, as much as possible, being exposed to annoyance from the defenders of the neighbouring works. It is true that the smallness of the towers rendered it impossible for the enemy to be wholly concealed at their front; but the desire of entirely depriving the enemy of the benefit arising from the undefended nature of that ground probably induced engineers to dispose the faces of their towers like those of a modern bastion, so that two of them might form a projecting angle, whose vertex was on the capital.

There is no reason to believe that any material change took place in the manner of constructing the towers of fortresses during all the long period in which the ancient arms were employed; but it is easy to conceive that the invention of fire-arms would render it necessary to enlarge the tower for the purpose of receiving the guns, and to increase the thickness of the rampart, that it might be able as well to resist the concussion produced by the discharge of the ordnance placed upon it, as the shock of the enemy's artillery when fired against it. On this account, also, the ramparts were constructed of earth, and their exterior surface was formed at such an inclination to the ground as would enable it to stand unsupported, except where it became necessary to prevent an escalade; in which case a facing of stone, brick, or timber was made sufficiently high and steep to create a serious impediment to any attempt of that nature. An opinion that the bastions are the weakest parts of a fortress remained in force, however, long after the modern artillery was introduced in sieges. On this account they were at first made very small, when compared with the extent of the wall between them; and the line of each face, when produced towards the town, was made to intersect that wall, in order that the fire from the part intercepted between this produced line and the flank of the next bastion might co-operate with the fire from the latter in defending the ditch in front of the former bastion. But when the ramparts of a town were found to disappear almost instantly under the weight of shot discharged from large ordnance, it became necessary to employ ordnance of corresponding size on the walls; and the dimensions of the bastions were finally augmented to those at present assigned. The lengths of the faces vary from 100 to 120 yards, and the flanks are usually about 50 yards long; but the magnitude of the projecting angle in front, called the *salient* or *flanked* angle, to distinguish it from the angles formed by the faces and flanks which are denominated *shoulder angles*, evidently depends upon the angle of the polygon on which the *enceinte* is constructed. Each face of a bastion, if produced towards the town, now falls at the interior extremity of the flank of the collateral bastion, so that the flank defence of the faces of a bastion depends wholly upon the fire from the flanks of those on its right and left.

It is to Italy that we must look for the invention of the modern bastion: the wars which raged in that country from the commencement of the 12th century, and which were more systematically conducted there than in any other part of Europe, gave rise to this, as well as to many other inventions for military purposes. The precise date of its first formation is quite unknown; but if we omit the improbable story related by Folard, that the Turkish commander, Achmet Pacha, caused bastions to be constructed about Otranto, when he took that place in 1480, we may observe that it is spoken of under the name of *Balvardo*, as an improvement of great importance in the military art, by Tartaglia, in his 'Quesiti ed inventi diversi,' which was published in 1546; and in the same work is given a plan of the fortifications of Turin, which exhibits a bastion at each of the four angles of the rampart. Both Vasari, in his 'Lives of the Architects,' and Maffei, in his 'Verona Illustrata,' ascribe the invention to San Michaeli of Verona: one of the bastions of this city has on it the date 1527, and its construction is still ascribed to that engineer, who, in fact, was about that time employed in the erection or repair of several of the fortresses in Italy. From the word Balvardo, denoting a stronghold, the earliest French engineers gave to this work the appellation of *Boulevard*; and such is its designation in the treatise of Errard, which was published in 1594. The term *Bastion* appears to have been taken from the Italian writers, for Maggi, in his treatise 'Della Fortificatione delle Citta,' applies the term *Bastioni* to redoubts constructed of earth; and, according to Père Daniel, the French subsequently gave to such works the name of *Bastilles*, or *Bastides*. Froissart also uses these terms in speaking of the forts constructed during the siege of Ventadour by the Duc de Berri, under Charles VI. It should be remarked, however, that Errard applies the name of *Bastion* indifferently to works in the situation of those now so called, and to those to which the name of *Ravelin* is generally given; and doubtless it denoted originally any work of earth constructed on the exterior of one more ancient.

It appears that it had been the practice from the earliest times to form a rampart, or bank of earth, in front of the walls of fortresses, in order to secure the latter from the destructive effects of the ram; and it is easy to conceive that, by forming such a bank in front of the old towers of a place, so as to connect those previously existing in front of the adjacent curtains, the work would assume a figure like that of a modern bastion; and indeed would very much resemble one of the detached bastions in what is called the second system of Vauban; the original tower of the fortress occupying the place of the interior bastion of that system, and constituting a sort of *retrenchment* to the new work. The construction was proposed by Castriotto, in his elaborate work published at Venice in 1564, seemingly as if it had been his own idea; but probably he meant only to recommend the adoption of a kind of work which must have been then a novelty.

The Italian engineers, immediately after the invention of the bastion system of fortification, became celebrated for their skill in military architecture, and they seem to have been extensively employed in the construction or repair of fortresses beyond the Alps: one of the first of their labours in the north of Europe was the fortification of Landreci, with bastions, for Francis I.; and the like works were executed about New Hesdin, on the frontiers of Artois, for Charles V. In 1568, the Duke of Alva employed Pacciotto in the construction of the citadel of Antwerp, a regular fortress, whose bastions still exist within those subsequently erected at that place; and, during the reign of Elizabeth, Genebella was brought from Flanders to this country in order to superintend the formation of a bastioned *enceinte* about the ancient castle of Carisbrook, in the Isle of Wight.

Albert Dürer, the celebrated engraver, proposed, in 1527, to fortify places with circular towers only, like those of the ancients, but of larger dimensions; and in most of the plans published during the 16th century by Italian engineers, there appears to be a union of the old and new methods; for the angles of the polygons are furnished with round towers, and these are protected exteriorly by bastions.

The guns mounted on the flanks of a bastion, by firing along the ditch in front of the curtain and of the neighbouring bastions, created a serious impediment to the passage of the enemy across the ditch in attempting an assault, and it became necessary for him to silence that fire by a battery placed for the purpose in the direction of the ditch; but the establishment of this battery necessarily compelled the defenders to augment the number of guns in their bastions. To get room for these guns, engineers were induced to form their bastions with a double and even a triple flank on each side, the flanks receding from each other, from below upwards, in the manner of terraces, towards the interior of the bastion; and, to prevent the enemy from dismounting the guns in the lower flanks by other batteries raised in the prolongations of those flanks, it became necessary to mask them by extending the rampart of the face beyond them, and giving it a return towards the curtain; this return was frequently rectilinear, but generally in the form of an arc of a circle, like a portion of a round tower, and the projection with its return received the name of *orecchione* or *orillon*. Besides masking the lower flanks from the effect of any enfilading, or lateral fire, it concealed one or more guns on the upper flank from the fire of an enemy's battery directly opposed to that flank, while it permitted those guns to defend the main ditch and the breach made by the enemy in face of the collateral bastion. In Castriotto's work above mentioned he describes bastions with triple flanks and cavaliers, and *orillons*, similar to those of Coehorn; also many other works supposed to be modern improvements, such as *chemin des rondes*. [Berme]. Countermines, Casemates, Counterarched Revetments, and the Fausse Bray.

The desire of avoiding the exposure of the flanks of the bastions gave rise to the practice of making them form a right, and even an acute angle with the curtain; but a better judgment subsequently rejected this disposition, as the musketry fire from the defenders of the flank was thereby liable to injure the men stationed on the curtain. The lower flanks also were eventually suppressed, because they contracted too much the interior of the bastion to which they belonged; and because the enemy's fire, soon destroying the parapets of those above, masses of brickwork fell among the defenders below, and obliged them to quit their guns at the very time that their service was most required. The *orillons*, moreover, are now considered useless, as they contract the length of the flank; and the guns which they protect from a fire in their front are liable to be dismounted by a fire from their rear.

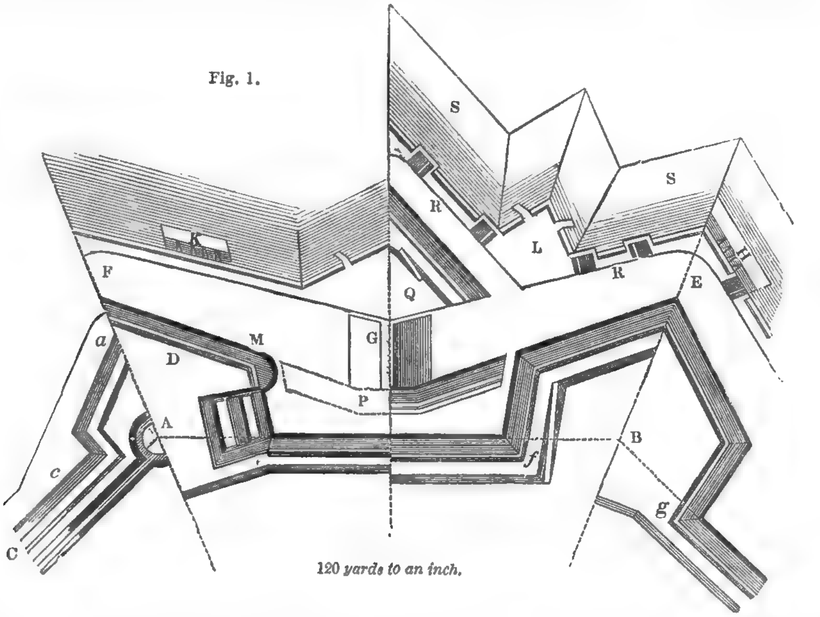
In what are called the second and third systems of Vauban, the principal bastions are detached from the *enceinte* by a ditch in their rear, and consequently the capture of those works would not immediately compel the surrender of the fortress. In these systems, a small bastion of brickwork, closed by a parapet-wall at its gorge, is constructed at each of the angles formed by the polygonal wall surrounding the place. The fire from the parapets of these tower bastions, as they are called, would have a powerful effect in preventing the enemy, after he has breached and stormed the great bastions, from erecting batteries in them to destroy the interior walls; and, in order to preserve the artillery of their flanks uninjured till the end of the siege, engineers placed it in casemates [Casemate], whence the guns might pour a destructive fire upon the assailants when crossing the ditch of the *enceinte*. In one of the systems of Coehorn, each principal bastion is attached to the *enceinte*, and contains an interior one for the purpose of prolonging its defence. At the shoulders of the former are constructed towers of masonry, serving as *orillons*, and containing galleries whose front walls are pierced with loop-holes, to allow a fire to be directed along the interval between the parallel faces of the two bastions.

Bastions are now made either solid or hollow: that is, either the interior is filled with earth up to the level of the platforms of the guns, or it is left coincident with that of the natural ground. Of the two methods, the former is generally preferred, because it affords some facilities for the formation and defence of interior parapets or retrenchments. In almost every system of fortification the ramparts of the faces and flanks of bastions have been made rectilinear on the plan; a few cases however occur in which the flanks have been curved, with their convexity towards the interior of the work. This seems to have been devised to allow room for a few more men to fire over their parapets than a straight wall could afford, and to prevent the distant batteries of the enemy from easily dismounting their artillery by firing along the interior side of the parapet. On some occasions these advantages may be worth obtaining, but as the soldier placed behind a parapet always fires nearly in a direction perpendicular to its length, it is evident that the curved flank may cause the lines of fire to tend towards the right or left of the main ditch, and thus endanger the safety of the defenders stationed in the neighbouring works.

The desire of lessening the effect of what is called the enfilading fire, or that which an enemy may direct along the interior side of any parapet, has led Bousmard to give a small curvature to the faces of his bastions, the concave part being towards the interior; but it is evident that, by this construction, the lines of fire directed from the collateral flank for the defence of the face, instead of grazing the latter in its whole length, can only be tangents to the curve, each line of fire meeting it in but one point. It is therefore probable that the injury inflicted on the enemy would be found so much less than that arising from the usual construction, as to neutralise entirely the advantage of the diminished enfilade fire of the enemy.

The destructive effect of this last mode of firing would be most effectually prevented by the formation of semicircular bastions, detached from the *enceinte*, in the manner proposed by Mr. Bordwine; but the ingenious author of that system is in consequence compelled to abandon, in a great measure, the advantage of having the exterior of his walls well defended from those which are in collateral situations. The batteries however which he proposes to raise in the interior of his

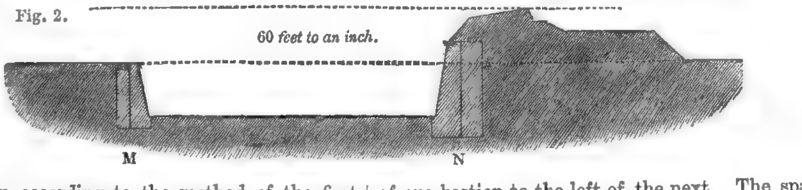
Fig. 1.



bastions cannot fail to produce a powerful defence towards the rear, for the rampart of his *enceinte*.

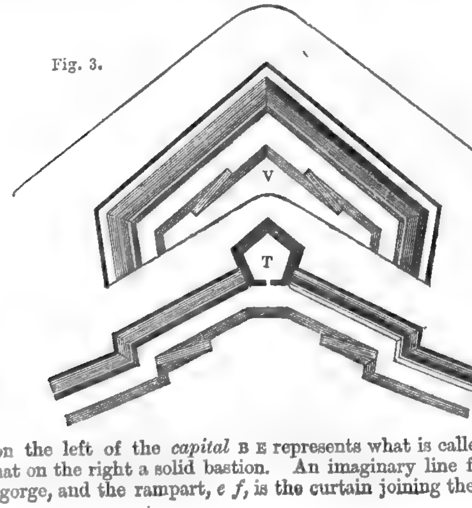
Fig. 1. The line A B represents one side of the polygon supposed to inclose the town fortified. The semicircular work at A is half a round tower; and A C is part of the curtain or connecting wall between two such towers, according to the ancient manner of fortifying places; *a c* represents a sort of *fausse braye*, or elevation of earth, protecting the ancient walls of a place; D represents half a bastion constructed

Fig. 2.



at the angle, A, of the polygon, according to the method of the first Italian and French engineers, with an orillon and triple flank. The pentagonal figure about B is the plan of a modern bastion, of which the

Fig. 3.



part on the left of the *capital* B E represents what is called a hollow, and that on the right a solid bastion. An imaginary line from *f* to *g* is the gorge, and the rampart, *e f*, is the curtain joining the right flank of one bastion to the left of the next. The space, F G E, is the main ditch; and H and K are respectively the positions of a counter and enfilading battery which might be constructed by the enemy to silence the fires from the triple flank of D. The outworks, P, G, Q, R, S, [TENAILLE, CAPONNIERE, RAVELIN, COVERED-WAY, and GLACIS] will be described under those words.

