THE

EDINBURGH NEW

# PHILOSOPHICAL JOURNAL.

THE

# EDINBURGH NEW PHILOSOPHICAL JOURNAL,

EXHIBITING A VIEW OF THE

PROGRESSIVE DISCOVERIES AND IMPROVEMENTS

IN THE

SCIENCES AND THE ARTS.

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CONDUCTED BY

## ROBERT JAMESON,

REGIUS PROFESSOR OF NATURAL HISTORY, LECTURER ON MINERALOGY, AND KEEPER OF THE MUSEUM IN THE UNIVERSITY OF EDINBURGH;

Fellow of the Royal Societies of London and Edinburgh; Honorary Member of the Royal Irish Academy; of the Royal Society of Sciences of Denmark; of the Royal Academy of Sciences of Berlin; of the Royal Academy of Naples; of the Geological Society of France; Honorary Member of the Asiatic Society of Calcutta; Fellow of the Royal Linnean, and of the Geological Societies of London; of the Royal Geological Society of Cornwall, and of the Cambridge Philosophical Society; of the Antiquarian, Wernerian Natural History, Royal Medical, Royal Physical, and Horticultural Societies of Edinburgh; of the Highland and Agricultural Society of Scotland; of the Antiquarian and Literary Society of Perth; of the Statistical Society of Glasgow; of the Royal Dublin Society; of the York, Bristol, Cambrian, Whitby, Northern, and Cork Institutions; of the Natural History Society of Northumberland, Durham, and Newcastle; of the Imperial Pharmaceutical Society of Petersburgh; of the Natural History Society of Wetterau; of the Mineralogical Society of Jena; of the Royal Mineralogical Society of Dresden; of the Natural History Society of Paris; of the Philomathic Society of Paris; of the Natural History Society of Calvados; of the Senkenberg Society of Natural History; of the Society of Natural Sciences and Medicine of Heidelberg; Honorary Member of the Literary and Philosophical Society of New York; of the New York Historical Society; of the American Antiquarian Society; of the Academy of Natural Sciences of Philadelphia; of the Lyceum of Natural History of New York; of the Natural History Society of Montreal; of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts; of the Geological Society of Pennsylvania; of the Boston Society of Natural History of the United States; of the South African Institution of the Cape of Good Hope; Honorary Member of the Statistical Society of France; Member of the Entomological Society of Stettin, &c. &c. &c.


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# CONTENTS.

# CONTENTS.

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*Errata in Mr King's paper on the Genus Sigillaria, in the last Number.*

Page 131, line 6 from the top, *for* Endogens *read* Cryptogams.

" " line 12 from the top, *dele* of this class.

" 132, line 5 from the top, *for* Monocotyledons *read* plants.

" 134, line 2 from the bottom, *for* Kenilworth *read* Killingworth.

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*On the Original Population of America, and the modes of access from the Old to the New Continent, with Preliminary Observations on the recently published Travels in North America, of Prince Maximilian of Wied.** By Lieut.-Colonel CHARLES HAMILTON SMITH. Communicated by the Author.

BOOKS of travels in North America, the Atlantic States, the interior, the Canadas, and Texas, have been of late so superabundant in our language, that to offer some remarks on one that does not appear to have been reviewed, although it was published some months ago, might be taken for an absolute work of supererogation. In the original, it is true, the language is German; but both French and English versions were brought out, we believe, at the same time, with the approbation of the author, Prince Maximilian of Wied, who formerly gave the scientific public an interesting account of his travels in Brazil, and is so well known for careful and extensive researches in natural history. The work before us (we refer chiefly to the German edition, the most complete of the three) differs somewhat from the English version, by having all the philological researches, and the zoological

* *Reise in das innere Nord America in den Jahren* 1832 *bis* 1834, *von Maximilian Prinz zu Wied.* 2 vols. imp. 4to, with Atlas of Plates. Coblenz. Travels in the interior of North America, by Maximilian Prince of Wied. London: Ackermann, 1843.

descriptions without restriction or omission; the more important to science, because none other will be published by the author in a separate form; since the greater part of his valuable collections have unfortunately perished by fire, in their passage by steam down the rivers of the United States, and, consequently, could not again be referred to.

We do not know how far, in the translations, the notion of adapting a foreign work, to what is called the national taste, has been extended, but in a general point of view, a scientific publication, necessarily intended for the learned and studious, should be, we think, translated with great caution, even though it hath appeared in the form of a journal. In England and America, the native writers of travels have often indulged, each adverting to the land of his own birth, in national self-complacencies and national reflections, but little creditable to their tastes, and calculated to increase more than abate the evils they profess to denounce. The work before us contains no evidence of a similar tendency, and in this sense may want the salt of malevolence: it is of quite a different mould, though the illustrious traveller, familiar with the courts of sovereigns, and well acquainted with the habits of many nations, might easily have indulged in that kind of remark which recommends itself so strongly to the curiosity of common readers; but he never descends into comment on the habits of private life, or domestic families; never holds up with triumphant complacency his own nationality, but, solely and enthusiastically bent on the pursuit of Natural History, self is not made prominent in any form. There are no smart repartees, no claims to the character of being a first-rate shot, no unheard-of hardships endured, although, for several months, his whole party were obliged to live entirely in the Indian fashion; and there is scarce mention of any danger having been incurred. Seeking new facts in the wildernesses of the far west, as he had previously done in the tropical regions of Brazil, not so much with that thrist for notoriety, which besets so many public men, that his name might be celebrated in the halls of science, as to follow the impulses of a nature which continues to draw him mightily to the abstractions of research, as they formerly did at Paris, during the period when the allied armies were all in a tumult of politics, ceremonies, and parades, and he appeared daily in his Prussian Hussar uniform, with note-book in hand, at the lectures of Cuvier, the only military student, although at that time he had already accomplished his visit to South America, and was advantageously known for his scientific addenda to the zoology of that region. The thirst for extending his knowledge in natural history is still so ardent, that we believe, if the Prince were not withheld by a somewhat advanced life, he would, even now, quit his peaceful study to undertake a scientific tour in Australia, reap a new harvest of facts and objects to deposit in his valuable zoological museum, or share them, with his usual liberality, with other collections of a similar nature, both public and private.

The contents of the museum at Neuwied are always accessible to the scientific, and even to the merely curious traveller; and the liberality which is ever ready to communicate information on the natural sciences, is only equalled by the unostentatious urbanity of the giver, and the interest he takes in the pursuits of his fellow-labourers in the same researches. But the quality of a book, it may be said, should not be estimated by the private worth of the author; and being destitute of the marvellous, or the piquancy of social comparisons, can excite but small interest with the generality of readers; and it may be asked, what is its prominent character? To this this we may reply, in a single word, namely, *truth!* Veracity unembellished by more colouring than what is necessary for the acquisition of a clear perception of the matter, is the pervading aim of every sentence. It is the spell that binds the author's observations on the general character of the social condition of man in the United States: he sees dispassionately from an elevated point of view, marking "the great result of unchecked industry, and a vigorous system of commerce, as the causes of that giant progress everywhere observable; exciting the astonishment of a traveller from Europe, when he meets at every step new and extensive cities, with numerous public buildings, and great institutions of all kinds. They rise up so rapidly, that maps, comparatively of recent publication, become almost useless, by reason of the new names of places and towns which have sprung up into reality within a few years; while the influx of colonists penetrates more and more into the interior, and is not likely to be checked but by the sterility of the higher plateaux of the north-western prairies." This piercing glance into coming events, though so recently written, dates, nevertheless, before the new direction which the expansion of settlements has taken, and is now rapidly taking, into Texas, a state torn from its Spanish allegiance, which popular or party clamour appears anxious to incorporate with the other provinces of the Federal Union, not without an ulterior view to Mexico. Indeed, to the initiated, the scheme had its commencement so far back as 1816. It is again illustrated by the still more recent Oregon question, urged on with an intemperance of zeal that would be amusing, if it were not for the reflection, that, among public men, external injustice and violence is only offensive when committed by a stranger or an enemy, and that the principle of national honesty is disregarded even more in republics than in monarchies; because there is no responsibility for consequences in the former, though there may be some in the latter.