Fig. 2 represents a section supposed to be made from B to L, perpendicularly across the rampart on the left face of B, and the main ditch in its front. M and N are sections through the revetments, or walls which support the earth on the sides of the ditch.

In *fig.* 3, V represents the plan of a detached bastion; T is a tower bastion at an angle of the polygon which surrounds the place. The bastioned systems will be further treated under FORTIFICATION.

(Vitruvius, *De Architecturâ*; Maggi, *Della Fortificatione delle Citta*; Errard, *La Fortification réduite en art*; De Ville, *L'Ingénieur Parfait*; Vauban, *Œuvres Militaires*, par Foissac; Belidor, *La Science de l'Ingénieur*; Fritach, *L'Architecture Militaire*; Cormontaigne, *Œuvres Posthumes*; Montalembert, *La Fortification Perpendiculaire*; Bousmard, *Essai Général de Fortification*; St. Paul, *Traité Complet de Fortification*; Savart, *Cours Elémentaire de Fortification*; Mandar, *De l'Architecture des Forteresses*; Dufour, *De la Fortification Permanente*; Carnot, *De la Défense des Places Fortes*; Col. Pasley, *Course of Elementary Fortification*; Malortie, *Permanent Fortification*; Capt. Straith, *A Treatise on Fortification*.

BA'TAVI, or **BATA'VI** (the forms Vatavi, Badai, and Betavi also occur in MSS. inscriptions), the name of the ancient inhabitants of South Holland, and some adjacent parts. The Batavi were a Germanic tribe of the race of the Catti, who, some time before the age of Cæsar, left their native district, and settled, according to Tacitus ('Hist.' iv. 12, 'Germ.' 129), "on the extreme borders of Gaul, such as they found destitute of inhabitants," but chiefly on an island formed by the northern arm of the Rhine (or Rhine of Leyden), the Vahalis, or Waal, and the Mosa or Maas after their junction, and the ocean; which island now constitutes part of the province of South Holland. The first mention of them is by Cæsar ('De Bell. Gall.' iv. 10), who calls their country by the name of Insula Batavorum, and appears to consider it as belonging to Germany, and not to Gaul; the limits of Belgic Gaul on that side being placed at the southern branch of the Rhine, or Waal, after its junction with the Mosa, or Maas. Cæsar did not carry the war into the country of the Batavi. Under Augustus the Batavi became allies of the Romans; they were exempted from taxes, and they furnished cavalry to the Roman armies on the Lower Rhine and in Britain, where detachments of them long continued to be stationed. Drusus, the brother of Tiberius, resided for a time among them, and dug a canal, Fossa Drusiana, which connected the Rhine with the modern Yssel. Besides the Batavi there was another people on the same island, probably in its north-western extremity, called by the Roman historians Canninefates. They were of the same origin as the Batavi (Tacitus, 'Hist.' iv. 15), but not so numerous, and their name became gradually lost in that of the larger tribe. Tacitus speaks highly of the bravery of both these tribes, and "for Germans" of their mental capacity.

The chief place of the Canninefates was Lugdunum Batavorum, now Leyden; and that of the Batavi was Batavodurum, afterwards called Noviomagus, and now Nymegen. This is Mannert's opinion, though others have placed Batavodurum at Duurstede, and made it a different place from Noviomagus. The other towns of the Batavi were Arenacum, generally supposed to be Arnheim, but placed by others near Werthuysen; Carvo, on the northern branch of the Rhine, probably near Arnheim; Grinnes, near the junction of the Waal with the Maas; Trajectum, the modern Utrecht; and Forum Hadriani, in the western part of the island near the sea. The name of the Batavi can be traced even now in that of Betuwe, which is a district of the ancient Batavorum Insula, between the Rhine, the Waal, and the Lek. Beyond the northern branch of the Rhine, and between that and the Flevium, or Yssel, in the province now called North Holland, were the Frisii and the Frisiaboni, tribes belonging to the great Frisian stock which inhabited the land north-east of the Yssel. Pliny places two other tribes, the Sturii and the Marsucii, on the islands off the western coast at the mouth of the Mosa, which islands now form part of Zealand.

After the death of Galba, the army of the Rhine having proclaimed Vitellius, and followed him on his way to Italy, the Batavi took the opportunity of rising against the Romans, whose alliance had become very burthensome to them. Claudius Civilis, a man belonging to one of their principal families, though bearing a Latin name, acted as their leader. At one time the insurrection seems to have spread among the neighbouring tribes of Germans as well as of Belgian Gauls, but the speedy return of the legions suppressed the movement. Civilis achieved many successes, and the Batavi, with their allies, fought bravely, but were at last subdued. According to Tacitus, however, they preserved their privilege of being exempt from taxation; they were a portion of the Roman empire; or, as he says, "free from all imposition and payments, and only set apart for the purposes of fighting, they are reserved wholly for the wars, in the same manner as a magazine of weapons and armour." (Gordon's transl. 'Germ.') As tools of this description they served under Hadrian in Mæsia, where they are stated to have swum across the Rhine in full armour. At this time, or as early as the reign of Trajan, the Roman domination was probably more complete, as we find in the Antonine Itinerary and the Peutinger Table, two Roman roads across the country, one from Lugdunum eastward to Trajectum, and following the course of the northern Rhine to its separation from the Vahalis, and another from Lugdunum southward across the island to the Mosa, and then eastward along the bank of that river and the Vahalis to Noviomagus. We also find places named after the emperors, such as Forum Hadriani, and fortified camps, such as Castra Batava, which some, however, suppose to have been the same as Batavodurum. (See Mannert, 'Geographie der Griechen und Römer.') There was another place in Upper Germany, or, more properly, in Noricum, called also Castra Batava, near the confluence of the Inn and the Danube, which was colonised by Batavi, apparently in conformity with the policy which led the Romans to transplant their subjects and allies from their homes to foreign countries. The Batavi were employed by Agricola in his wars in Britain. (Tacit. 'Agric.' xxxvi.) In some inscriptions they are called "friends and brothers of the Roman people," or of the "Roman emperors." The date of one of these inscriptions is determined by the name of the Emperor Aurelius. (Gruter. lxxi.)

In the latter part of the 3rd century, during the civil war which desolated the empire, the Salian Franks invaded the country of the Batavi, and established themselves in it. They armed pirate vessels, which were encountered and defeated at sea by Carausius. Constantius and Constantine waged war against the Franks of the Batavian island, but could not drive them out of it. The Franks lost it, however, under Julian, by an irruption of Frisians, who came from the northern country near the Zuiderzee, and drove the Salian Franks beyond the Maas. After this the Insula Batavorum formed part of the country called Fresia, which, in the time of the Merovingians, extended southward as far as the Scheldt. Under Charlemagne it formed a duchy bearing allegiance to the empire, "Ducatus Fresiæ usque ad Mosam." It afterwards became divided into Western Frisia, called Fresia Hæreditaria, which was subject to hereditary counts; and Eastern Frisia, or Fresia Libera, which remained independent. The Yssel formed the division between the two. About the 11th century we first find Western Fresia called by the name of Holland, some say from *hohl land*, "a low hollow land," and its counts took the name of Counts of Holland. The country of the ancient Batavi formed the southern part of their dominions; but the islands at the mouth of the Maas, and between it and the Scheldt, were the subject of frequent contentions and wars between them and the Counts of Flanders. (D'Anville, 'Etats formés en Europe après la Chûte de l'Empire Romain;' Meyer, 'Res Flandricæ.') Although the name Batavi has fallen into disuse, it has always been employed by modern authors writing in Latin, to signify the Dutch or Hollanders generally.

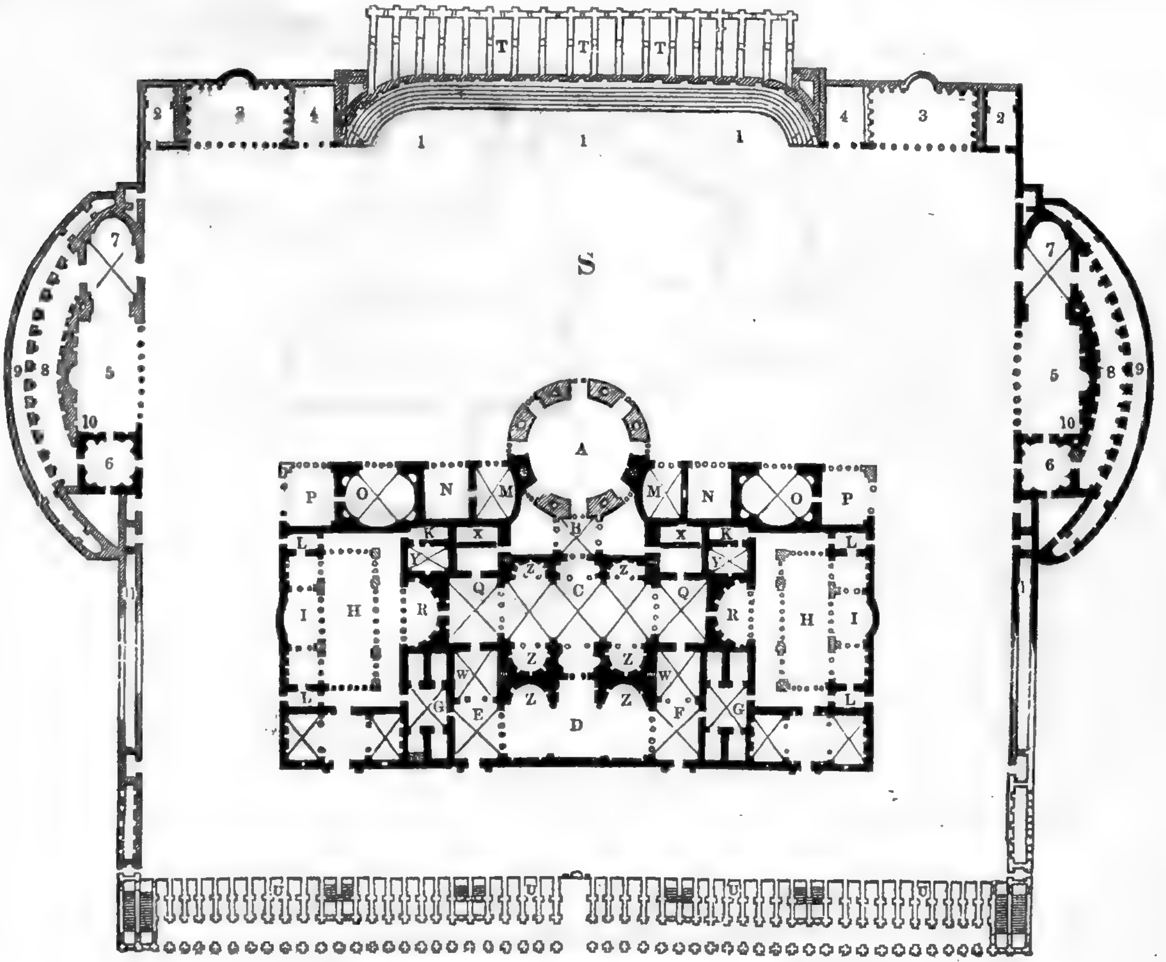
BATH, a place for the purpose of washing the body, either with hot, warm, or cold water: the word is derived from the Saxon bað. The Greek name is balaneion (βαλανεῖον), of which the Roman balineum, or *balneum*, is only a slight variation: the elements *bal* and *bad* in the Greek and English words are evidently related. The public baths of the Romans were generally called *Thermæ*, which literally means "warm waters."

The bath was also in common use among the Greeks, though we are not well acquainted with the construction and economy of their bathing-places. Homer often refers to the practice of bathing, but he speaks of the warm-bath as an unmanly habit ('Odyss.' viii. 248), and this view of the effeminacy of warm bathing was that held in the time of Demosthenes (Polyc.) At Athens there were both private and public baths: the public baths appear to have been the property of individuals, who kept them for their own profit or let them to others. (See Isæus, 'On the Inheritance of Dicæogenes,' cap. vi.; ditto 'of Philoctemon,' cap. vi.) Lucian, in his 'Hippias' (vol. iii. ed. Hemsterh.), has given a description of a magnificent bath. Though he does not tell us whether it was built in the Roman or the Greek style, we may safely conclude that he is speaking of a bath in a Greek city. His description is not precise enough to render it certain that this bath in its details agrees with those of Rome and Pompeii; but the general design and arrangement appear to be nearly the same.

We learn from Seneca that the Roman baths were very simple, even mean and dark, in the time of Scipio Africanus; and it was not until the age of Agrippa, and the emperors after Augustus, that they were built and finished in a style of luxury almost incredible. Seneca ('Epist.' lxxxvi.), who inveighs against this luxury, observes that "a person was held to be poor and sordid whose baths did not shine with a profusion of the most precious materials,—the marbles of Egypt inlaid with those of Numidia; unless the walls were laboriously stuccoed in imitation of painting; unless the chambers were covered with glass, the basins with the rare Thasian stone, and the water conveyed through silver pipes." These, it appears, were the luxuries of plebeian baths. Those of freedmen had "a profusion of statues, a number of columns supporting nothing, placed as an ornament merely on account of the expense: the water murmuring down steps, and the floor of precious stones." (Sen. 'Epist.' lxxxvi.) These baths of which Seneca speaks were private baths.