Thus the grasping selfishness of civilized nations disposes of the earth's surface according to the dictates of ambition, without the least regard to the claims and rights of the indigenous tribes to whom they send traders to demoralize them; then come missionaries, as if it were to prepare them for removal; for, notwithstanding their high calling, they cannot arrest the fatal results of gunpowder, ardent spirits, and new diseases spread among them: nay, it would appear that some undetected law in nature blights the vitality of the children of the wilderness; since every care cannot prevent the gradual extinction of the natives from the moment civilized man becomes a permanent dweller among them. The humane and the pious cannot but reflect earnestly upon these too common results of their most benevolent exertions: and we mention these reflections not without despondency; for in more than one region have we been eye-witnesses to their operation. Meanwhile, in America, that portion of the aboriginal race which still exists undevoured by the mild processes of the civilized encroacher, and which, as it will not bow to servitude, must submit to extermination, is fast becoming (that is, in the exact proportion of its decrease) the theme of romantic story ; and when the last tribe shall have been effaced, the stoical virtues of the red warrior shall obtain full credit with the "pale faces" of the Caucasian stock, and rise into more deserved, because more real, grandeur than the Titans, the Pelasgi, or the Scythians of the poetical East.

As it was not to describe the Anglo-Americans that the Prince undertook his voyage, but to become acquainted, by personal research, with the natural productions of North America, its mineral and vegetable riches, its zoology, and, above all, its fast vanishing indigenous nations, it is in relation to these aboriginal tribes that the work before us is particularly valuable, being written from notes dating, in point of time, two or three years before the travels of the benevolent Catlin, whose narrative, when speaking of those nations which were observed by the Prince, notices the same chiefs and braves ; and they mutually illustrate each other. Where the more extensive and varied intercourse of the American author among the whole range of Red tribes occasionally rectifies a slight mistake, the German diary, particularly where the remarks bear upon the natural history, origin, and languages, of this race, develops a more profound knowledge of the zoological condition of the questions at issue, a greater and more varied historical research, and the power of comparing the different dialects, extinct and spoken, of that part of the Western Continent. A previous personal study of the native clans of Brazil afforded another signal advantage for comparison ; and the facility which the Prince possessed of communicating with such authorities as Humboldt, Blumenbach, and many other celebrated investigators of Germany, both in the physiology and linguistics of America, give the more weight to his opinions, and make them all the more acceptable, because they are not offered in the form of peremptory conclusions.

It is, indeed, evident in the context of the expressed inferences, that identity with the Malay race, or an exclusive Mongolic extraction, is far from being a fact admissible without very considerable qualification: but there is a tendency in philosophical researches, as well as in fashion, to follow in the wake of certain favoured opinions, where given reasonings are for a time admitted to be conclusive, and receive all the support of dogmatic authority, until they are undermined by time, or suddenly overthrown by the disclosure of some new undeniable fact. The original population of the Western Continent, perhaps above all other speculative crotchets, has been, and occasionally continues to be, a theme of this kind, particularly among that class of day-dreamers who neither understand physiology, nor think it important to investigate and compare the languages of those regions. Among the more ancient writers, several did not scruple to make and overcome all sorts of difficulties; they embarked in the strangest fancies, and, even in more recent times, there have been authors who were able to dwell with satisfaction on the discovery of the Ten Lost Tribes of Israel, or the Welsh followers of Madoc, who, according to their fancies, were the progenitors of the whole or of a part of the present indigenous race. But though, perhaps, neither of the above assertions is entirely erroneous, there is evidence in every direction of the probability that men of different stocks had reached the Western World at very different times and from different quarters. We think His Highness might have gone further in his admissions, and at once have allowed the considerable admixture of a Caucasian element in the races of America, whether the progenitors of that stock reached their destination by a western course from Europe, from some submerged Atlantis, or whether a Guanche tribe went by successive stages from Africa, and within the certain course westward of the trade-winds and currents, or a people proceeded by an eastern route from the South Sea Islands, the Aleuthian chain, or from the mouth of the river Amur, whither a Caucasian tribe appears to have lost its way among the chains of the Kuan-Lun and Thien-chan mountains at a most remote period of human existence.

We know so little of the primeval world; of the first distribution of man; of the question whether all historical record of the west be not exclusively applicable to the Caucasic or bearded stock; and of a diluvian destruction, which, if it be admitted to have affected the whole earth, would still not substantiate that it was total, by submerging every mountain-ridge, and include the absolute destruction of the whole human race, with the sole exception of the Arkite family. We know nothing of the original conditions of existence of the Mongolic and Ethiopian stocks, nor when nor how they acquired their distinctive characters; excepting that when the first mentioned can be traced in history it is already as strongly marked as at present, and still more the second, which is found pictured on the oldest monuments of Egypt, dating, according to the best authorities, nearly as far back as the age of Abraham, that is, according to the common chronology, to within the fourth century after the Deluge; we see that it is delineated in features, hair, and colour, with all the attributes of the present negroes. We can scarcely deny that at that time India and China, probably also Bactria, were also densely peopled and already ruled by considerable monarchies, though the civilizations of Etruria, of Asia Minor, Syria, and Greece, were, for ages after, still small independent communities, rising out of the patriarchal form, and not yet united into nations by conquest,—always a result of time. Still less is known of those ages where, by our present discoveries, we find that there was in some unknown region an advanced civilization, since it left evidence of a progressive science which was again followed by ages of darkness, to revive and perish again or reappear in other quarters, till the contemplation would appear like the phantoms of a dream, if evidence far stronger than historical assertions were not found in ruins of man's handiwork in parts of the world of all others the most unlooked-for. Such, for example, is the ruined city or cities—for more than one is reported to exist in the same vicinity—built of huge squared blocks of stone, and in surface extending to dimensions that must have required a vast population, though they be now sunk below the level of the sea, and are situated on small islands of the volcanic range in the Chinese seas, known by the name of the Carolines. This range is still subject to the action of all the phenomena attendant upon subterranean fire, and the parts above water, in many places, seem to indicate that a great surface of the earth has sunk into the sea, leaving only summits above water, or that these summits, with the ruins upon them, are gradually returning to the surface; but that once a more numerous people existed here than could find subsistence on the present surfaces, and was in possession of certain arts of civilized life, is beyond dispute. Here, then, we have the counterpart of our western Atlantis, and perhaps the foundation of that Zepangri which Marco Polo had heard of in the East. In Japan, according to Dr Syburg, wrought jewellery has been found under conditions which must refer it to a people and age totally unknown; and in the Chinese seas, near the Island Formosa, a peculiar green porcelain, that cannot now be manufactured, is fished up, unless the trade is an imposture, which may ever be suspected where that crafty people is concerned.

Again, there are the Parallellitha of Tinian, the rock idols of Christmas Island and of Pitcairn's, where no human foot was supposed to have trodden till the mutineers of the Bounty landed, and found, in these sculptured remains, unequivocal proof that a people had anteriorly lived upon that rock, and had perished or had departed. On the west coast of America, no structures of the class usually denominated cromlechs have yet been noticed; but they exist on the north-eastern side of that continent, in Newfoundland, and in several places of the United States, to a distance in the interior, precluding all probability that at any time they were set up by the Scandinavian adventurers who visited Greenland, and, it would seem, from later information, explored the coast southward as far as Brazil, where, it is asserted, a Runic inscription has been discovered; or there was a far greater number of tempest-driven adventurers from the west of Europe than Scandinavian Sagas knew of, not lost at sea, but cast upon the east coast of the new world, and absorbed in its population. There exist beyond the Alleghanies well-defined traces of ancient fortified cities or camps; great sepulchral tumuli, the work of unknown nations; for nearly all traditionary knowledge among the different tribes now existing in these localities accounts for their arrival from the north-west or the north, at periods apparently not exceeding seven or eight centuries' distance from the present time, excepting with a few, who have puerile legends, ascribing their descent from beavers, elks, rabbits, trout, and even from a species of moth and snail. That these are not more aboriginal than the rest, is proved by the languages they speak being mere dialects of those who acknowledge an immigration, and by the general physical similarity of their persons.

From California to Chili there are, however, far more numerous remains of departed nations, not wholly admissible as the work of Toltecs, of Astecs, Anahyuacans, or of Peruvians. From the shores of the Pacific eastward, a system of civilization had waxed and waned more than once, not entirely self-created, and in some places not without western elements, but, in the main, worked out into a homogeneous character exclusively its own. The pyramids of Cholula, near Mexico,—which bear more affinity to the Morais of the Friendly and Society Islands than any other work of the kind—might, indeed, be the consequences of human reason under similar circumstances adopting similar ideas, if they did not also stand as landmarks of a marine route, since we find them connected with Indo-China, by similar works in Java, &c. But in a later class of buildings, temples, palaces, and the ruins of great cities in Yucatan, &c., there are bas-relief figures of gods, heroes, attendants, and captives, remarkable for their lengthened proportions, aquiline noses, and flattened occiputs, of which we find living types only among the lofty tribes of northern Indians, although in the antique burying-places of Peru there are numerous instances of skulls similarly flattened at the back, but with totally distinct cranial characters. The aquiline-faced race was, therefore, at some anterior period, possessed of civilization and power in tropical America, sufficient not only to leave its physical characteristics impressed on ideal personages, but even to serve as types for the fashions of remote and distinct nations. Why should these not be the tall Allegwi tribes, anciently driven southward by the Lene Lenapes, who, many ages ago, came, according to their own traditions, from the west, far beyond the Missisippi, and made themselves masters of the country? Nevertheless, even these appear to be copies, as will be pointed out in the sequel.

Reverting to the oscillations of social life and emigration, it may next be remarked, that all the South Sea Islands, when first discovered, were found to be in possession of domestic poultry, indigenous only in Asia and Australasia. It is said that the same species was discovered by the first Spaniards, among the Aurocanos of the coast of Chili; and Cortez, in his letters, addressed to the Emperor Charles V., casually observes, when first he visited the markets of Mexico, that poultry and onions were abundantly sold in them. Had he referred to turkeys, grouse, or other gallinacea of America, he would most likely have been somewhat more explicit, because they would have afforded the interest of novelty, which the first-named birds soon after excited in Spain. He mentions, in another place, fields of Indian corn (*Zea Mais*), by the name of *mayz*, making it, therefore, distinct from the *Tritica* of the Old World. The objection that might be raised, that if poultry had really been introduced before the time of Columbus, the species would have been found wild in all the congenial latitudes, may be answered with the fact, that, although three centuries have elapsed since the arrival of the Spaniards, none are yet found wild in any part of the country, while the Guinea and pea-fowls brought so late as the seventeenth century, are abundant in the woods of the Great West India Islands, and in parts of South America.

In the works of art at Palenque, representations have been found, bearing strong analogy to the scriptural records in Genesis; and even the cross is sculptured between two high-nosed heroes. Again there are rocks carved with diagrams of similar design near Boston (at Dighton, on the banks of the Taunton), in many places of Guiana, and near Ekaterinenburg in Siberia. We find the ears perforated, and the *septum nasi* bored through, to bear a rod of bone (by sailors termed a spritsail yard), both in the South Sea Islands and on the east coast of Asia; from Nootka Sound in America to beyond the equator. Several weapons of the Malays are of a similar fashion to those of South America. Peter Martyr, who wrote his decades from papers of the first discoverers, and during their lives, relates that Oaseo Nunez found a colony of negroes at Quaraqua in the Gulf of Darien. There are others of Papua appearance on the west side in California. About Nootka, a white coloured skin would efface the radical distinction of the Red Men; and the Caribs of the West Indies, from our personal knowledge, are, if any remain, ochry, like Arookas, and not nearly so red as Spanish and French seamen exposed to the sun.

Finally, there exist in both Americas linguistic formulæ, which Balbi refers to a Semitic and even Hebrew affinity, and many words in the Carib tongue, particularly among the trading, vagrant, and fighting, Accawas, have a striking resemblance to the languages of ancient Syria and Carthage. Of the diversity of origin existing among the so-called aboriginal inhabitants, there are the Arookas or Arowaks, in the south, whom we have ourselves heard the Caribs declare to be a distinct race from every other in northern South America, and to have come up from the south, possibly an ancient offset of the heroic Araukanos, apparently themselves belonging to the Oceanian stock of New Zealand, mixed Semitic Malays, from time immemorial the seamen of the South. The Wapisians of Guiana may be a stray sept of the destroyed high-nosed tribes of ancient Mexico, and, in that case, remotely allied to the Cherokees, who are affirmed to be of the same Allegwi stock; and, in North America, we see no reason why a people of Celtic origin should not have reached the western continent, since their monuments can be traced upon it, and we find a well-marked chain of these same structures on the old continent, from the river Indus eastward through southern India to Macao in China, and the island of Loochoo; and from the same river westward through Persia, Armenia, Asia Minor, Epirus, and the Tyrol on the north, and along the coast of Africa, on the south side the Mediterranean, then following the west coasts of Spain and France to Great Britain, and through western Germany into Norway, where the Scandinavians appear to have continued to raise similar monuments after the Cymbers of the north had been expelled.

It is not necessary to adduce the numerous instances of Oceanian natives being scattered by the monsoons to immense distances from their homes, with and without women. The fact is sufficiently proved, since constant voyages of our commercial and military navies traverse the Pacific, and often meet with examples of the kind. The truth is established still more positively by the similarity of aspect, languages, and manners, of the greater part of the islanders over the whole surface of Polynesia; and the practicability of frequent escape from destruction, is indicated by means of the numerous coral islands where the wanderers find temporary shelter. A strong instance of another kind is recorded in the case of a Japanese junk, which, having been blown out of its course, was allowed to float at random for eight months, until an English brig, seeing its wreck-like aspect, sent a boat on board, within forty-eight hours' sail of the coast of California, and took seven persons out of her, being all that survived of forty, who composed the original company. They were brought safe to the Sandwich Islands, in order to be restored to their native country by the first vessel that might sail for the Chinese seas.

On the Atlantic, the Norwegian discoveries have already been mentioned. Columbus, in his second voyage, found the sternpost of a vessel on shore at Guadaloupe. Instances have occurred, likewise, of vessels parting their anchors at Teneriffe (one in 1731), being driven with a part of the crews on board, to Trinidad in tropical America. Another was taken in possession by the people of a British ship, not far from Caraccas, and carried into La Guira. The Black Caribs of St Vincents were a race of Negroes found on that island; but their early history, so far as it relates the circumstance that they are descended from revolted Africans on board a slave-ship, which was stranded near the island, is by no means a fact so well authenticated, as it is inferred from general reasoning. Both the facility of reaching tropical America from the Atlantic, and the general credulity or ignorance on the subject, was, we remember, well illustrated by a fact which occurred about the year 1798. An American merchant, with a black boy, arrived in a ship's gig, provided with water and food, and containing some valuable merchandize, at Paramaribo, in the colony of Surinam. The account he gave of himself was, that he came a passenger from the East Indies in a British ship; and having purchased the boat in the proper latitude for reaching the West Indies, had embarked with his servant, and run before the trade-wind, intending to make Barbadoes; but indifferent steering in a small boat—unsteadiness for taking observations—sleep, and probably currents—had, it appeared, carried him so far south as to make the mainland of South America. He was disbelieved, and detained until the truth of his narrative was fully established. Thus, within the trade-winds, an open boat may run with safety, and within a determinable time, from Africa to America. Indeed, it was an open boat which brought the first intelligence of De Gama's safe arrival in India—having gone the whole distance across the Indian Ocean—round the Cape of Good Hope to Lisbon. Of the vessels of Columbus which he used to discover America, only one was completely decked.

What the trade-winds effect constantly on the Atlantic, the monsoons produce alternately on the Pacific,—the effect of which we have already mentioned; but as a further proof in what manner European vessels may have formerly wandered, and the crews been saved in unknown lands, may be mentioned a Venetian ship, about the last quarter of the fifteenth century, bound to Bordeaux, losing its rudder after passing Gibraltar, and beating about during the whole winter, till it was wrecked on the coast of Norway, where the crew was ultimately saved and sent to Copenhagen. Had this vessel's head been cast to the south instead of to the north, after she had lost her rudder, it is evident that her drift way would have led to the trade-winds, and thence the currents affecting her course, and a permanent favourable wind must infallibly have driven her to some shore in the West Indies or tropical America. There existed, besides, already in that age, a vague notion of land to the westward. A chart existed in the library of St Mark at Venice, representing the west coast of Europe and Africa with islands scattered on the Atlantic Ocean, terminating in the west with one of great extent, denominated Antilia, and another, only partially introduced, bearing west from Cape Finisterra, and not so eastward as Antilia, with the name of Isola de Laman Fatanaxio. The chart is ascribed to the Venetian hydrographer, Andrea Bianco, and dated 1436. Now, although this document might be a forgery of the Venetian government, to colour some claim to a share in one or other of the Indies, after they were both discovered; still we have the certainty, that, already in 1493, the Spaniards applied the name Antilia to Hispaniola and Cuba, as recorded by Peter Martyr; and if the name be what Hofmann asserts, derived from Ante insula, it would prove that there was an opinion extant of a continent beyond it; which, moreover, is vaguely asserted to have been known to Biscayan fishing ships and whalers, driven far to the west from their then usual stations on the coast of Ireland. With us the wonder that such a fact should have been so long left disputable would be the greater, if it were not known to what extent the industrial sciences were condemned by the scholastic learned, until the news arrived from both the Indies that gold was abundant beyond sea, and the subsequent interest of Spain to cast discredit on all prior knowledge of a western world.