Ammianus Marcellinus reckons sixteen public baths in Rome. The chief were those of Agrippa, Nero, Titus, Domitian, Antoninus Caracalla, and Diocletian. These edifices, differing, of course, in magnitude and splendour, and in the details of the arrangement, were all constructed on a common plan. They stood among extensive gardens and walks, and were often surrounded by a portico. The main building contained large halls for swimming and bathing, some for conversation, others for various athletic and manly exercises, and some for the declamation of poets and the lectures of philosophers; in a word, for every species of polite and manly amusement. These noble rooms were lined and paved with marble, adorned with the most valuable columns, paintings, and statues, and furnished with collections of books for the studious who resorted to them. (See 'Pompeii,' published by the Society for the Diffusion of Useful Knowledge, vol. i.) These baths, which were called *Thermæ*, are now all in ruins. The best preserved are those of Titus, Diocletian, and Antoninus Caracalla. (See 'Life of Anton. Caracall.' by Æl. Spartianus.) We here subjoin a plan of the baths of Caracalla, which were finished, according to Eusebius, in the fourth year of that emperor's reign. These baths were among the most magnificent structures in existence. Mr. Fergusson says, that "even allowing for their being almost wholly of brick, and being disfigured by the bad taste inseparable from everything Roman, there is nothing in the world which for size and grandeur can compare with these imperial palaces of recreation." And he adds a comparison which will enable the ordinary English reader to form a better estimate of their size and character than he can readily do from mere description. He says: "St. George's Hall in Liverpool is the most exact copy in modern times of a part of these baths. The hall itself is a reproduction both in scale and design of the central hall of Caracalla's baths, but improved in detail and design, having five bays instead of only three. With the two courts at each end, it makes a suite of apartments very similar to those found in the Roman examples. The whole building, however, is less than one-fourth of the size of the central mass of a Roman bath, and therefore gives but little idea of the magnificence of the whole." (Fergusson, 'Hand-book of Architecture,' p. 333.)

The most complete and elegant baths had generally the following apartments: An apodyterium, or room for undressing; an unctuarium, for the ointments; a sphæristerium, or large room for exercises; a calida lavatio, or warm bath; a laconicum, or hot room for sweating; a tepidarium, or warm room with a tepid bath; and a frigidarium, which contained the cold bath: to these may be added rooms for feasting and conversation. (Cameron 'On Roman Baths.')



[Plan of the Baths of Caracalla from the measurements of Palladio.]

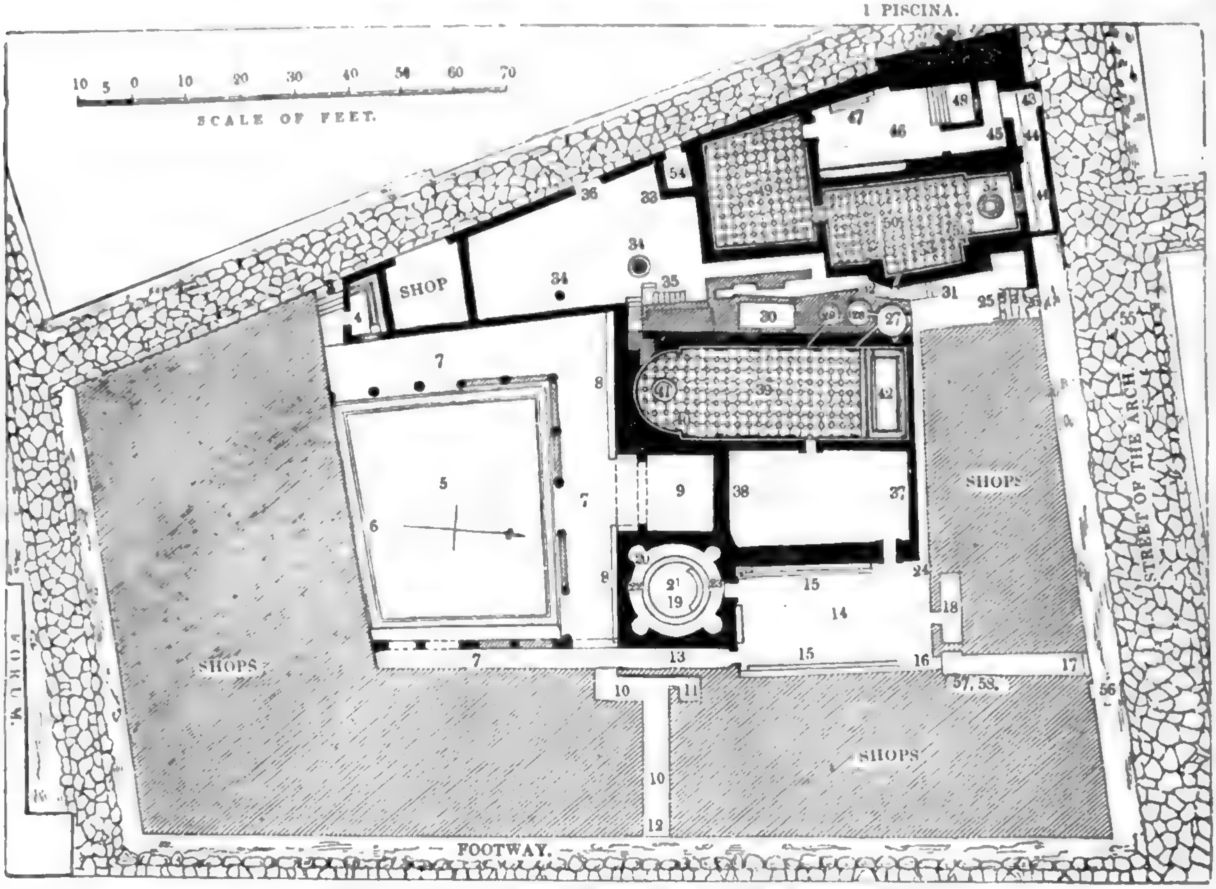
Scale of English Feet.
0 100 200 300 400 500

A, a circular room, over which was a roof of copper; B, the Apodyterium; C, the Xystus; D, the Piscina; E, Vestibules, on the side of the Piscina, which served for the spectators and to contain the clothes of those who bathed; F, Vestibules at entering the Thermæ; on each side were libraries; G, G, Rooms where the wrestlers prepared for the exercises of the Palæstra, with a staircase to ascend to the upper story; H, H, the Peristyles, which we find in all the Roman Thermæ, having in the middle a Piscina for bathing; I, I, the Ephebium or place of exercise; K, K, the Elæothesium, or Elæothekium (Ελαιο-θέσιον-θήκιον): L, L, Vestibules, over which there is another room with a Mosaic pavement; M, M, Laconicum; N, N, Warm Bath; O, O, Tepidarium; P, P, Frigidarium; Q, Q, Rooms for the spectators and for the use of the wrestlers; R, R, Exhedræ for the philosophers; S, Stadium; T, T, Places for heating the water; V, V, Cells for bathing; W, W, Rooms for conversation; X, X, Cisterns of three stories to receive rain water; Y, Y, the Conisterium; Z, Z, Recesses for ornament, and which served for the spectators to sit in; 1, Theatre for the spectators to see the exercises in the open air; 2. Apartments of two stories for the use of those who had the care of the baths; 3, 3, Exhedræ, where the gymnastic exercises were taught; 4, 4, Rooms for those who exercised in the Stadium; 5, 5, Atria to the academies; 6, 6, Temples; 7, 7, Academies; 8, 8, Arcades for the masters to walk in, detached from the noise of the Palæstra; 9, 9, Covered Baths; 10, 10, Stairs, &c., which led to the top; 11, 11, Stairs by which you ascend to the Palæstra.

Flaminius Vacca informs us that in 1471 there was to be seen in these baths an artificial island formed of marble, full of the remains of figures which had been carved on it. Near the island was a ship, with many figures in it, much broken. There was also a bathing vessel of granite. Two labra, of granite, found in the same place, are now employed as fountains in the great square before the Farnese Palace at Rome. In these baths were also found the Farnese Hercules and the great group of statues known by the name of the Farnese Bull. Besides the great granite column now in the palace of S. Lorenzo at Florence, Piranesi tells us that he saw, in the peristyle, two fountains enriched with the remains of bas-reliefs.

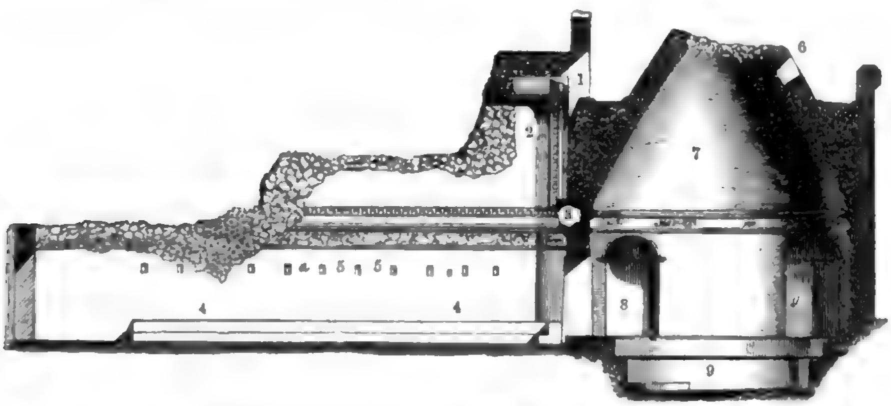
The provincial towns had also their baths, both public and private. The public baths of Pompeii, which were discovered in 1824, in a very perfect state, throw much light on what the Roman writers (and especially Vitruvius) have written on the subject. The following description of them is taken from the second volume of the 'Pompeii' (published by the Society for the Diffusion of Useful Knowledge), with a few verbal alterations, and some omissions: These baths occupy a space of about 100 feet square, and are divided into three separate and distinct parts. One of them was appropriated to the fireplaces and to the servants of the establishment; the other two were occupied each by a set of baths contiguous to each other, similar, and adapted to the same purposes, and supplied with heat and water from the same furnace, and from the same reservoir. The apartments and passages are paved with white marble in mosaic. It is conjectured that the more spacious of the two sets of baths was for the use of the men, the smaller for the women. Vitruvius (lib. v. cap. 10) says that the caldarium for the women should be contiguous to that for the men, and be exposed to the same aspect; for thus the same hypocaustum, or stove, may suffice for both. Annexed is the plan of these Pompeian baths, situated near the Forum.

The piscina or reservoir was separated at Pompeii from the baths themselves by the street which opens into the forum. The pipes which communicated between the reservoir and the bath passed over an arch thrown across the street. There were three entrances to the furnaces which heated the warm- and vapour-baths. The chief entrance opened upon a court of an irregular figure, fit for containing wood and other necessaries for the use of the establishment, covered in part by a roof; the rafters of the roof rested at one end on the lateral walls, and at the other on two columns, constructed with small pieces of stone. From hence a very small staircase led to the furnaces and to the upper part of the baths. Another led to the small room, called the præfurnium, into which projects the mouth of a furnace. In this room were the attendants on the furnace, or stokers (fornacarii), whose



[Plan of the Baths discovered in Pompeii, from the 'Museo Borbonico.']

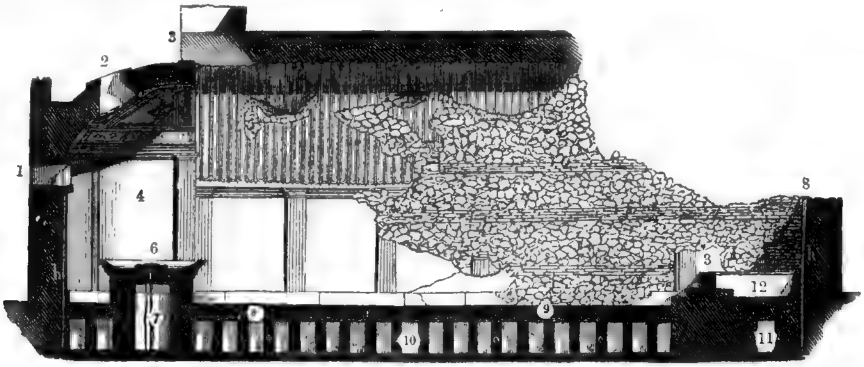
1, Piscina; 2, Street, over which was an aqueduct to convey the water from the Piscina to the baths; 3, Entrance to the baths of the men; 4, Watercloset; 5, Cortile, court, or vestibule to the baths; 6, Channel to collect the rain-water from the portico; 7, Colonnade round three sides of the vestibule; 8, Seats under the colonnade (*Scholæ*); 9, Oecus or exhedra; 10, Passage leading out of the baths; 11, Watercloset; 12, Entrance from the Street of Fortune; 13, Passage leading into the Apodyterium; 14, Apodyterium; 15, Seats; 16, Passage leading to the street; 17, Entrance from the Street of the Arch; 18, Wardrobe; 19, Frigidarium; 20, Niches in the Frigidarium; 21, Alveus or vase of the Frigidarium; 22, a bronze spout, through which the water ran into the Alveus; 23, Pipe out of which the water escaped; 24, Passages which lead from the Apodyterium to the furnaces; 25, Apartment for the stokers; 26, Doorway leading from this apartment to the Street of the Arch; 27, Furnace; 28, Calidarium, or boiler for hot water; 29, Tepidarium, or receptacle for tepid water; 30, Frigidarium, or reservoir for cold water; 31, Stairs leading to the boilers; 32, Passage which leads from the boilers to the court, where the fuel for the stoves was kept; 33, the court for fuel; 34, Columns which supported the roof of the court; 35, Stairs which lead to the arched roofs of the baths; 36, Door opening into the Street of the Forum; 37, Tepidarium; 38, Place where the bronze brazier was found; 39, Caldarium, having a suspended or hollow floor; 40, Laconicum; 41, Labrum: 42, Hot bath; 43, Entrance to the baths for the women; 44, Vestibule with seats; 45, Passage leading to the Apodyterium; 46, Apodyterium; 47, Seats in the same; 48, Frigidarium; 49, Tepidarium; 50, Caldarium with a hollow pavement; 51, Laconicum; 52, Labrum; 53, Hot bath; 54, a small room, use unknown; 55, Street, called the Street of the Arch; 56, Stairs; 57, 58, Two small voids without any communication.



[Section of the Apodyterium and Frigidarium of the Men's Baths.]