Dicuil, the Irish monk, who wrote in the time of Charlemagne, might be mentioned here, as an instance of geographical information existing in his time, which was afterwards overlooked or denied; for he incidentally notices Iceland, then already inhabited by British families, though the discovery is accorded, at a later period, to a Northman navigator. See his work, De Mensura Orbis.

But for want of space many facts and arguments to illustrate the questions under consideration might be added. What has been said appears sufficient to establish the conclusion, that, although no ships which had actually visited the natives of America (always excepting the Scandinavians) were known to have returned, still, among many that perished, some must have reached the New World at different periods, and from different directions, sufficient to account for all the phenomena of languages, traditions, arts, and physical characteristics, found therein ; but not, therefore, bearing proofs that any credible records existed of a former intercourse, or that either Jews or Welshmen, or rather Phœnicians and Celts, were sufficiently numerous to be nationally distinguishable at subsequent periods. Although there was a received tradition among the Mexican and several other nations, of a people superior to themselves dwelling beyond sea, which, they believed, was destined to visit the West at some future period, this legend, or popular rumour, cannot have been else than an obscure record of a remote event, anciently brought by a Carthaginian, Celtic, Greek, or Roman ship, or by more than one of them, but certainly from Europe, or at least from nations belonging to the European system of civilization.

On the west side of America, the evidence appears in favour of a more frequent and varied intercourse. Towards the southern coast, and in the interior, Malay characteristics are obvious, and in the north whole tribes must have passed, using their seal-skin coracles, or crossing on the winter ice from the more desolate east of Asia, at Behring's Straits, scarce forty miles asunder, and beset with islands, to a comparatively fertile and wooded region, such as the north-west coast of America offers. The form of the native boats is nearly alike round the whole arctic circle ; and in the national habits of Laplanders, Karakasses, Tongusians, Tschutski, Samoyeds, and Ostiaks, there are traits which seem to have had permanent influence even far in the south of America, as if a very early stem of population had proceeded southward along the west coast, and a second at a later period had been encountered and partially checked by races of different origin and irreconcileable temperaments, perhaps the nigh-nosed heroic people already noticed. Several tribes, and among others the Toltecs, asserted that they came in a boat to Colhuacan. As a proof that the skin coracles will convey human beings through the most turbulent seas, mention may be made of one stranded on the west of Holland in the sixteenth century, with its tenant still securely girt within the seal-skin opening, but dead, probably from privation; and that the Greenlanders were considered as belonging to the same arctic stock by the first Northmen who visited their country, is indicated by the common name of Skrelings (that is Eskimaux) which they gave to both. More to the south, at the bay of St Francisco, the Californian tribes are almost black, as if they were descended from a mixed race of Mongolic Papuas, akin to the Formosans and other black Polynesians.

All the nations of the west coast had anciently a solar worship, in common with the Asiatic Karakasses and other Siberian tribes; they had also a mythical record of the Deluge, some with, and others without, fears for the safety of the moon when assailed by the celestial dragon, which is common to Negroes, Malays, Chinese, and many South Sea Islanders, who make noises and draw their knives during the moments of an eclipse. It is only another version of the Ark endangered by the overwhelming waters, transferred to the heavenly bodies. In Mexican idols and pictures, and in bas-reliefs of Yucatan and Peru, the same event is represented in the form of a woman being swallowed by the great serpent; a counterpart of ancient pagan Mythi of Western Asia and Europe, and occurring also in an ivory carving executed in Ceylon. But what unites the American arkite legends from north to south, is a bas-relief upon a box of Peruvian workmanship, dating before the middle of the sixteenth century, and representing the hero of the Deluge, who in the north is denominated "Young Chippewa:" with his bow in hand he is seen riding the ark, or the aboriginal elk—parent of human nature,—and the sun shining over its palmated head. The elk is winged, and, though four-footed, the body terminates in a fish's tail with a serpent standing upon the back, and the turtle dove or the raven (for they are often confounded in pagan mythologies), flies out before the rider, while diluvian sea-monsters, Boa or Python serpents, and

Howler monkeys, Pumas, Alligators, and the Electrical Eel, the principal zoological objects of America, are distinctly traced around. On other faces of the box are a Gothic palace, probably the first Spanish edifice raised at Cusco, also a circus, and a European hog; but the two end compartments represent a solar worship with the planetary system, and the *dragon* within the rays of the sun in the centre, and the other a lunar mythus, with the goddess of nature in the form of woman within the moon's horns, both having Peruvian Yncas or high priests on each side, and shewing that the national worship was not yet forsaken by the artist who made it.* The light thus thrown upon a Peruvian mythological representation, by means of a North American legend, is one of many proofs of the nomadic character of the ancient population, and that they have had their periods of swarming as well as the ancient nations of Asia. The time of duration when these great movements in the human families took place in both countries, synchronise sufficiently to warrant a conclusion of their cause being the same. It may be surmised that they were the effect of some law in nature, which on some occasions affects man, as others in many known instances influence the brute creation; but concerning which we, as yet, know nothing more than that the successful passions of warriors and conquerors are not sufficient to produce similar continuous results. They may be the sign, but cannot be the cause.

To our general conclusion, that the population of America consists in a partial mixture of human beings from different stocks and quarters, the objection that all the tribes have more or less characteristics which connect them with the Mongolic, is of little weight, when we consider that by far the greater proportion of the existing races are known to have proceeded from the north-west angle of North America, and are, therefore, in all likelihood, of the beardless or Mongolic variety, and, as all the nations of the American continent have practised the admission of grown men in their

* This box is now, we believe, in the British Museum.

families, the adoption of male children and the abduction of females, that their blood is mixed in all, and necessarily the most predominant in the whole population. There exist, nevertheless, from the Arctic circle to Terra del Fuego, practices having no counterpart that we know of in any other region of the world, and affording proofs of antiquity as remote as the oldest works of art, and the most ancient skeletons of man in those regions, can suggest. From them it might be inferred, that once the vast territory of the Western World had been in possession of a variety of man distinct from the three great stocks of the Old Continent, unless we can understand it to be of that swarthy undefined race of Asiatic antiquity, the Flatheads, Kakasiah, Nimrecs, and Dombuks of Persia, primeval enemies of the Iranian race, vanquished by the Huscheng and Tahmuras; and the same as the Præadamites of La Peyrere, whose treatise, derived from oriental sources, caused so much commotion and so many victorious refutations in the seventeenth century. The skulls of these antique Americans present peculiarities not quite satisfactorily explained by physiologists, being extremely elongated, and the facial angle depressed, leaving scarcely any forehead. Now, although this monstrosity may be produced in a great measure by artificial means, the heads of infants, considered to belong to the same race, so young as to have still all the sutures open, have the forehead depressed, the temples enlarged, but no evident sign of similar pressure at the back, where the occipital bone is distinctly separated into an upper and a lower portion, each of greater size than the single bone of Caucasians of the same age, and the facial bones are already exceedingly solid, with an elevated ridge round each of the orbits. Whether these are precisely the same as the Aturian crania of Blumenbach, we shall not decide, but remark only upon the controversial statements we have seen on the subject, that the diversity of opinion, in a great measure, arose from the inspection of another set of Peruvian, and even Titicaca skulls, whereof the forehead is but little depressed, but the occiput is vertical, and obliquely contracted, from evident early contact with a hard substance behind. We have seen and made drawings of several of both these forms of head, and the second mentioned appear to be incomplete attempts to rival the first by artificial means. Now, this occurs likewise in the aquiline-featured bas-reliefs of Yucatan, and among some tribes of the north, tending to an unlikely conjecture that men of a higher order of conformation should have endeavoured to distort themselves to the imitation of a more brutal race, and made that the type of its divinities and heroes.

We stop here without adverting to the relative cubical capacity of the skulls, and have indulged so far in this somewhat unphilosophical field of observations, only because they may perhaps tend to enlarge the inquiries of those who shall again embark in the same research, by pointing out objects and arguments which, albeit well known, we have never seen brought together in juxtaposition. They will be found to have reference to many points of the observations which the travels before us contain, relating to the native tribes of the Missouri and other parts of the United States; and although, among the alleged facts here produced, some may possibly be denied, or rest upon insufficient authority for implicit credence, there still remains such a mass of evidence to support our general inference, that we contend plural sources of the aboriginal population to be undeniable; and, had it been possible to advert, in a notice like the present, to the innumerable coincidences of opinions and traditions between the native tribes and those of very distinct and remotely separated races in other parts of the world, the ultimate conclusion would have been greatly corroborated.