1, Window closed with one great pane of glass; 2, Decorated archivolt; 3, a place for a lamp; 4, Seats of the Apodyterium with a raised step, serving as a footstool; 5, Holes in which were pegs for the dresses; 6, a window; 7, Conical ceiling of the Frigidarium; 8, Niches; 9, Alveus or marble vase.

duty it was to keep up the fires. Here was found a quantity of pitch, used by the furnace-men to enliven the fires; the stairs in the room (25) led up to the coppers. The third entrance led from the apodyterium of the men's bath by means of a corridor (23). There is no communication between these furnaces and the bath of the women, which was heated *from* them. The furnace was round, and had in the lower part of it two pipes, which transmitted hot air under the pavements, and between the walls of the vapour-baths, which were built hollow for that purpose. Close to the furnace, at the distance of four inches, a round vacant space still remains, in which was placed the copper (*caldarium*) for boiling water; near which, with the same interval between them, was situated the copper for warm water (*tepidarium*); and at the distance of two feet from this was the receptacle (30) for cold water (*frigidarium*), which was square, and plastered round the interior, like the piscina or reservoir. A constant communication was maintained between these vessels, so that as fast as hot water was drawn off from the caldarium, the void was supplied from the tepidarium, which being already considerably heated, did but slightly reduce the temperature of the hotter boiler. The tepidarium in its turn was supplied from the piscina, and that from the aqueduct.



[Section of the Caldarium of the Men's Baths.]

1, Window; 2, a circular aperture by which the temperature was regulated; 3, another window; 4, Laconicum; 5, a place for a lamp; 6, Labrum; 7. Leaden pipe through which the water of the Labrum was either introduced or made its escape; 8, Hollow walls of the Caldarium; 9, Hollow pavement covered with Mosaic; 10, small piers which support the pavement; 11, the communication between the hollow pavement and the furnace; 12, Hot bath; 13, Steps to ascend the bath. ('Museo Borbonico,' vol. ii.)

The terms frigidarium, tepidarium, and caldarium were applied to the apartments in which the cold, tepid, and hot-baths were placed, as well as to the vessels already described under these respective names. The furnace and the coppers were placed between the men's baths and the women's baths, as near as possible to both, to avoid the waste of heat consequent on transmitting the fluids through a length of pipe. The coppers and reservoir were elevated considerably above the baths, to cause the water to flow more rapidly into them.

The men's bath had three public entrances (3, 12, 17). Entering at the principal one (12), which opens to the street leading to the forum, we descend three steps into the (5) vestibule, cortile, or portico of the baths, along three sides of which runs a portico (ambulacrum). The seats (8), which are arranged round the walls, were for the slaves who accompanied their masters to the baths, and for the servants of the baths themselves, to whom also the apartment (9) appears to have been appropriated. In this court was found the box for the quadrans, or piece of money, which was paid by each bather. Another door (17) leads to the same vestibule by means of a corridor. From the Street of the Arch (55) we proceed through the passage (17) into the apodyterium, or undressing-room (14), which is also accessible by another corridor (13) from a street called the Street of the Arch: a vast number of lamps were found here. The ceiling of this passage is decorated with stars. The apodyterium has three seats, made of lava, with a step to place the feet on; holes still remain in the wall, in which (it is conjectured) pegs were fixed for the bathers to hang their clothes upon. This room is highly decorated with stuccoed ornaments, relieved by colour. In the centre of the end of the room is a small opening or recess, once covered with a piece of glass; in this recess, as is plain from the appearance of smoke, a lamp has been placed. In the archivolt, or vaulted roof, immediately above, is a window two feet eight inches high, and three feet eight inches broad, closed by a single pane of cast glass two-fifths of an inch thick, fixed into the wall, and ground on one side: the floor is paved with white marble worked in mosaic, and the ceiling divided into panels. In this room there are six doors, one leading to the præfurnium; another into a small room, perhaps designed for a wardrobe; the third, by a narrow passage into the street; the fourth, to the tepidarium; the fifth, to the frigidarium; and the sixth, along the corridor to the vestibule or portico of the bath.

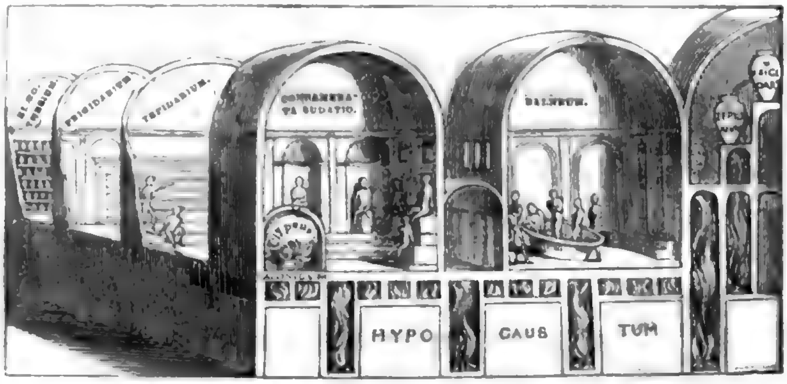
The frigidarium (19), or cold bath, is a round chamber, with a ceiling in the form of a truncated cone; near the top is a window from which it was lighted. The plinth, or base of the wall, is entirely of marble, and four niches are disposed round the room at equal distances; in these niches were seats (scholæ) for the convenience of the bathers. The basin (alveus) is twelve feet ten inches in diameter, two feet nine inches deep, and entirely lined with white marble; two marble steps facilitate the descent into the basin, and at the bottom is a sort of cushion (pulvinus), also of marble, to enable those who bathed to sit down. The water ran into this bath in a copious stream, through a spout or lip of bronze four inches wide, placed in the wall, three feet seven inches from the edge of the basin. At the bottom of the alveus is a small outlet, for the purpose of emptying and cleansing it; and in the rim there is a waste pipe to carry off the superfluous water: like the apodyterium, the frigidarium has been highly decorated, and is remarkable for its preservation and beauty. The tepidarium (37), or warm-chamber, adjoining the apodyterium, was so called from a warm, but soft mild temperature, which prepared the bodies of the bathers for the more intense heat of the vapour and hot-baths, and *vice versâ*, softened the transition from the hot-bath to the external air. This apartment is decorated with niches, divided by telamónes. [ATLANTES.] The room was highly enriched, both with stucco ornaments and colour, and was lighted by a window two feet six inches high and three feet wide, in the bronze frame of which were found set four very beautiful panes of glass, fastened by small nuts and screws, very ingeniously contrived with a view to their being removed at pleasure. In this room a large bronze brazier and three bronze benches were found. A doorway led from the tepidarium into the caldarium, or vapour-bath (39); at one end was the laconicum, where a vase (41) for washing the hands and face was placed, called labrum; on the opposite side of the room was the hot-bath, called lavacrum. Vitruvius, in explaining the structure of the apartments, says (cap. xi. lib. v.), "Here should be placed the vaulted sweating-room, twice the length of its width, which should have at one end the laconicum, made as described above, at the other end the hot-bath." This apartment is exactly as described, twice the length of its width, exclusively of the laconicum at one end, and the hot-bath at the other. The pavement and walls of the whole were made hollow, to admit the heat. Vitruvius never mentions the laconicum as being separated from the vapour-bath; it may therefore be presumed to have been always connected with it in his time, although in the thermæ constructed by the later emperors, it appears always to have formed a separate apartment. In the baths of Pompeii they are united, and adjoin the tepidarium, in this respect exactly agreeing with the description of Vitruvius.

The laconicum is a large semicircular niche, seven feet wide, and three feet six inches deep, in the middle of which was placed a vase, or labrum. The ceiling was formed by a quarter of a sphere; and it had on one side a circular opening one foot six inches in diameter, over which, according to Vitruvius, a shield of bronze was suspended, which, by means of a chain attached to it, could be drawn over, or drawn aside from the aperture, and thus regulate the temperature of the bath.

The laconicum at Pompeii does not exactly correspond with the laconicum painted on the walls of the Baths of Titus, and the laconicum described by Vitruvius. In the laconicum of Pompeii there is no cupola, such as we see represented in the painting of the Baths of Titus, nor aperture in the floor, although the flue in the hypocaustum runs beneath it. The brazen shield also is applied to regulate the escape of heat through the roof, not to admit or exclude the smoke and flame coming direct from the furnace, as appears to have been the case in the Baths of Titus. The latter was a clumsy and dirty way of heating a room, and strangely at variance, if it were really practised, with the finished elegance and luxury prevailing in every part of the Roman baths. The cupola in the Baths of Titus might, however, have been a contrivance similar to our modern stoves for heating with hot air. Where this cupola did not exist, the room probably was heated, as at Pompeii, by a large brazier. The proper meaning of the word laconicum, whether it should be applied to the cupola and clypeus, or to the room in which they were placed, has been much disputed. It seems pretty certain that the name laconicum, which meant in the first instance, the small cupola with the clypeus, became afterwards the name for that part of the room for which it was originally placed, even after the cupola had fallen into disuse, possibly from the discovery of a better method of heating the room.

Where the ceiling of the laconicum joined the ceiling of the vapour-bath, there was immediately over the centre of the vase, or labrum, a window three feet four inches wide; and there were two square lateral windows in the ceiling of the vapour-bath, one foot four inches wide, and one foot high, from which the light fell perpendicularly on the labrum as recommended by Vitruvius, "that the shadows of those who surrounded it might not be thrown upon the vessel." (Vitruv.)

The labrum was a great basin, or round vase of white marble, rather



Representation of Baths, from the paintings discovered in the Baths of Titus.

more than five feet in diameter, into which the hot water bubbled up through a pipe in its centre; it served for the partial ablutions of those who took the vapour-bath. It was raised about three feet six inches above the level of the pavement, on a round base, built of small pieces of stone or lava, stuccoed and coloured. In the Vatican there is a magnificent porphyry labrum, found in one of the imperial baths; and Baccius, a great modern authority on baths (see his work 'De Thermis,' Venice, 1588, and Rome, 1622), speaks of labra made of glass. This apartment, like the others, is highly enriched. The hot bath (42) on the plan, occupied the whole end of the room opposite the laconicum and next to the furnace. It was four feet four inches long, and one foot eight inches deep, constructed entirely of marble, with only one pipe to introduce the water, and was elevated two steps above the floor, while a single step led down into the bath itself, forming a continuous bench round it for the convenience of the bathers.

The Romans, who, according to Vitruvius, called their vapour-baths caldaria, or sudationes concameratæ, constructed them with suspended or hollow floors, and with hollow walls communicating with the furnace, that the smoke and hot air might be spread over a large surface, and readily raise them to the required warmth. The temperature was regulated by the clypeus or bronze shield already described, which acted as a ventilator.

In the baths of Pompeii, the hollow floors are thus constructed: Upon a floor of cement, made of lime and pounded bricks, were built small brick pillars, nine inches square, and one foot seven inches high, supporting strong tiles, fifteen inches square; the pavement was laid on these tiles, and incrusted with mosaic. The hollow walls, the void spaces of which communicated with the hollow of the suspended pavement, were constructed in the following manner: Upon the walls large square tiles were fastened, by means of iron clamps. These tiles were made in a curious manner; while the clay was moist, some circular instrument was pushed through the tiles, so as to make a hole, at the same time forcing out the clay and forming a hollow projection or pipe, about three inches long, on the inside of the tile: these being made at the four corners, iron clamps passed through them, and

[Transverse Section of the Apodyterium.]

fastened them to the wall. The sides of the apartments being thus formed, were afterwards carefully stuccoed and painted. The hollow space in the walls of the bath at Pompeii reaches to the top of the cornice; but the ceilings are not hollow, as in the baths which Vitruvius described, and which he distinguishes, for that reason, by the name of concameratæ. The ceilings of the apodyterium, tepidarium, and the caldarium are arched.

The women's bath resembles very much that of the men, and differs only in being smaller and less ornamented: for an account of it, we refer to Gell's 'Pompeii,' the 'Museo Borbonico,' and 'Pompeii' published by the Society for the Diffusion of Useful Knowledge.

Vitruvius recommends a situation for baths, which is defended from the north and north-west winds, and he says that the windows should be opposite the south, or, if the nature of the ground will not permit this, at least towards the south, because the hours of bathing among the Romans being from after mid-day till evening, those who bathed could by these windows have the advantage of the rays and the heat of the declining sun. Accordingly the baths just described have the greater part of their windows turned to the south, and are constructed in a low part of the city, where the adjoining buildings served as a protection from the north-west winds.

The baths at Rome were on a much larger scale. The public baths of Caracalla were 1500 feet in length, and 1250 in breadth: "at each end were two temples, one to Apollo, and another to Esculapius, as the tutelary deities of the place (*genii tutelares*), sacred to the improvement of the mind, and the care of the body; the two other temples were dedicated to the two protecting divinities of the Antonine family, Hercules and Bacchus. In the principal building were, in the first place, a grand circular vestibule, with four halls on each side, for cold, tepid, warm, and steam baths; in the centre was an immense square for exercise, when the weather was unfavourable to it in the open air; beyond it a great hall, where 1600 marble seats were placed for the convenience of the bathers; at each end of this hall were libraries. This building terminated on both sides in a court surrounded with porticoes, with an odeum for music, and in the middle a spacious basin for swimming. Round this edifice were walks shaded by rows of trees, particularly the plane; and in its front extended a gymnasium for running, wrestling, &c., in fine weather. The whole was bounded by a vast portico, opening into exhedræ or spacious halls, where the poets declaimed, and philosophers gave lectures to their auditors. This immense fabric was adorned, within and without, with pillars, stucco-work, paintings, and statues. The stucco and paintings are yet in many places perceptible. Pillars have been dug up, and some still remain amidst the ruin; while the Farnesian bull and the famous Hercules, found in one of these halls, announce the multiplicity and beauty of the statues which once adorned the Thermæ of Caracalla." (Eustace's 'Classical Tour,' vol. i. p. 226.) For an account of the baths of Titus and Diocletian, see the same author.

On entering these baths the bathers first proceeded to undress. They next went to the elæothesium (the oil-chamber), as it was called in Greek, or unctuarium, where they anointed themselves all over with a coarse cheap oil before they began their exercise. (Plin. xv. c. 4 & 7.) Here the finer odoriferous ointments which were used on coming out of the bath were also kept (Plin. l. ii. 'Epist.' 41), and the room was so situated as to receive a considerable degree of heat. This chamber of perfumes was full of pots, like an apothecary's shop; and those who wished to anoint and perfume the body received perfumes and unguents. In the representation of a Roman bath, copied from a painting on a wall forming part of the Baths of Titus, the unctuarium, called also elæothesium, appears filled with a vast number of vases. The vases contained a great variety of perfumes and balsams. When anointed, the bathers passed into the sphæristerium, a very light and extensive apartment, in which were performed the various kinds of exercises to which this part of the baths was appropriated. (Plin. lib. i, 'Epist.' 101.) When its situation permitted, this apartment was exposed to the afternoon sun, otherwise it was supplied with heat from the furnace. (Plin. l. 11. 'Epist.' 41.) After the exercise, they went to the adjoining warm-bath, wherein they sat and washed themselves.

The seat was below the surface of the water, and upon it they scraped themselves, or were scraped, with instruments called strigiles, which were usually made of bronze, but sometimes of iron or brass. (Martial, lib. xiv. 'Epig.' 51.) This operation was usually performed by an attendant slave. The use of the strigil is represented on a vase, found on the estate of Lucien Bonaparte at Canino. The vase is large and shallow, and painted within and without. (Vol. i. p. 183, 'Pompeii.') From the drawings on it we learn that the bathers sometimes used the strigils themselves, after which they rubbed themselves with their hands, and then were washed from head to foot, by pails or vases of water being poured over them. They were then carefully dried with cotton and linen cloths, and covered with a light shaggy mantle, called gausape. Effeminate persons had the hairs of their bodies pulled out with tweezers. When they were thoroughly dried, and their nails cut, slaves came out of the elæothesium, carrying with them little vases of alabaster, bronze, and terracotta, full of perfumed oils, with which they had their bodies anointed, by causing the oil to be slightly rubbed over every part, even to the soles of their feet. After this they resumed their clothes. On quitting the warm-bath they went into the tepidarium, and either passed very slowly through or stayed sometime in it, that they might not too suddenly expose their bodies to the atmosphere in the frigidarium; for these last rooms appear to have been used chiefly to soften the transition from the intense heat of the caldarium to the open air.

"It is probable that the Romans resorted to the baths, at the same time of the day that others were accustomed to make use of their private baths. This was generally from two o'clock in the afternoon till the dusk of the evening, at which time the baths were shut till two the next day. This practice however varied at different times. Notice was given when the baths were ready, by the ringing of a bell; the people then left the sphæristerium, and hastened to the caldarium, lest the water should cool. (Martial, lib. xiv. 'Epig.' 163.) But when bathing became more universal among the Romans, this part of the day was insufficient, and they gradually exceeded the hours that had been allotted for that purpose. Between two and three in the afternoon was, however, the most eligible time for the exercises of the palæstra. Hadrian forbade any but those who were sick to enter the public baths before two o'clock. The thermæ were by few emperors allowed to be continued open so late as five in the evening. Martial says, that after four o'clock they demanded a hundred quadrantes of those who bathed. This, though a hundred times the usual price, only amounted to nineteen-pence. We learn from the same author, that the baths were opened sometimes earlier than two o'clock. He says that Nero's baths were exceeding hot at twelve o'clock, and the steam of the water immoderate. (Mart. lib. x. 'Epig.' 48.) Alexander Severus, to gratify the people in their passion for bathing, not only suffered the thermæ to be opened before break of day, which had never been permitted before, but also furnished the lamps with oil, for the convenience of the people." (Cameron 'On Roman Baths,' p. 40.)

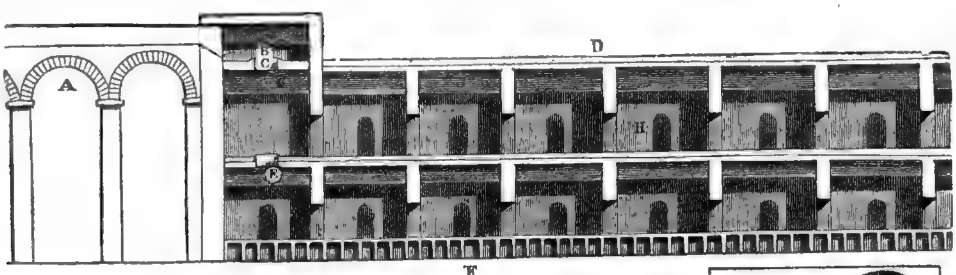
Coin representing the Baths of Alexander Severus.

The thermæ were constructed at a vast expense, and principally for the use of the poorer classes, though all ranks frequented them for the sake of the various conveniences which they contained.

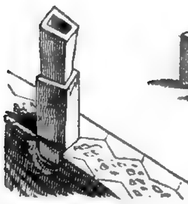
"Nothing relating to the thermæ has more exercised the attention of the learned than the manner of supplying the great number of bathing vessels made use of in them with warm water. For, supposing each cell of Diocletian's baths large enough to contain six people, yet, even at that moderate computation, 18,000 persons might be bathing at the same time; and as no vestiges remain of any vessels in the thermæ, to give the least foundation for conjecturing in what manner this was performed, it has been generally referred to the same process described by Vitruvius on a similar subject.

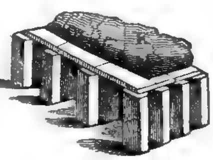
"Baccius has more professedly treated this subject than any modern author. He imagined that the water might be derived from the castella, which he observed to be situated without the thermæ; but as these castella were upon a level with the thermæ themselves, he thinks for that reason they were obliged to make use of machines to raise the water to such a height, as he observed it to have been by the ruins of Diocletian's baths. What led Baccius into this way of thinking was the number of pipes which he saw dug up under the open area, where there had never been any buildings, all of them surrounded with flues from the hypocaustum. He therefore imagined that the water was heated on the outside of the thermæ; but this supposition appeared so full of difficulties, as, upon reflection, to discourage him from inquiring any further into the subject." (Cameron.) By the assistance of two sections of the castella of Antoninus, drawn by Piranesi, Cameron endeavours to show the method adopted by the Romans to heat the large bodies of water which their extensive thermæ must have required.

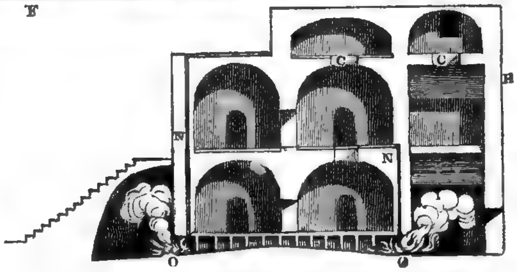
"To have a clear conception of the manner in which this was executed, it will be necessary to refer to a plate of these two sections.



Longtudinal Section of the Castellum, placed at T. T, on the Plan, cols. 993, 994.







Transverse ditto.

Flues in the floors and walls.—From Cameron. Specimen of Hollow Pavement.—From Cameron. Section of the Castellum of Antoninus Caracalla.—From Cameron.

"The castellum of the thermæ of Antoninus Caracalla was supplied with water by the aqueduct of Antoninus. Two of the arches of this aqueduct are represented at A; B is a cistern which received the water from the aqueduct; C is an aperture for permitting the descent of the water from the receptacle to the chamber below; D is a receptacle with a mosaic pavement, wherein the water was exposed to the heat of the sun; E is another aperture through which the water passed into the lowest chambers placed immediately over the hypocaustum; F, the hypocaustum; O O, doors for introducing the fuel. A transverse section through the middle of the same castellum is given at H.

"By the plan of this castellum, it appears that there were twenty-eight of these vaulted rooms placed over the hypocaustum; they were placed in two rows, fourteen on a side, and had all a communication with each other. The sections show, that over these were twenty-eight other rooms, having likewise a communication with each other, although only one of them had any communication with the chambers below, through the aperture at E. Upon the top of all was a spacious receptacle, not very deep, but extending the whole length of the castellum, in which the water was considerably heated by the influence of the sun, before it passed into the several chambers. This receptacle received its water from the cistern B, and not immediately from the aqueduct. The use of this cistern appears to have consisted in promoting a more gentle flow of the water into the receptacle, that its surface might not be ruffled by the least agitation, as that would very much have counteracted the purposes to which the receptacle was applied, nothing contributing so much as tranquillity in the water to acquire all the advantages from the influence of the sun its situation would permit. When there was no efflux from the inferior chambers, there could be no demands for water from the receptacle, which would have been liable to overflow were there not an aperture in the side of the cistern, through which the water ran off in different directions from that which was used for bathing. During all this time the water in the receptacle would be in the most perfect state of rest. The cistern, therefore, answered two material purposes, as it prevented any agitation in the water of the receptacle, and likewise carried off what was superfluous. The twenty-eight vaulted chambers, placed immediately over the hypocaustum, would now begin to be heated, which heat they would acquire so much the quicker, as only one of them had any communication with the external air by the apertures C and E. They therefore evidently were constructed upon the same principle as Papinius's digester, the strength of the walls and of the roof being sufficient to resist the force of the rarefaction of the air in the water, and consequently to prevent any loss from evaporation. Flues were still necessary to give the water a heat sufficient for bathing. The arched chambers were also suppled with flues, N N, from the hypocaustum, and served as a reservoir of tepid water for those below. The water they received was likewise heated by the sun. When the time for bathing was come, the cocks were turned to admit the hot water from the lower chambers into the labra of the baths, to which it would run with great velocity, and ascend a perpendicular height in the thermæ, equal to the surface of the receptacle in the castellum. The current would be accelerated by the great tendency the water would have to expand itself after having been confined in the chambers. The pressure of the column of tepid water was equal to, if not greater than the diameter of the column of hot water which ran out from the chambers below. To prevent the water cooling as it passed through the tubes underground, they were all carefully surrounded with flues from the præfurnium, so that these tubes were in the centre of a funnel, and always considerably heated before the water entered them. Each of these chambers was, within the walls, 49 feet 6 inches long, by 27 feet 6 inches wide, and about 30 feet high; the number of superficial feet in the bottom of the rooms being 38,115. If we allow 30 feet for the mean height, the whole quantity of water in these lower rooms will amount to 1,143,450 cubic feet, and the like quantity must be allowed for the upper rooms; allowing, therefore, 8 cubic feet of warm water as sufficient for one man to bathe in, and that water preserved in a bathing heat in the labrum half an hour, the whole consumption of hot water in this given time, for 18,000 people, would be 144,000 cubic feet. By this calculation there would be a sufficient quantity of water for three hours, or until five in the evening, for 108,000 people. The water, however, would gradually cool as it flowed in from the higher chambers.

"We have no intimation from the ancients when they first fell upon this expedient for heating such large bodies of water, whether it was the invention of the Romans or brought from the East. We may reasonably suppose, that as it was not necessary before the public warm-baths were built in Rome, it was not more ancient than the time of Augustus, in whose reign we are told by Dion Cassius (lib. lv.) that Mecænas first instituted a swimming-bath of warm water, or a calida piscina." (Cameron.)

But few Roman citizens in easy circumstances were without the luxury of a private bath, which was varied in construction according to the taste or prodigality of the owner. "Amongst many articles of luxury for which Pliny censures the ladies of his time, he takes notice of their bathing-rooms being paved with silver. Even the metal flues of the hypocaustum were gilt." (See Cameron 'On Roman Baths.' For an account of the private baths, see 'Pompeii,' vol. i. p. 199.)

The Persian manner of bathing, as described by Sir. R. Ker Porter, is in some respects not unlike that adopted by the ancient Romans. The Russian baths, as used by the common people, bear a close resemblance to the laconicum of the Romans. (See Tooke's 'Russia;' and BATHING.)

Ancient Roman baths have been found in several of the Roman villas in England; that at Northleigh in Oxfordshire, near Blenheim, is the most perfect. (See the account of the villa at Northleigh, Oxfordshire, by Mr. Hakewill.) Baths have been discovered also at Wroxeter in Shropshire, near Arundel in Sussex, and elsewhere. In the former, the suspended pavement was very perfect; in the centre of a chamber in that near Arundel is an octagonal bath sunk in the floor, the pulvinus of which is quite perfect. There are also some curious Roman baths at Vallogne in Normandy.

(Montfaucon, *Antiq.* t. iii. pl. 2; Cameron's *Roman Baths;* Gell's *Pompeii; Museo Borbonico*, vol. ii.; *Pompeii*, by the Society for the Diffusion of Useful Knowledge; Eustace's *Classical Tour;* Becker's *Gallus*, vol. ii.)

BATH, KNIGHTS OF THE, so called from the ancient custom of bathing previous to their installation. The origin of this order of knighthood has been described as of very remote antiquity; but as Camden and Selden agree that the first mention of an order of knights, distinctly called Knights of the Bath, is at the coronation of Henry IV. in 1399, there can be little doubt that this order was then instituted. That bathing had been a part of the discipline submitted to by esquires in order to obtain the honour of knighthood from very early times, is admitted; but it does not appear that any knights were called Knights of the Bath, till these were created by King Henry IV.

Froissart (see Lord Berners's 'Translat.,' edit. 1812, vol. ii. p. 752), speaking of that king, says:—"The Saturday before his coronation he departed from Westminster, and rode to the Tower of London with a great number; and that night all such esquires as should be made knights the next day, watched, who were to the number of forty-six. Every esquire had his own bayne [*bath*] by himself; and the next day the Duke of Lancaster made them all knights at the mass-time. Then had they long coats with strait sleeves, furred with mynever like prelates, with white laces hanging on their shoulders."

It became subsequently the practice of the English kings to create Knights of the Bath previous to their coronation, at the inauguration of a Prince of Wales, at the celebration of their own nuptials or those of any of the royal family, and occasionally upon other great occasions or solemnities. Fabyan ('Chron.,' edit. 1811, p. 582) says, that Henry V. on 1416, upon the taking of the town of Caën, dubbed sixteen Knights of the Bath.