We do not regret to have left ourselves so little space for reverting to the travels of the Prince, because the scientific questions they were chiefly intended to clear up do not well admit of extracts, and the occasional opinions on species announced in the work, which may differ from those of British travellers in more northern regions, deserve that sober consideration and confidence which the well-known skill and impartial temper of the illustrious German deserve; particularly as on many points he could consult our old and valued friends, Say, Le Sueur, and Maclure, who were then residents at New Harmony, and have left names which will ever be respected by all students in the natural sciences. Speaking of these gentlemen, who, we believe, to be now all numbered with the dead, another name of one departed, whose talents were of service to the Prince, should not be passed unnoticed by us, who long reckoned him among our most intimate friends, as a steady, enlightened, and public-spirited man,—we mean, Colonel William Thorn, K. H., one who distinguished himself in the wars of India under Lord Lake, shared in the daring enterprises of Major-General Sir Robert Gillespie, to whom he was Brigade-Major, and ultimately became Lieutenant-Colonel of the 23d Light Dragoons. He was author of Campaigns in India and in Java, and of a Life of General Gillespie. To the scientific ability of this officer is due the beautiful map, marking the Prince's travels up the Missouri to the rocky mountains, and his various excursions in the United States. Finally, of the plates composing the magnificient atlas, and the smaller illustrations in the two volumes, amounting in all to forty-eight, besides vignettes, we have only to say, that they are by the hand of Karl Bodmer, an artist who accompanied Prince Maximilian, and whose talents are at once attested by the portraits of natives and the landscape scenery, which we believe to be unrivalled in any book of travels yet published.

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## *On the Biluchi Tribes inhabiting Sindh, in the Lower Valley of the Indus and Cutchi.* By Captain T. Postans.

(Concluded from Vol. xxxvii. p. 402.)

The style of living, as seen among the Sindhian Bilúchis, is totally devoid of the little comfort even adopted by the inhabitants of India. Each district wherein they are located, possesses a small capital or head-quarters of the chief, which is only distinguished by the presence of a small mud fortification, from the usual reed and mud-built hovels comprising the Bilúchi villages all over the country, which have an appearance of dirt and discomfort, unlike anything to be seen in the least important even of our Indian districts. Their fields, in many parts of Sindh and Cutchi, have a small mud tower in their centre, whence the possessor with his retainers guards his produce from the predatory attacks of his neighbours; and a striking proof is thus afforded of a rude and unsettled state of society. In their houses (if they can be so termed) and persons, the Bilúchis are filthy in the extreme, and appear to be totally regardless of all beyond the mere every-day wants of an animal existence. It is no uncommon thing to see whole families sharing the shed, or, as it is called, *Marri*, which, composed simply of the reeds growing on the banks of the river, or the dried stalks of the Juwari, gives an inadequate shelter from the intolerably scorching sun of Sindh to themselves, their cattle, and horses, a *charpái*, or rude cot made of the Múnj grass of the country, being the only furniture. Yet there is no cause for this apparent misery, since many of them inhabited a fertile country, and possessed some of its richest portions, but the lazy and indolent habits with which they were embued, forbode their turning any attention to the improvement of their condition. Their food is principally composed of Juwari flour cakes, curds, and sour milk (the country being particularly rich in kine), and animal food, when they can obtain it. They prefer goats flesh to mutton for its strong flavour, and use spiritous liquors when attainable. The costume of the Bilúchis in Sindh had undergone considerable alterations during the last dynasty, and differed greatly from that still adopted by the mountaineers and wild tribes of the desert. The turban gave way to a curiously-shaped cap, which appears to have been a bad imitation of a Persian head-dress, which looked much like an inverted hat, offering no protection whatever to the face, though the crown extended somewhat beyond the summit. This is composed of the most gaudily-coloured cotton stuffs (or silks with the chiefs), and looked upon as an indispensable ornament. They affect exceedingly wide Turkish drawers, which are closely buttoned at, and fall over the ancle. The surcoat is of white thin cotton, or mixed woollen and cotton in winter, and the waist is ornamented with an enormous roll of silk or cotton cloth of bright colours, the chiefs adopting the lúnghi, a beautiful description of half silk and cotton manufacture, for which Tattah was once so famous, and which was coveted at the most brilliant courts of India. Over this is buckled a strap of broad deer-skin leather, with numerous appendages of all the pouches and paraphernalia required for the matchlock, highly ornamented with metal studs (gold and silver with the chiefs), and bright embroidery. The sword is an indispensable article of costume, and never abandoned. These people are passionately fond of arms, and are lavish in their expenditure to procure them. The Amirs sent emissaries, even as far as Constantinople, to obtain sword blades and matchlock barrels, though very beautiful ones were manufactured in the country. The shield, composed generally of rhinoceros horn, is large and flat, and usually suspended between the shoulders. The people dye their garments generally with indigo, and thus are enabled to wear them until they literally drop off, though the Cutchi tribes do not even take this precaution, and wear their flowing robes until they become literally black with grease and dirt. In person the Bilúchis may be considered as a fine race of men, and are decidedly handsome. Those living in the hotter climate of the plains have somewhat deteriorated from the unusually large size and muscular strength for Asiatics peculiar to the mountaineers, but they are still a portly people. Amongst all classes corpulence is considered a great mark of beauty, and is encouraged to a ridiculous extent. Nasir Khan, the late head of the Hyderabad family, though only in the very prime of life, and a strikingly handsome fair complexioned man, was so unwieldy with obesity, that it was with difficulty he could walk across his hall of audience, and on rising, or attempting to rise, from his seat, was obliged to be assisted by his courtiers. The author has observed some extraordinary and frequent instances of longevity amongst the Bilúchis located in Upper Sindh and Cutchi, far beyond what is usually seen in India, which with the large size and stature of this people united, warrant the conclusion, that the dry soils and climate, notwithstanding a degree of heat which is at times unequalled, is rather congenial than otherwise to the human constitution, certainly more so than the swampy banks of the river ; yet the deadly simúms of the

Upper Sindh and Cutchi countries are certain death to all but a Bilúch, who, without any hesitation, exposes himself fearlessly to them, at a period when he tells you the very crows even are obliged to leave the country. For eight months in the year Cutchi is, however, a fine climate, and for five as cold as the most fastidious need require. The author, speaking from experience, would prefer Shikarpore, with a good protection from the sun, to any climate in Sindh, though the range of the thermometer there is 115° to 120° in the shade from May to August. The Sindhian Bilúchis are of very dark complexion, with fine oval contours of countenance, aquiline nose, and large expressive eyes. Unlike Mahomedans generally, they cultivate the growth of the hair on the head as well as the beard. In Sindh, the former is confined under the cap by a knot and comb, being thrown back from the forehead; but in Cutchi and the mountains, it is allowed to fall in wild luxuriance over the shoulders, and is often twisted in with the folds of the turban, imparting a peculiarly wild and savage appearance. A slight sketch of one or two of these figures would tend better to elucidate their appearance than an inadequate description. The hair is dyed black when it becomes grey, and holy characters use the henna plant to induce a red tinge to the beard and hair. The costume of the women is simply a pair of full drawers, confined by a string at the waist, and a loose shirt over them, reaching to the knees, and open at the bosom. Over the head is thrown a loose cloth. Their condition is that of perfect slavery, doing the whole of the hard work and drudgery for their lazy lords, who, occupied in the unceasing amusement of smoking or talking in groups, pass their time away. The Bilúchi women are hard featured and plain, bearing in their manner and countenances strong proofs of the degradation to which they are exposed.

The Jutts do all the laborious work of the cultivation; for though the Bilúchis possessed the land, they considered themselves, like the military class in India, above such menial occupations. This people profess the Mahomedan religion, and are, for the most part, of the Suni faith, though the chiefs were of the Sheah persuasion; totally ignorant, however, of any beyond the mere outward forms of their profession, they leave the whole to Scynds, Pirs, and other holy men, who are well paid, and encouraged to settle amongst them; so great is their reverence for these sacred characters, that they find a safe conduct at all times for themselves, and those whom they choose to protect, even through the most murderous clans, and in localities where no other stranger dare venture to trust himself; and are always employed as mediators to settle quarrels. If a Bilúch have the promise of a Scynd, he considers himself safe; but he knows full well the little value of that of his deadly enemy. Of course, under such circumstances, many claim the prophetic descent, who are little entitled to it; and, indeed, most of these men in Sindh and Bilúchistan are as ignorant as all around them, though, such is their enthusiasm, that many learn the sacred volume by rote, without being able to translate a single word, and thus acquire the title so much coveted of "Hafiz," or remembrancer. For the Koran they hold a superstitious reverence, commensurate with their ignorance of its contents; and a Bilúchi falls on his knees when the sacred volume is produced: he would not dare even to touch it; but when he takes an oath, the book is put upon his head by the priest or scynd. Each tribe has its spiritual pastor, and a great portion of Sindhian cultivated territory was held in enam or gift by these men. A great authority, on Sindhian matters, has said (Mr Crow), "that the Sindhian has no liberality but in feeding lazy Scynds—no zeal but in propagating the faith—no spirit but in celebrating the edes or festivals,—and no taste but in ornamenting old tombs:" this is certainly true of the Bilúchis. Reputed holy and rapacious mendicants flourish amongst them whilst living, and their tombs become places of pilgrimage after death. In their fanatical zeal, they carry proselytism to the extent of often forcibly circumcising Hindús; and those of the latter, who held the principal offices as revenue collectors under the late Bilúchi government, were invariably obliged to adopt the beard and full costume of the Mahomedan. The exactions of holy mendicants in Sindh are a real source of evil to the country; and so great are their numbers, and so distinct is their classification, that they would provide materials for a chapter by themselves;—some even carry their effrontery so far as to travel mounted and fully armed. Such a vagrant character is not likely to go away empty-handed!

The arms of the Bilúchis are the matchlock, sword, and shield, in the use of which they are very expert, though they pride themselves particularly, and trust implicitly, to the sword. Their country is considered famous for its breed of horses; and though these are large and powerful animals, their paces, of a fast walk and shuffling amble, are intolerable to a European; they themselves, however, invariably use mules, or a small description of pony, called in the country a jabú, very useful, and wonderfully enduring animals. The marauding clans ride only mares, to prevent the noise which horses make when together. The distances these little insignificant-looking animals will carry a heavy armed man, are incredible; and some of their *chapaos* or forays prove incontestably that no breed of horse, except, perhaps, the Turkoman, could beat them at this kind of work; yet are they kept half-starved, and, to all appearance, quite unfit for exertion. The author recollects, on one occasion, having to ride a distance of forty miles express, and had, therefore, a relay of three horses to do the distance: he was accompanied by a Bilúchi guide, mounted as described, who laughed heartily at the quantity of horses required to do what he performed with one sorry looking brute, riding in advance the whole way, his steed shewing no symptoms of distress at the journey's end. On another occasion, a party of Hindostan horsemen, in pursuit of a predatory band, disabled twenty-eight horses, and left three dead on the field, in vainly attempting to catch these Bilúchis. As the Bilúch, in his boasted character of soldier and robber, is so intimately connected with his steed, this digression may be excused. The chiefs ride well-trained camels of the Mekran and Malwah breeds, but principally the former, which are much prized. One of the great propensities of the Sindhian Bilúchis, is their immoderate love of field sports. The chiefs, it is true, set the example, by making them the all-absorbing occupations of their lives, appropriating extensive and valuable portions of territory to preserves; but throughout the whole of Sindh, the poorest Bilúch, if he can muster a pair of hawks, or a dog or two to assist him in his chace, will be seen pursuing it. This is not so much the case beyond the river, where it is not easy to find game. Sindh swarms with every description, and hence, probably, the inducement. They have no idea of firing at winged game, but knock it down with blunted arrows; and this they will do with great precision.

The courts of the Sindh Amirs, at Hyderabad and Khyapúr, furnished striking characteristics of Bilúchi manners, and were certainly peculiar. At the former resided the heads of the family, who, as is well known, divided the sovereignty of the lower Indus between them, and ruled conjointly under a singular participation of power. The leading features of a rude and semibarbarous state of society, were here exemplified; the public durbars, or councils of the state, were attended by a heterogeneous mob of Bilúchis, (chiefs and wild retainers,) Persians, Affghans, Seikhs, Rajpúts, and adventurers from every part of the East; and although the greatest respect, even to devotion, was intended by the Bilúchis to their lords, yet their manner of shewing it was little in accordance with our notions of etiquette or propriety,—they spoke in the loudest tone, and by their uncouth manners and gestures, would appear to a stranger to be anything but obedient followers. Knowing no respect of persons outwardly, the lowest Bilúch would unhesitatingly beard even the Amirs themselves in open durbar; and as a brother, and by caste an equal, he could not be denied any *virâ voce* representations which he might have to make. In a corner of the same hall of audience, where the most important affairs were probably discussed, a group of nautch women would add to the din and noise by their inharmonious yelling; and, taken altogether, it was quite impossible to find anything in the East—where generally a ruler or chief is surrounded by so much studied etiquette—half so barbarous as a Sindh durbar. That of Khyrpúl, in Upper Sindh, was much more primitive, and therefore barbarous, than the Hyderabad court. Yet the effect of such a combination of savage and armed groups was highly picturesque, and decidedly interesting. Strikingly contrasted with the rude and totally unpolished manners of their retainers, were the conduct and bearing of the Amirs themselves; for they were decidedly as courteous, and indeed gentlemanlike in this respect, as all around them was to the contrary. How they obtained this distinction, it is difficult to understand; for they are scarcely a whit more enlightened than any other of their Bilúchi brethren,—having adopted a system of living excluded from the world and countries about them, which kept them centuries behind even the scanty civilization of their neighbours. Yet certain it is, and all who have had the opportunities of seeing much of them will corroborate it, that the Amirs, particularly of Lower Sindh, were individually and collectively, gentlemanly and polished men in their intercourse and familiar style. Nasir Khan, the late head, was particularly so, and could, indeed, render himself quite fascinating by his very agreeable deportment. The same may be said of his late elder brother and his nephews, the sons of Húr Mahmud. A Bilúchi welcome to court, has been described by the author in his work on Sindh, (see page 200 to 205,) and it was illustrative of the rude virtue of hospitality which this people certainly possess. The Bilúchi forces, when assembled, were principally remunerated by supplies of food, and a very small proportion of pay. A certain number of these rude troops were always on duty at the capital; for so distrustful and jealous were the Amirs of each other, that they took especial care to be well attended. The wild uncouth figures encountered in the bazar, and even the royal residence of Hyderabad, were composed of these guards. A Bilúch army, when assembled, was not easily dispersed; and the chief's authority became subservient to the general feeling, and they were borne along by it. Some striking instances of the absence of any control over their savage troops by the Amirs, have been repeatedly given of late years,