Sixty-eight Knights of the Bath were made at the coronation of King Charles II. (See the list in Guillim's 'Heraldry,' fol. Lond. 1679, p. 107); but from that time the order was discontinued, till it was revived by King George I., under writ of Privy Seal, dated May 25, 1725, during the administration of Sir Robert Walpole. The statutes and ordinances of the order bear date May 23, 1725; and by them the constitution of the order, with the rites and ceremonies of the order, more particularly that of bathing, were entirely changed. By these it was directed that the order should consist of a grand master and thirty-five knights, a succession of whom was to be regularly continued. The order, besides the grand-master, are the dean, the genealogist and Blanc Coursier herald, the Bath king-at-arms, the registrar and secretary, the gentleman-usher of the scarlet-rod and Brunswick herald, and the messenger. The dean of the collegiate church of St. Peter, Westminster, for the time being, was appointed *ex officio* dean of the Order of the Bath, and it was directed that the other officers should be from time to time appointed by the grand-master.

On Jan. 2, 1815, the Prince Regent, being desirous to commemorate the auspicious termination of the long and arduous contests in which the empire had been engaged, and of marking, in an especial manner, his sense of the valour, perseverance, and devotion manifested by the officers of the king's forces by sea and land, directed that the order should consist of three classes; and on April 14, 1847, it was further enlarged by the constitution of it as a civil order.

The first class consists of knights grand cross, which designation was substituted for that of knights companions previously used. The knights grand cross, with the exception of the sovereign, princes of the blood-royal, and distinguished foreigners,—who may hold rank as honorary knights,—are not to exceed fifty for the military service, and twenty-five for the civil service.

The second class is composed of knights commanders, who have precedence of all knights bachelors of the United Kingdom: the number, for the military service, not to exceed one hundred and two, exclusive of foreign officers, who may be admitted into the second class as honorary knight commanders, or fifty for the civil service: but in the event of actions of signal distinction, or of future wars, the number of knights commanders may be increased.

The third class is composed of officers holding commissions in Her Majesty's service by sea or land, to the number of five hundred and twenty-five, and for the civil service of two hundred, who are styled Companions of the said Order, to take precedence and place of all esquires of the United Kingdom. No officer to be nominated a Companion of the Order, unless he shall have been specially mentioned by name in despatches published in the 'London Gazette' as having distinguished himself.

The badge of the order for the military classes is a gold Maltese cross of eight points, enamelled *argent*, in each of the four angles a lion passant guardant *or;* in the centre the rose, thistle, and shamrock issue from a sceptre between three imperial crowns, surrounded by the motto "Tria juncta in uno." Within a circle *gules*, surrounded by two branches of laurel proper, issuing from an escrol *argent*, inscribed "Ich dien," in gold letters. It is worn by grand crosses pendant from a red ribbon across the right shoulder; by knights-commanders pendant from the neck; and by companions at the button-hole.

The collar is of gold, weighing 30 ounces troy, composed of nine imperial crowns, and eight roses, thistles, and shamrocks, issuing from a sceptre, enamelled in their proper colours, tied or linked together by seventeen gold knots, enamelled white, and having the badge of the order pendant from it.

The star is formed by a gold Maltese cross, around which are rays of silver, and in the centre, within the motto, are branches of laurel, issuant as in the badge. That of the knights-commanders is in the form of a cross patée *argent*, with the centre as in that of the grand crosses, but without the Maltese cross *or* thereon.

The civil Knights Grand Crosses bear the old badge and star of the Order. The badge is of gold, and consists of a rose, thistle, and shamrock, issuing from a sceptre between three imperial crowns, encircled by the motto, "Tria juncta in uno," and is worn pendant over the right shoulder. The civil Knights Commanders wear the same badge pendant from the neck; and the civil Companions, one of a smaller size pendant from the button-hole, all by a red ribbon.

The star of the civil Knights Grand Crosses is of silver, with eight points or rays charged with three imperial crowns proper, upon a glory of silver rays, within a red circle, bearing the motto, "Tria juncta in uno." That of the civil Knights Commanders is of the same form and size as that of the military, but the laurel wreath and the motto, "Ich dien" are omitted.

BATHING means the temporary surrounding of the body, or a part of it, with a medium different from that in which it is usually placed. The means employed for this purpose are generally water, watery vapour, or air of a temperature different from that of the common atmosphere. The objects for which these are employed are usually the prevention of disease, the cure of disease, or the pleasure derived from the operation. To understand in what way these ends are accomplished, we must observe that the human frame is endowed with a power of maintaining, within certain limits, a nearly uniform temperature in whatever circumstances it is placed. The general temperature of an adult in a state of perfect health is from 97° to 98° of Fahrenheit's thermometer; that of a new-born infant about 94°. In some cases of disease the temperature rises far above this standard, even to 106°, while in others it sinks far below it. The power by which the body maintains a uniformity of temperature is the property of developing *animal heat*, the perfection of which function is intimately connected with the state of the nervous system, and through that with the circulation. When the body is well nourished and the circulation vigorous, the temperature is high, and nearly equal over all parts of the body, provided the supply of nervous energy be adequate. If anything impairs the vigour of the circulation generally, or of an artery going to a particular limb (as when it is tied in the operation of aneurism), the temperature of the whole or of the part will be low. On the other hand, if the whole nervous system be impaired, a lower temperature will prevail generally, and especially at the extremities; or if a particular limb, such as a paralysed limb, have an imperfect share of nervous energy, a lower temperature of the part will exist. The respiratory function is also intimately connected with the development of animal heat, and the skin assists in regulating it, especially in reducing it when too high. When the body is placed in a medium of a temperature much lower than itself, the heat is abstracted from the surface with more or less rapidity, according to the difference of temperature, and, if the medium be air, according to its state of humidity or dryness; the effect of which would be a reduction of the temperature of the whole body, were it not counteracted by an increased development of animal heat. Again, when the body is surrounded by a medium much higher than itself, the exhalation from the surface, both of the skin and lungs, is greatly augmented: that from the former being thrown off in the form of perspiration, that of the latter in the form of vapour. The evaporation attending these processes causes a reduction of temperature. As illustrations of the truth of these two positions, we need not do more than allude to the nearly equal temperature of the body maintained by Sir Joseph Banks, Sir Charles Blagden, Drs. Fordyce and Solander, in their experiments, when the heat of the room was 260° of Fahrenheit (see 'Animal Physiology, Library of Useful Knowledge,' part i. p. 3), and that maintained during the winter by the members of the expeditions under Captains Ross, Parry, and Franklin, when the thermometer frequently fell to 51° below zero of Fahrenheit.

In a moderate temperature the animal heat is generally prevented from rising too high by means of the *insensible* perspiration, the quantity of which varies with circumstances. According to the experiments of Seguin, the largest quantity from the skin and lungs together amounted to thirty-two grains per minute, or three ounces and a quarter per hour, or five pounds per day. The medium quantity was fifteen grains per minute, or thirty-three ounces in twenty-four hours. The quantity exhaled increases after meals, during sleep, in dry warm weather, and by friction, or whatever stimulates the skin; and it diminishes when digestion is impaired, and the body is in a moist atmosphere. These last-mentioned circumstances prove the sympathy which subsists between the skin and the internal organs. The skin must not, therefore, be regarded as a mere covering of the body, but as an organ, the healthy condition of which is of vast importance to the well-being of the whole frame, but especially of the stomach and lining membrane of the lungs, with which, as mucous membranes, it has the closest sympathy. It also sympathises with the kidneys, the quantity of discharge from which is regulated by the action of the skin. Hence in summer, when the perspiration from the skin is abundant, the secretion from the kidneys is less; and when, in winter, the secretion from the skin is diminished, that from the kidneys is increased.

The perspiration is the channel by which salts and other principles, no longer useful in the system, are removed from it. According to Thenard, it consists of a large quantity of water, a small quantity of an acid, which according to circumstances may be either the acetic, lactic, or phosphoric; and some salts, chiefly hydro-chlorates of soda and potass. Taking the lowest estimate of Lavoisier, the skin appears to be endowed with the power of removing from the system, in the space of twenty-four hours, twenty ounces of waste; the retention of this in the system is productive of great injury, and the inconvenience is only lessened by the increased action of some internal organ, which becomes oppressed by the double load thus cast upon it. Even the retention of the perspired matter close to the skin, from neglect of changing the clothes, is the source of many cutaneous diseases, particularly in spring and summer.

The great vascularity of the skin, and the manner in which the vessels of this part are influenced by affections of the mind, as in blushing, when it becomes red from more blood being sent to it, and during fear when less blood goes to it, and more to the vicarious organs, as the kidneys, point out how an exposure to a cold and damp atmosphere and how mental emotions are concerned in producing morbid action of this organ. The skin must also be regarded as a network of nervous filaments, and the most extensive organ of sensation: in this way it enables us to judge of heat and cold, though not with absolute certainty, as the sensation conveyed will depend upon the temperature of the medium in which the body or any of the limbs may have been placed immediately before. To understand this doctrine, it is necessary to be acquainted with the action of heat and cold on the human system; in our explanation of which, we will endeavour to be as concise as possible. We treat first of cold; in doing which it is necessary to distinguish between the immediate *primary* action of cold on the organ or part with which it is brought into contact, and the *secondary* action, depending upon the organic activity residing in the part, or that train of effects usually denominated *re-action*. The primary effect is always the same, consisting in the abstraction of heat from the part, and the consequent reduction of its temperature, while the internal development of heat becomes greater, so that the organic life strives ever to maintain an equilibrium between the conflicting powers, in order that it may not be limited or disturbed in its healthy action. Yet it must be remembered, that both the external and internal degree of the primary action of cold, as also the period in which it slowly or suddenly shows itself, and the time, whether longer or shorter, that it lasts, occasion a variety of effects, both in the part to which it is applied, and those more immediately sympathising with it, as well as in the whole system. The degree of primary action of cold can vary in endless degrees, from the lowest, where it scarcely affects the sensibility, to the highest, when it utterly destroys life. This difference of degree depends upon the concurrence of several circumstances, partly relating to the action of the cold itself, and partly to the nature of the organic life upon which the cold operates. The essential conditions which must be here borne in mind are, that the continual evolution of animal heat is closely connected with the development or exercise of animal life; and that the power or extent of action of external media, having a lower temperature than that of the animal they surround, depends less on the absolute degree of their temperature than upon the quantity of caloric which they can abstract in a given time.

The relative power and quickness of abstracting heat, with which different external media are endowed, depend upon different properties, such as their density, conducting power, capacity for heat, &c., and display themselves through the diversity of sensations which, at the same absolute temperature, they occasion. Thus, air at the temperature of 65° Fahr. feels pleasant, while water at the same degree feels somewhat cold. The organs of the body also differ in their power of sustaining the same temperature; hence, in the employment of vapour-baths, it is of importance to know whether the watery vapour is to be breathed or not, since, where it is to be breathed, the temperature must be much lower. The following table is given by Sir John Forbes as an approximation to what may be deemed correct as a measure of sensation in the cases where water and vapour are used.

	Water.	Vapour.	
		Not breathed.	Breathed.
Tepid Bath.	85° to 92°	96° to 106°	90° to 100°
Warm Bath.	92 „ 98	106 „ 120	100 „ 110
Hot Bath.	98 „ 106	120 „ 160	110 „ 130

As a full exposition of the subject of the temperature of animals is given under the article HEAT, ANIMAL, we must refer to it for further details, confining ourselves here to remark that the ultimate action of cold, when extreme, is a sedative to the nervous system, and alters the circulation from external to internal; and that moderate cold continued causes the same consequences as severe cold of short duration. (See Beaupré, 'On Cold,' Edinb. 1826.) Heat, on the other hand, is a stimulant to the nervous system, and alters the distribution of the blood from internal to external. Taking these principles as our guide, we proceed now to consider the different kinds of baths, and their action on the system in different states both of health and disease.

First, of water-baths. The common division is into cold and warm; but various subdivisions are formed, marked by a certain range of temperature, which are designated

1. The cold-bath, from	40°	to	65°
2. The cool	,,	65	,,	75
3. The temperate	,,	75	,,	85
4. The tepid	,,	85	,,	92
5. The warm	,,	92	,,	98
6. The hot	,,	98	,,	112

We shall treat first of the cold-bath, as applied to the whole surface of the body.

A healthy person upon entering a cold-bath experiences a sensation of cold, followed by slight shuddering, and if the immersion has been sudden, a peculiar impression on the nervous system, called a shock. The skin becomes cooler and paler, the respiration hurried and irregular, the action of the kidneys increases and the bladder contracts. In a few moments the colour and warmth return to the skin, and a glow is felt, especially if assisted by rubbing the surface. If the person remains more than five or ten minutes in the bath, the glow disappears, and paleness returns, which again gives place, though less quickly and perfectly, to a renewed glow. During the existence of the primary action of the cold, the bulk of the whole body, but especially of the more contractile parts, diminishes. Should the stay in the water be greatly prolonged, no reaction ensues, but a general feeling of chilliness prevails, with quick feeble pulse, convulsive breathing, cramps of the limbs, or fainting. If the person quit the bath after the few first minutes, as in prudence he should, the blood returns to the surface, accompanied with a sensation of pricking, itching, and sometimes throbbing of the arteries: the elasticity of the muscles being increased, more animal power is felt, accompanied with a general feeling of enjoyment.

Very young or feeble individuals are either incapable of bearing the shock, or the re-action is so slight that they cannot endure to stay in the bath beyond a very short time. If they unwisely stay or are held in the bath longer than one or two minutes, the heat never regains its proper height, the extremities remain contracted, and they, as well as the lips, nose, &c., are of a livid hue. In such cases, either artificial means must be used to bring about reaction, or the bath must be relinquished, as improper for such persons, as we shall show at a future part of our observations.