The wild and marauding tribes of Bilúchis who inhabit the desert tracts and rocky hills of Cutchi, are not to be confounded with their brethren who dwell in Sindh;—little claim as the latter have to any but a barbarous title, they are yet far advanced when compared to the former; and, moreover, do not so completely merit the titles of murderers and robbers, which have not undeservedly been applied to hordes, who lived by plunder and relentless cruelty—at deadly feud with each, and the scourge of the cultivated and peopled country in their vicinity. Some of these tribes are again distinct in this particular from those in the neighbourhood of Kelat, or the mountaineers. Two or three of the former, of whom the author had personal experience whilst in Sindh, deserve particular notice, as they afford examples of a reckless bloodthirsty propensity, and irreclaimable love of a lawless life, which none of the other tribes so markedly possess. A strong proof of this was afforded in the deadly animosity they shewed to a clan claiming holy extraction, and therefore highly esteemed; the Kyhirís, who styled themselves Sheikhs, but who were driven from their possessions, and treated with every imaginable cruelty by the tribes now to be mentioned, though with all others their sacred stock procured for them the highest respect, and they lived amongst them peaceably and were protected. These are the *Dúmkis*, *Jekranis*, and *Búrdis*;—though thus mentioned together, it must not be concluded that they were partners in their vocation; on the contrary, the *Búrdis* owned no connection with the other two, who offered almost a single instance of any two Bilúchi tribes combining continually for a definite object, and that was plunder, effected often by the most violent and cruel means. The *Dúmkis* and *Jekranis* inhabit the western borders of Cutchi, at the foot of the hills, (commonly known as the Muru hills, from the tribe inhabiting them,) and separated from Sindh by a broad belt of complete desert. Cutchi, or as it is better known by its title of Cutch Gunderva, is that portion of territory extending from the desert to the point north and west of Shilialpú, where the inundations of the rivers cease to influence cultivation, to the mountains which separate the valley of the Indus from the higher country of Bilúchistan and Affghanistan. The partial fertility afforded by mountain streams on the western side of Cutchi, and the effects of rain in fair seasons, causes it to be held as the granary of the Brahúe and higher Bilúch country; but it is in various parts inhabited by the wildest of the Bilúchi tribes, particularly in its eastern confines, where a dry climate and scanty supply of water from wells, hardly furnish the means of raising forage for cattle; and where (but for the fact of Sindh possessing interminable extents of uncultivated land capable of any amount of fertility), the Bilúchis might plead necessity for the lawless life they lead. Under a redoubtable leader, it was found on our first entry into Sindh, and during the march of our armies, that these clans, though comparatively few in number, were powerful in a wild and desert country, which was habitable solely by themselves, scarcely affording more than forage for their horses, to do immense mischief. They had from time immemorial laid the Sindhian frontier completely at their disposal, and held the high road to Sandahar through the Bolan, quite at their mercy; the traders purchased safety for their Kuffillars at exorbitant exactions, and in short, completely unmolested, these robbers ruled supreme; they were all horsemen, and had for chiefs and leaders well approved and long-tried warriors. In campaigning against these hordes, and reducing them to obedience, much was seen of them, and they presented the appearance of wildness and ferocity to a degree unequalled in our Eastern experience. The inhabitants of Sindh, when the leaders were captured and brought in, would scarcely believe it possible, with all our power, that we could reduce such (to them) impracticable enemies. In person, these tribes differed much from those seen in Sindh, being larger in bulk and stature, and much more ferocious in aspect. Their costume was composed of the coarsest materials, large and flowing; the turban a piece of loose dirty cloth twisted round the head, and interwoven with the long shaggy hair which hung in masses over the neck and shoulders. At all times fully armed and accoutred, and mounted on his singular-looking jabú, the *Dúmki*, or *Jekrani* warrior, or rather robber, formed a fitting subject for a study. The chapaos or forays of these tribes are services of danger, and made, as they often are, to an extreme distance from their own line of country. If, through fatigue or other accident, any individuals should fall, they deservedly receive little mercy at the hands of the inhabitants. Each Bilúchi carries a supply of grain and water with him, the latter by means of a small skin slung under his horse's belly. Hardy, and innured to a trying climate, horses and men will undergo an almost incredible degree of fatigue and exertion in these raids, of which they are passionately fond. Neither age nor sex are spared to accomplish their pillaging purposes, and on these occasions they often kidnap children, who they bring up as slaves. When it is known that a *chapao* of Bilúchis is out, or has been seen in the desert, the whole cultivated country is in a state of alarm, for, like a flight of locusts, it is impossible to say where the descent may occur. It was found totally impossible to impress these people with any sense of their being culpable in the lawless life they led; they owned without the slightest hesitation, and rather, indeed, with a sense of merit, that they were born and nurtured in robbery and murder, and considered them lawful and honorable vocations. One miscreant, who, for his awful catalogue of crimes, was particularly denounced, and considered fully deserving of extreme punishment, exultingly shewed his sword, a murderous weapon, and declared that he counted one hundred lives to the blade. At a distance of thirty leagues from the Dúmki and Jekrani haunts, the poor inhabitants trembled for their safety, for no police existed to protect them. Strange to say, the leader of these very men was an old chief, far above his countrymen in sagacity and experience, with a great degree of dignity in his manner; and Bigar Khan, for so he was called, was a far superior man to any real Bilúchi whom the author has met with. Though living in this uncontrolled way, these tribes nominally owned the authority of the Khan of Kelat, though of course they paid no tribute beyond military service when required. The Amirs of Sindh were so afraid of them, that they gave them good lands within their own territories.

The *Búrdis*, an exceedingly troublesome and restless tribe, inhabitated a tract of rich country to the north and east of Shikanpur, and, before our arrival in Sindh, were almost as annoying as the two clans before mentioned; but being at deadly feud with all about them, they were more confined in their operations. The author recollects a striking instance of the extraordinary state of society amongst these people, which may be quoted. On one occasion, having to transact business with a party of Búrdis, some twenty of the tribe were seated around him, and it was suggested by a spectator that not a single individual of the party would be found with a whole skin, or without wounds over some part of his body. The examination was made, turbans were removed, and chests and arms bared; the result was, that every man was more or less desperately seamed with sword cuts; skulls indented, and awful scars, the results of fearful wounds, more or less disfigured each individual. As the party was accidentally assembled, they offered a pretty fair specimen of the *peaceable* habits of Bilúchis. The Sindhian authorities, whenever they had the good luck to catch a notorious delinquent, (which was seldom,) mutilated him or them by cutting off the left hand; for the Bilúchi men never deprived a Bilúchi of life; and many does the author know so situated, yet still managing, with his Khuassan mare, and right hand at liberty, to be capable of setting a whole district in a state of perfect misery and commotion! The experiment was tried by the British authorities, of reclaiming these tribes by holding out inducements to peaceable occupations, but in vain; for as the Asiatics happily express it, the "ass on which the prophet* rode was still an ass"—the robber was a robber to the last. The Bilúchis, as well as the Mekrains, are found in India, serving in the capacity of mercenaries; and the author heard of a colony of them settled in the neighbourhood of Aurungabad, in the centre of the Deckan, where they had originally emigrated in the above capacity. They do not, however, hold so high a title as the Arabs as military hirelings—the latter being some of the most determined enemies we have had to encounter.

It would be uninteresting to describe in detail all of the tribes; but we may mention the really powerful clan of *Murris*, who inhabit the rocky defiles and valleys of the Murri hills. This division holds a very high reputation for bravery and independence, and it was proved by us that they fully merited it; for on its being considered necessary to occupy their country, we were brought into hostility with them, and they behaved with true gallantry, and shewed a high-minded and generous sense

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* Our Saviour.

of honour and good faith, which was little to be expected from what we had seen of their neighbours. The occupation of this stronghold, its gallant and almost unparalleled defence by a mere handful of our men, the fierce battle of Nufúsk, which cost us an awful sacrifice of valuable lives, were the prelude to scenes, wherein the most extraordinary and striking proofs were given by the Murri Bilúchis, of their being a high-minded set of men; actuated by principles which all must honour, even in more civilized communities, and lastly begetting, from deadly hostility, that mutual confidence, and indeed admiration, which springs from just appreciation of good qualities. (Interesting details of these may be seen in the *United Service Gazette* for March, and subsequently.) Inhabiting the same range of hills are the *Búgtis*. Neither these nor the Murris were actively predatory, though they allowed the Dúmkis and Jekranis the shelter afforded by the strong hilly country they inhabited. The Murris commanded the lower portion of the Bolan pass, disputing the domain over this terrific defile with the Kakurs and Khusacks; and beyond these again, westward, the Muzaris and Kulpurs. These two latter were troublesome subjects of the Punjaub government, and as restless and predatory as all about them; but they were kept in admirable order by the governor of Multan, who occasionally dispatched large forces against them. The Muzaris are at deadly feud with the Búrdis, alternate devastating forays being made by both.

The Bilúchis, particularly the wild tribes of Cutchi, entertain Bards, or as the Rajputs call the same class of people, Bháts; in Sindh the Lúris are a kind of gipsy vagabond tribe, who make this their vocation. The songs are often composed on the warlike deeds or records of forays, or chapaos; the music, if so it can be called, is rude in the extreme; the opening of each stanza being given by a loud cry, as of a person in intense pain, or under great grief, and the voice is gradually lowered until the conclusion of the stanza; it is accompanied by a rude guitar. Thus amused, a group of these wild men will sit for a whole night smoking and dozing, their greatest idea of happiness being the "dolce far niente" of the Italian, or the *Kheif* of the Turk. With the Cutchi tribes, the women appear to hold a higher rank than in Sindh;—here they are said to be admitted to council, and in warfare share the dangers with their husbands or relatives. On several occasions, these heroines presented their own bodies as shields to protect individuals from the fire of our troops.

As the Mahomedan laws with regard to marriage, plurality of wives, &c., are generally adhered to by these tribes, it may be unnecessary to revert to them.

The Brahiús, who form the large body of the mountaineers and pastoral people in and around Kelat, are a distinct race from the Bilúchis, and have been so accurately and minutely described by Sir W. Pottinger and Mr Masson, that these authors must be consulted for all information on this people, who preserve implicitly a primitive, simple, and patriarchal style of living, and whose character as inoffensive and industrious, is far superior to that of their neighbours the Bilúchis.

In speaking of the character of the Bilúchis, our remarks should be tempered with due consideration for the circumstances which have conduced to form it; living in a state of semibarbarism, and separated from all civilizing and ameliorating influences by their somewhat isolated position, they have retained only some of the ruder virtues, and have ingrafted, on these, many propensities which may be denounced as vices. But first, of their better qualities, we may allude to their hospitality, good temper, sociability, good faith when pledged, courage, and patience of endurance. Hospitality is peculiar, I believe, to nomade people, and it is a prominent feature amongst the Bilúchis. The kind welcome given to the wayfarer or stranger, is very marked and pleasing. In all, the true patriarchal mode is adopted, as seen with the Arabs to the present day, of giving the stranger the tenderest of the flock, and the best the hut or tent affords. Amongst the chiefs and rulers, it was carried to a great excess; and on any arrival of a man of rank at their courts or strongholds, he was not only entertained himself, but all his retainers were feasted to their hearts' content, and all their wants provided for, for any length of time he or they chose to sojourn as a guest. The first study of a Bilúch, from the highest to the lowest, was this display of kindly feeling. On arrival, tired or wayworn at a Bilúchi village, the author has often thrown himself in a cot, and, to his surprise, has suddenly found himself surrounded by a party of these wild men, who began to chafe and knead his limbs, and continued to do so for hours, to dispel lassitude and fatigue; vying with each other, at the same time, in supplying his wants, or appeasing hunger or thirst with the best of their simple food or beverage. Not to receive such civilities is the height of rudeness, and, on the other hand, to eat of his salt and dip your hand into his dish, is the signal for claiming him as a brother;—in short, all who have travelled through their countries have been forcibly impressed with this very pleasing trait of Bilúchi character.