The phenomena just described generally accompany cold bathing; and it is clear that we can recognise in them a series of three or even four distinct actions: namely, 1st, the shock; 2nd, the cooling effect; 3rd, the contraction or astringent effect; and 4th, the re-action. Cold-bathing may be employed therefore in such a way as to insure the predominance of one action over any of the rest, according to circumstances, where all are not desired. They vary with the degree of cold and the suddenness of the application, as well as from the body being plunged into the water, or the water dashed against the body. Where the shock, as a stimulus to the nervous system, is desired, the water should be very cold, and where practicable should be dashed against the body, or, if the contrary, the stay in the bath should be momentary. This mode of using it may be either general or local. It has been employed generally—that is, the whole body exposed to the action of the water—in mania, with occasional success, and in the early stage of the common continued fever (under certain regulations, for which see Currie's 'Medical Reports'), sometimes with great success, cutting short the train of morbid actions which constitute the fever. It has been employed also in nervous affections, accompanied with a convulsive action, or deficient action of the muscular system, as in hysteria, in lock jaw (see Paper by Dr. Wright, 'London Medical Observations and Inquiries,' vol. vi. p. 143): in some cases of obstinate constipation, dashing cold water on the person, or the cold bath frequently repeated, has been of great service.

Its stimulating effect is sometimes best procured by a local application, in the form of a stream of water falling on the head, from a considerable height. The simplest example of this is the common practice of sprinkling the face with cold water in case of a tendency to faint; and in many diseases of the most dangerous character it is a remedy superior to any other. It is called the *cold dash*, or *douche*, or *douse*, and is beneficially employed in fever, particularly when the brain continues the seat of inordinate action of the blood-vessels, after depletion has been carried as far as prudence will allow. (See the instructive case of Dr. Dill in Dr. Southwood Smith's 'Treatise on Fever,' p. 398). It requires to be used with the greatest caution. Also in the state of stupor or *coma* which occurs in the last stage of *hydrocephalus acutus*, or water in the brain, it often succeeds in rescuing the patient from imminent danger. (See Abercrombie, 'On Diseases of the Brain,' first edit. 1828, p. 157.) Its utility is well known in the East in rousing drunken soldiers from their stupor so effectually as to enable them to rise up and appear immediately on parade. In the melancholy and mania which overtake habitual drunkards it is of great efficacy, and also in cases of loss of nervous power from excessive mental exertion. In apoplectic stupor it has also been very advantageously employed. In the sinking stage of croup, when all other remedies have failed, cold affusion has sometimes restored the functions of life to new action.

The cooling or refrigerating effect of cold bathing is most desired in diseases where the animal heat rises above the proper standard, as in fevers, both continued and eruptive, especially scarlet fever; also in some local inflammations, particularly of the brain. For the principles which should regulate our practice in this application we must refer to Dr. Currie and other writers, only remarking that, in the hot and restless stage of scarlet fever, when the heat is steadily above the natural standard, the skin hot and dry, and neither sleep nor perspiration can be procured, a plunge into cold water will be followed by both, to the relief and often recovery of the patient. (See Bateman 'On Cutaneous Diseases,' edit. 1829, p. 120.) In applying cold locally, as in inflammation of the brain, one rule is of the utmost importance to be observed, namely, that the application of the cold shall be continuous; therefore a second set of cold cloths or bags of ice should be applied before the former has become warm. This plan, especially pursued during the night, along with judicious internal treatment, will save many children from perishing under the most insidious and fatal disease of childhood—water in the brain.

The cases already mentioned are mostly acute diseases, where the cold affusion is employed to avert an imminent but temporary danger. It is generally in chronic diseases that the cold bath is employed for a length of time, and in these it is chiefly the secondary effect, the glow or reaction, which is desired. The rules to be observed in order to obtain this effect are founded upon the strength, which is generally inferred from the age, of the individual. The degree of reaction is, for the most part, dependent upon the coldness of the water and the length of time the person remains in the bath. Very cold water, in which the person remains but a short time, will in general produce a greater degree of re-action than a more moderate temperature in which he remains longer. But here everything depends upon the general power of the individual, the state of the system, especially of the skin at the moment of immersion, and the nature of the bath, according as it is fresh or salt water, and also the season of the year. As the immersion of infants and young children in tubs of water must be considered as bathing, we deem it necessary here to explain the principles upon which the temperature of the bath for them should be regulated, especially during winter. The experiments of Dr. Edwards (see Edwards 'On the Influence of Physical Agents on Life,' London, 1832) have proved that "the power of producing heat in warm-blooded animals is *at its minimum at birth*, and *increases successively to adult age*." It is clear therefore that water of a higher temperature than what feels cool to the hand of the nurse should be used, particularly in winter, when the power of regaining a proper degree of heat is necessarily less. The attempt to harden children by exposure to too great a degree of cold is of the most injurious nature; it either produces acute disease of the lungs, which are then very sensible to external impressions, or disease of the digestive organs, leading to disease of the mesenteric glands, scrofula, water in the brain, or, if they survive a few years, to early consumption. (See an illustrative instance in a young sister of Southey the poet, in vol. i., p. 28, of his 'Life,' 1st edit., 1849.) Delicate and feeble persons of all ages require a higher temperature of the bath, and a shorter stay in it than others. If the re-action does not speedily take place, means must be employed to ensure its so doing, or the use of the cold bath must be abandoned. A tepid or temperate bath may be used in the early treatment of feeble persons, and the cold bath gradually substituted for it, or a glass of wine, or, what is far preferable, strong coffee or chocolate may be taken before entering the bath. Where the arrangements are such as to admit of it, a brief stay in a warm bath before going into the cold has a good effect. Nor, in general, is danger to be apprehended from such a proceeding. Though in most cases moderate exercise is advantageous before bathing, unless the person has an opportunity of springing out of bed into the bath, still he should never think of undressing and going into the water when fatigued, or when the skin is covered with perspiration. It is a good rule to wet the head before taking the plunge. For a person in good health, early in the morning is the best time to bathe; for one more delicate, from two to three hours after breakfast is preferable; but no one should bathe immediately after a full meal, particularly if there be a tendency of blood to the head, and a disposition to apoplexy. Epileptics should rarely bathe, least of all in the sea.

Exercise while in the bath, such as friction of the limbs and chest, or swimming, is advisable, but not even this can prevent evil consequences if the bather remain too long in the water. To say nothing of the risk of cramps and convulsive action of the respiratory muscles, from the blood being pent up in the large internal vessels, which may occur while the person is in the water, the foundation may be laid for future internal disease if the blood do not soon revisit the surface, either from the natural powers of re-action, or from friction with coarse dry cloths. Friction should follow the use of the bath in most instances, except where the bath has been in the sea, in which case the salt particles if allowed to remain in contact with the skin, stimulate it more.

The cases of disease for which cold bathing is a valuable remedy are, morbidly increased irritability and sensibility, accompanied with general debility. If the sensibility be extremely high, it is best to begin with the tepid or cool bath, and pass gradually to the cold. Where there is a tendency to colds and rheumatism, the cold bath is an excellent preventive; for this purpose it should be used continually throughout the year, and the chest should be sponged with cold water, or vinegar and water may be substituted in winter, when there are not facilities for using the complete bath. Before beginning this practice, careful investigation of the state of the mucous membranes of the chest and intestinal canal should be made, as it will certainly prove hurtful where chronic inflammation of these organs exists. If tubercles are suspected to exist in the lungs, cold bathing should be dispensed with. Though cold bathing is very useful in a tendency to scrofulous diseases, it is very hurtful when these are really developed, though tepid and warm bathing are allowable.

Where the increased irritability shows itself in the mental functions or in the muscular system, as in hypochondriasis or hysteria, cold bathing is very useful; and especially in the hypochondriasis of literary persons, accompanied with a disposition to indigestion, and a dry harsh skin. In actual indigestion, especially if complicated with sub-acute inflammation of the mucous membrane of the stomach or intestines, cold bathing is very injurious.

In cases of torpor and loss of power, cold bathing is of much service; in a relaxed state of the skin, subject to debilitating perspirations, it is often the most effectual remedy; in weakness of the limbs, or of any member, and after sprains or paralysis, the local cold bath is very useful. The astringent as well as tonic effect of the cold bath is employed to prevent the prolapsus or descent of different parts: hence, in a tendency to hernia (or even when it has occurred, ice laid upon the tumour, and frequently renewed, has restored the bowel to its place, or at least warded off the inflammation till other means could be tried); in loss of power of the sphincter muscles, or of the contractile power of the bladder, pumping cold water on the back is very useful; but it should be used only for a minute at a time. In chronic hæmorrhages, cold applied locally or generally has a good effect.

The cold bath, like every other powerful agent, when improperly used, is capable of producing much mischief; in some states of the system it must be carefully avoided. In infancy and very advanced age it is less admissible than at other times, and even quite improper if the debility be great. It is inadmissible during, or immediately before, certain conditions of the female system; also when there is congestion of blood in the veins or internal organs: hence it is not suited to chlorosis. In any organic affection of the heart, or aneurism, it is altogether improper.

Of the cold shower-bath and douche we shall only observe here, that their effects are more speedy, and extend more to the internal organs: consequently they are only to be used for a very short time, whenever recourse is had to them. A glow of the surface is sooner felt after the shower than the common bath; and as soon as this is perceived the person should withdraw himself from the stream. If the douche falls upon the head, it produces almost instantaneous and most powerful effects. If its use be prolonged, it quickly lowers, then destroys the sensibility, induces faintings, and places the patient in the most imminent danger. Medical superintendence is therefore required through every stage of its employment.

When the body is surrounded by media of a temperature in some cases lower, and in some higher than its own, it receives caloric, instead of parting with it. The difference of density and humidity is the cause of its receiving it from some media which are of a lower temperature than its own, as well as from most which are higher. This depends upon the capacity for caloric, and the conducting power of the surrounding medium. Thus, dry air at 70° Fahr. will impart heat to the body, while water at 92° will abstract it, though water at 96° may impart heat. The tepid bath, therefore, being so close upon the limit of abstracting or imparting heat, cannot exercise a very powerful effect upon the function of the development of animal heat; neither does it much affect the circulation, which it rather retards than quickens; but its influence is mostly confined to the skin, which it cleanses, softens, and renders more fit to execute its duties. The cases in which the tepid bath is to be preferred to that of a different temperature, are those of a febrile character joined to an irritability of the skin, which is generally dry and harsh; some cutaneous diseases, where, by friction, the scales are removed and a new surface presented; and, lastly, as preparatory to the cold bath in delicate persons, or for those whose peculiarities of system render them unable to bear a warm bath of a high temperature. It is of much use in the form of tepid sponging of the surface in the advanced stage of fevers, and in convalescence from acute diseases. In this case vinegar is often added to the water with increased good effect. The natural tepid waters of Buxton furnish a most valuable bath for persons suffering from gout or rheumatism.

The primary effect of the application to the surface of the body of water of a temperature varying from 93° to 98°, is, in consequence of the communication of warmth, the same as that of dry heat, namely, a stimulating, enlivening, and expanding effect. Hence there is a quickening of the circulation and respiration, as well as the direction of a greater quantity of fluid to the surface, manifested by the swelling and redness of the part. There results also a freer and more lively action of the muscular system, and increased sensibility and activity of the nervous system. Diminished exhalation from the skin takes place, while a greatly increased absorption occurs: the exhalation from the lungs, however, is increased. An increased quantity of heat is thus introduced into the system, felt first in the superficial, but afterwards in the most internal parts of the body.

The secondary or ultimate effect is somewhat different. The increased action of the arteries gradually subsides, the pulse becomes fuller and slower, and the greatest quantity of the blood lodges in the veins, particularly in the great venous centres, such as the *vena porta* and the *liver*, which it stimulates to increased secretion of bile. Corresponding changes occur in all the other organs; and if the application of the warmth be continued for a longer time, the increased energy and elasticity of the muscles disappear, and a sense of fatigue, with atony, and a tendency to sleep, succeeds.

The final result of the action and re-action is an augmented secretion from the skin, and a corresponding diminution of urine, and of the secretion from the mucous surfaces.

The warm bath may be employed to effect two opposite ends, to stimulate or calm and soothe. It accomplishes the first when its temperature is high (98°), and its use is confined to five or ten minutes; the second when it is about 93°, and continued for three-quarters of an hour, or an hour. Employed in this last way, Marcard found that it always diminished the velocity of the circulation, and that the longer the bath was continued the slower the pulse became; also, that the more the pulse deviated from a state of health, the more it is diminished by the warm bath. The bath may even be prolonged till it induce fainting and other consequences of a depressed circulation. Short of actual fainting it may be beneficially employed to produce great relaxation of the muscular system, so as to enable dislocations or hernias to be more easily reduced. The state of relaxation bordering upon fainting is very favourable to the process of absorption; it may, therefore, be advantageously employed in dropsy arising from weakness of the absorbents. As the warm bath has generally the effect of equalising the circulation, and relieving internal congestion, it is much resorted to as a remedy in spasmodic and convulsive diseases; but here the utmost caution and discrimination are necessary. If the spasmodic actions result from an inflammatory state of any of the nervous centres, more harm than good will be done by a bath. The inflammatory condition must first be removed or greatly lessened by bleeding, purgatives, and other appropriate means, before the bath can be safely used. These cautions do not so strictly apply to the convulsive excitement which often precedes the eruption of small-pox, or even measles, which is often greatly relieved by the warm bath, which may also be repeated during the early stages of the eruption. (See Marcard, 'Uber die Bäder,' Hanover, 1793; or Duncan's 'Med. Comm.' 2nd Decade, part x. p. 153.) The convulsions of infants during teething are almost invariably attempted to be removed by the warm bath, but in many instances more harm than good is done. The condition of the brain must be carefully inquired into by the medical attendant, and the state of the gums investigated, before this measure should be had recourse to. If there be congestion of blood in the brain, this must be removed before any good can result from a bath, and after its removal the convulsive actions will generally subside. The same good effect will follow free scarification of the gums, if a tooth be preparing to protrude. [ANTISPASMODICS.] Even when the bath is properly applied, the good which might be derived from it is often frustrated by inattention or ignorance. The bath is prepared at random, and the temperature is never sufficiently regarded. If above 96°, it cannot fail to be injurious.

During the existence of all active inflammation, at whatever age, the warm bath may be pronounced an unfit measure; and even after the acuteness may have been reduced by active antiphlogistic means, the warm bath is a doubtful remedy, if we except a very few cases. Of these, inflammation of the peritonæum is the best marked exception; but even here the bath is a very secondary means towards lowering the action of the system, though it may assist the flow of blood from leech-bites, and may be continued till a tendency to faint show itself.

In acute rheumatism, after venesection, the warm bath may perhaps be employed, if we can ensure its being followed by copious perspiration. For this purpose the patient should have the bath close to his bed, remain in it for half or three-quarters of an hour, be well rubbed with warm flannel cloths, replaced in bed between warm blankets, take diaphoretic medicines, and drink bland warm fluids, such as gruel or weak tea, and maintain the perspiration for twenty-four or forty-eight hours.

In a disposition to gout or rheumatism the warm bath is more proper than when a paroxysm of these diseases occurs. In such cases the natural warm baths are preferable: those of the Queen's Bath, or Cross Bath, at Bath, the temperature of which is from 94° to 96°, are well calculated for such cases.

In few chronic inflammatory diseases are warm baths allowable, if we except some of those of the digestive organs, especially sub-acute inflammation of the mucous membrane of the stomach and intestines. Indigestion is often the most common symptom accompanying this state, and it is almost always benefited by a course of warm or tepid bathing.

The other states to which warm bathing is unsuited are great general torpor, but especially of the skin; also when there is a tendency to profuse secretion from the skin; when there is great plethora or fulness of the vascular system, especially of the veins; in tendency to active hæmorrhage; in aneurism, or any disease of the heart; also in cases of a tendency to apoplexy: lastly, in extreme atony, or excessive irritability of the nervous system. In the very extreme cases of derangement of the nervous system, the warm bath is unfit; in more moderate derangements of it, a more applicable or useful remedy cannot be found. In cases of nervous exhaustion from intense literary employment, or official or parliamentary duties, the warm bath is of great service, more particularly when, in addition to the warm bath, the cold douche is employed, directed upon the head for a few seconds, while the patient is in the bath. In the milder cases of mania it has been found of great use.

In cases of contractions of the joints from rheumatic or gouty inflammation, the warm bath, or, what is better, the local vapour bath, is of service in restoring the flexibility of the limb.

It may be briefly stated that the warm bath is much more serviceable when there is a tendency to disease, constitutional or accidental, or in convalescence, than in any other circumstances. It is therefore rather to be considered as a preventive than remedial measure. But its value in this point of view is very great; and it is to be regretted that it is not sufficiently appreciated and used. It is exceedingly beneficial as a means of allaying the irritation of the vascular system, which occurs in young persons disposed to consumption, when the disease is beginning slowly to impair the integrity and healthfulness of the lungs or other important organs. To prevent the development of the morbid deposit in the lungs is of infinite importance; and this will be best accomplished by keeping up a more vigorous action of the skin. The bath must be persevered in for a length of time. Proper bathing-rooms should exist in every well-constructed house; but as this is rarely the case in this country, a good substitute may be obtained by using some of the recently-invented bathing-machines, which combine facilities for using the different kinds of bath in the same apparatus. The best which we have seen is that made by Read, Regent Circus, which possesses an apparatus for applying the douche while in the warm bath, and may be used as a cold, a shower, a warm, a douche, or a vapour-bath. Baths should be attached to all large manufactories, as a refreshment for the workmen, to ensure cleanliness, and as a means of warding off many diseases: in lead-works, painters' and plumbers' establishments, they would protect the men from painters' colic; and in other establishments, they would preserve the workmen from many cutaneous diseases. "A multitude of chronic inflammations of the skin are produced by uncleanliness, or other agents, which directly irritate the skin; and it is to the want of cleanliness in the inferior classes that Willan attributes the frequency of cutaneous diseases in London. In France, advantages are placed within the reach of the poor, to which the rich alone aspire in other countries. The number of gratuitous baths which are given at the hospitals of St. Louis and La Charité is truly prodigious: in 1822 it amounted to 127,752 for the out-patients only of the hospital of St. Louis." (Rayer, 'On Diseases of the Skin.') Why some portion of the funds of hospitals and dispensaries in London and other large towns should not be applied in a similar way, we can see no good objection: there is as much philanthropy and benevolence in preventing disease as in curing it. The establishment of public baths in London and other large towns has proved of incalculable benefit. Where washhouses are attached to them, the advantage has been still greater.

A partial warm bath, such as the foot-bath, is of much service in warding off many complaints. After getting the feet wet, plunging them into warm water will often prevent any ill consequences; and even when the first chill and slight shiverings, which usher in colds, fevers, and other inflammatory complaints, have been felt, the disease may be cut short by the use of a foot-bath, continued till free perspiration occurs. In inflammatory diseases, where the head and throat are much affected, the employment of a foot-bath, at a later period, often gives great relief, by causing a revulsion of the blood from the upper to the lower part of the body.

Water of a temperature from 99° to the highest which can be endured, is termed the hot-bath. When a person in health enters such a bath, it greatly excites the nervous system, and, through that, the heart and arteries; causes heat and constriction of the skin, with disturbance of the internal organs generally, but especially those of secretion. This state of uneasiness is lessened by the breaking out of perspiration, which is succeeded by great languor, torpor, and disposition to sleep. In such a bath little absorption takes place through the skin, and the body is found to have lost weight. The hot-bath is a powerful stimulant, and can never be used by persons in a state of health. The same cautions which were stated under the head of the warm-bath apply to it in a greater degree. The few cases to which it is suited are chronic affections of the nervous system, such as paralysis, when all vascular fulness of the brain or spinal cord has been removed. The waters of the King's Bath at Bath, and some of the hot-baths on the continent, are very beneficially employed in such cases; but careful discrimination must be made to suit the temperature to the degree of sensibility remaining in the paralysed part. Where the power of motion is lost, the sensation is sometimes increased: here the hot-bath would be very hurtful. On the other hand, the sensation may be lost, while the power of motion remains: here equal care must be observed not to use too high a temperature. Erythema, erysipelas, mortification, or death may follow the use of too high a temperature or a stay too prolonged even in a proper temperature.

Sudden retrocession or repulsion of some cutaneous or eruptive diseases is relieved by the use of a hot-bath for a few minutes, the eruption often coming out favourably after it. Some chronic cutaneous diseases, in which great thickening or torpor of the skin exists, are benefited by the hot-bath.

Vapour-baths are either natural or artificial. Several natural vapour-baths exist in the Neapolitan States, in Switzerland (Pfeffers in the country of the Grisons), and in Ischia. The artificial vapour-baths are much in use in the East and in Russia, where they are public, or intended for several persons to use at the same time; and occasionally in Britain, where they are always solitary or for a single individual. The Russian baths are described in Lyall's 'Character of the Russians,' pp. 112-115. The bathing-room contains tiers of benches, like an amphitheatre, the seats nearest the bottom being the coolest, those higher up hotter. The temperature varies from 112° to 224°. Persons commencing the use of such baths occupy the lower seats, and ascend as they become accustomed to them. While exposed to the vapour, the body is washed or rubbed with soap or bran, and beaten with fresh birch-twigs. The head is surrounded with a cold cloth, or cold water is dashed over the head. When the person does not wish to breathe the heated vapour, a sponge which has been dipped in cold water is held to the mouth and nose. On first employing the vapour-bath, the person usually remains about fifteen minutes, but afterwards three-quarters of an hour, and at Pfeffers, the temperature of which is only 100°, sometimes four, eight, ten, or sixteen hours. After coming out of the bath, the bather goes into a room heated with dry air, where he is rubbed, puts on a flannel dress, and then reposes upon a couch for some time, where he may drink warm drinks to promote the perspiration.

"As soon," says Dr. E. D. Clarke, "as the inhabitants of these northern nations have endured the high temperature of their vapour-baths, which is so great that Englishmen would not conceive it possible to exist an instant in them, they stand naked, covered with profuse perspiration, cooling themselves in the open air. In summer they plunge into cold water, and in winter they roll about in the snow, without sustaining injury, or even catching cold. When the Russians leave a bath of this kind, they moreover drink copious draughts of mead, as cold as it can be procured." ('Travels in Russia,' part. i. p. 143). The absence of all risk in exposing the person to such extremes of temperature is explained by the experiments of Dr. Edwards, who found that "after an exposure to cold, sufficient to diminish the power of producing heat, continuance in a high temperature tends to the recovery of this power; for in exposing animals to successive applications of cold, their temperature will fall the more slowly the longer they shall have been subjected to the influence of warmth. It follows, therefore, that the effect of the application of a certain degree of heat is continued after the cessation of the cause. Hence, we see that those who are liable to frequent exposure to severe cold are rendered more capable of supporting it, by subjecting themselves in the intervals to a high temperature,—a practice adopted by northern nations, and justified by facts." (Edwards on the 'Influence of Physical Agents on Life,' p. 125.)

The vapour-bath is distinguished from all other means of introducing more heat into the body, chiefly by the circumstance, that as a portion of the vapour is converted into water, by coming in contact with the surface of the body, it communicates a quantity of sensible caloric to it. It is without doubt the most powerful means of supplying a great heat to the greatest portion of the surface of the body, internal as well as external; for when breathed, the extensive surface forming the interior of the lungs is influenced by it in the same way as the skin. On the skin it exerts a peculiar influence. It does not cause that constriction of the skin, which follows the application of dry air, nor does it exert that pressure upon the surface, which, in the case of warm water, retards the breaking out of the perspiration. On the contrary, moisture of the skin, followed by profuse perspiration, occurs immediately upon entering the vapour-bath.

In Russia, where such baths are used on a large scale, their employment is not found to be productive of weakness. The subsequent exposure to cold restores the tone of the skin which had been lost, and the process leaves the person with a general sense of good health, strength and power, both of the internal organs and of the skin. "These practices," says Dr. Clarke, "seem to delight them, and to add strength to their constitution."

The vapour-bath, by attracting the blood more speedily to the surface, and by being followed by more profuse perspiration, is more powerful than the warm water-bath. It is employed as a remedy in gout and rheumatism, and in the numerous consequences of these when they have assumed the chronic form. Many cases of rheumatic and gouty contraction of the joints have been removed by persevering in the use of vapour-baths, as employed by the continental nations. In scrofulous diseases, especially when they affect the skin and the glands, benefit is derived from the vapour-bath, unless there be a manifest tendency to active inflammation, and great irritability of the nervous system. In some chronic affections of the nervous system, especially when connected with the repulsion or imperfect development of cutaneous diseases, the vapour-bath is of great use; and also in some affections of the respiratory organs, such as dry catarrh, asthma, spasms of the muscles of respiration, if these are not complicated with inflammation or organic disease of the lungs or heart.

The use of the vapour-bath would be found to ward off many acute diseases resulting from exposure to cold, if had recourse to immediately after exposure to the exciting cause; as after travelling, or falling into the water in winter.

The local application of warm vapour is very serviceable in many recent diseases. Catarrhs, sore throats of an inflammatory kind, inflammations of the eyes and ears, are greatly alleviated by such means. But when the lungs are inflamed, though Mudge's or other inhaler is much recommended, yet the effort required to draw in the vapour is injurious. The head, from which a flannel cloth may fall down in such a way as to hinder the vapour from escaping, should be held over a bason full of warm water, and the vapour inhaled in the ordinary mode of respiration. The vapour-bath is very improper for plethoric persons, those predisposed to congestion, or to apoplexy, and also for individuals in a state of great debility.

The employment of heated air, as an application to the body, causes the primary action of heat to manifest itself more than the secondary. The hot-air bath is therefore powerfully stimulant to the skin and nervous system, and is of great service in all cases where the production of animal heat is less than natural, as in the cold stage of fevers, and exhaustion of the nervous power. It has been employed beneficially in congestive fever, and after great and continual mental exertion. It proved less useful in the Asiatic cholera than was anticipated. A convenient apparatus for applying it was invented by the late Dr. Gower, called a *Sudatorium*.

Medicated baths rarely possess greater power than that possessed by the water alone; but there are a few exceptions. The admixture of common salt makes the water more stimulating and tonic.

Sulphurous vapour-baths fall under the head of medicated baths, and a few remarks may be here made respecting them. Nightmen, and other individuals who live much in an atmosphere charged with sulphurous exhalations, are rarely affected with chronic diseases of the skin, while other trades seem to predispose to their development, such as the baker's itch and grocer's itch. It is chiefly for the cure of cutaneous diseases that the sulphurous vapour-baths are employed. In many of these they are very useful, especially those belonging to the genus scabies and genus impetigo of Bateman. A caution is requisite for their safe employment, that the vapour should not be applied to more than a fourth part of the body at one time, lest the disease should be suddenly cured, and the internal organs suffer by the repulsion. The person who uses the sulphurous vapour-bath must be careful not to breathe any of the vapour. This kind of bath has been used in rheumatic affections, some diseases of the stomach, and in chronic paralysis. It may sometimes be a useful addition to internal treatment, but alone can be of little avail, till the state of the internal organs be improved, especially the liver, the action of which is almost always faulty in gout and rheumatism.

The nitro-muriatic bath of Scott is of use in chronic inflammation of the liver, such as occurs in warm climates. The iron-baths in Nassau and the Hartz are more tonic than the simple cold-bath, but none of the iron can be absorbed at the low temperature of these baths; it is only, therefore, by their direct action upon the skin, and the sympathies of this with the internal organs, that they are more beneficial. We have no knowledge of the effects of the mineralised mud baths, called by the Italians *Lutatura*. (See Gairdner 'On Mineral Springs,' p. 404.)

Though unacquainted with the results of employing hot sand or ashes, as done by the Turks, we can conceive them useful in allaying cramps and neuralgic pains, as heat generally does in whatever way applied. A collection of the opinions of ancient writers on the subject was published in the sixteenth century. ('De balneis omnia quæ extant apud Græcos, Latinos, et Arabes,' fol. Venet. apud Junt. 1553.) The best modern treatise is that of Marcard, in German, an abstract of which may be found in Dr. Beddoes's 'Treatise on Consumption.' A French translation of it was published in 1802. The natural baths will be treated of under the article WATERS, MINERAL.

END OF VOLUME I.

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