These people have an amazing stock of good temper mixed with their ignorance, almost amounting to stupidity. A Bilúch can readily understand and enter into a joke, and, like the Arab of Egypt, it is the best means of effecting a purpose with him. He may be thus brought to meet your views when other plans would probably fail; when excited, however, he is fierce and savage enough for any deed of blood or violence. The Bilúchis are sociable even to an extent unknown amongst Asiatics generally, as evinced in their ordinary salutations, and the great delight they take in forming parties for the sole purpose of smoking, talking, singing, or drinking together. They accost each other with a curious string of inquiries, not only after the health of the individual addressed, but those of his family, and the welfare of his house generally; the Salaam uleikúm, is only a prelude to the usual chunqo, hullah? khiîar? sullah?* &c., which, when concluded by one party, must be taken up by the other. In a large assembly, as for instance a burbar, these inquiries and rejoinders occupied a considerable space of time, and even after these, if, during the interview, the stranger's eye caught that of an acquaintance, he would join his hand, and demand

* Are you well, happy, comfortable?

inquiringly and earnestly, "*Koosh?*" Are you well, or happy? The Bilúchis embrace a friend by laying the head alternately on each shoulder; and being, as before described, a portly race, the ceremony was trying in so sultry a climate, for each individual of a party exacted this ceremony. In all this, however, there was, beyond the mere ceremonies which in the East are a regular portion of education, and as indispensable as any other occupation of life, a great deal of sociable and kindly feeling, and, from the most polished to the rudest of the race, formed a marked feature of character. The author could quote some personal anecdotes of this, but they are perhaps unnecessary. When a Bilúch has plighted his faith to the performance of any particular act, as of safe-conduct or protection (except in cases where a strong enemy may come within his power), he is generally to be relied upon, at least as far as his influence may extend. The traders found this in traversing their country; for though they paid a certain amount for the service performed, yet completely at the mercy of their escort with highly valuable consignments, they could only look for safety to this principle; and, indeed, acting upon it, the commerce of those countries was carried on to a certain extent flourishingly, whilst we ourselves, in attempting to alter it, and protect the merchant, were the most formidable enemies to the latter, and almost ruined his vocation.

The Bilúchi is brave when occasion calls for the display of bravery, as late and many previous events have testified; and when, with his rude arms and total ignorance of any other principle, than that the best swordsman and strongest man is the best soldier, he meets a disciplined force and falls at the muzzles of our guns or points of our bayonets, we must, in justice to him as well as his gallant opposers, pronounce him a warrior worthy of our steel. Reverting here to some of his bad points, we may attach his courage with cruelty; and certainly amongst some of the wilder tribes, this accusation may fairly be supported, though it is doubtful if it will stand against the whole body. The late Amirs were particularly distinguished for a total absence of this vice, and, though their power was absolute, they seldom or never punished with death any of their subjects, and it may be doubted if, except amongst the determinedly lawless tribes, the Bilúchis generally are obnoxious to this accusation. With hordes who exist by plunder, the result must be sanguinary and ferocious habits, but though the whole of the Bilúchi tribes have been pronounced, and are more or less knavish and prone to thieving, there are only a few who follow robbery as a regular profession; and these have acquired for the mass, at least those who have suffered more or less from their violence, a really worse character, in this respect, than they deserve. A high authority (Captain M'Murdo) has said, that this thieving propensity is so inherent in the Bilúchis, that in Sindh, chiefs and men, otherwise in no way impelled to do so, will, for the mere love of the thing, take the road and turn highwaymen. Pride commensurate with a state of barbarous ignorance, is a leading feature in the Bilúchis, and they are mean and avaricious. Bigoted in proportion to their want of knowledge of all beyond the mere forms of their religion, they treat with studied intolerance all Kafirs or unbelievers; and the miserable Hindú, who to suit his own purposes of traffic and gain, has located himself amongst them, is at all times prepared for violence prompted by fanaticism and degradation, the result of his creed; but this, and more, he is contented to bear to effect his object (not only with Bilúchis, but even Turkomans), and, curiously enough, one vice counteracting another, in many parts of Sindh the Hindús have become not only wealthy, but so influential, as to be able at times to resist oppression by a sort of tacit opposition, which is very effective. Thus, in any extraordinary act of oppression, threatened or committed on any of their body individually, the Hindús of Shillinpur would shut up their shops and abandon the city. All trade was thus at a complete stand-still, and the revenue ceased altogether; they thus soon obtained their own terms with their avaricious rulers. The state of the Hindús in these countries, however, is by no means so bad as that of the Copts in Egypt, or the Jews occupying nearly the same relative position in Mahomedan countries generally. Captain M'Murdo's summary of Sindhian character may be applied, to a certain extent, to the Bilúchis situated between Mickran and Hindustan; they seem to have acquired the vices both of the barbarity on the one side, and the civilization on the other, without the virtues of either.

The Bilúchis are addicted to the use of spiritous liquors, and the intoxicating seed of the hemp plant, or Bang. They do not, however, carry these to the effect of downright inebriety, but induce a certain degree of stupidity, which may be analogous to that so much coveted by the opium eater. The pipe, with both sexes, is scarcely ever from the mouth. They are, as may be supposed, indolent and lazy, leaving labour of every kind to the Jutts, and other working classes.

The language of the Bilúchis is different from that of their neighbours, whether Sindhs, Brahúis, or Affghans; and, in sound, assimilates to bad Persian; so that, as observed by Sir H. Pottinger, it is possible to catch the meaning occasionally by a knowledge of the latter tongue. It is not written, however, and is considered altogether so barbarous even in these barbarous countries, that the Bilúchi is said to have learnt it of his goats when he was a shepherd in the mountains. A vocabulary and grammar was formed by Lieut. Leed, a highly intelligent officer, which exists in the records of the Company.

Having thus concluded the few observations which he has to offer on the Bilúchis, as seen by him in the course of a residence of 3½ years, divided between Upper Sindh and in the Cutchi districts,—he only trusts they may be found of some trifling interest, though he does not presume for a moment to place his rough notes in conjunction with the records of those higher authorities whom he has quoted, and who should be consulted by all anxious to obtain a more intimate acquaintance with a people, over a great number of whom we now wield a direct sway, and whose interests may therefore be said to be in our keeping. Though the Bilúchi has been considered an implacable enemy, the author would remark, as the result of his experience, that if the interests of these people were duly cared for, and sufficient inducements, with a conciliatory manner adopted, there is no reason, he thinks, to doubt, but they would duly appreciate a change which might thus be effected in their condition. But this is a subject scarcely admitting of inquiry here; and it only remains to observe, that with all their faults, he looks back with many pleasing recollections to opportunities he enjoyed in Sindh, for seeing much of a wild but interesting people.

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## *On the Mismanagement of Stable-Dung Manure, especially as regards Exposure to Rain.* By JOHN DAVY, M.D., F.R.S. Lond. and Edin. Communicated by the Author.

Whilst, at a vast expense, the farmer is importing bones from the shores of the Black Sea, nitrate of soda from South America, guano from the coast of Peru and from the African coast, he is, in too many instances, negligent of the manure that his stable and stalls supply.

This negligence has been pointed out, and emphatically dwelt on, by every recent writer of authority on agriculture. As regards exposure to rain, and the injurious effects of it on the kind of manure just alluded to, examples of it, in this part of England (Westmoreland), where an unusual quantity of rain falls, are of every-day occurrence, and almost everywhere to be met with: the instances of neglect constitute the rule; of care and attention, the rare exception to the rule. The farm-steadings here are commonly on declivities; the dung-heap is usually placed on a declivity, often by the side of a road, and, in consequence, after every shower of rain, the water that runs off, percolating through the manure, robs it of some of its most valuable ingredients, especially its soluble salts, and soluble animal and vegetable matter, tending to starve the fields and pollute the roads. I have had the curiosity to collect portions of such drainage, and subject them to examination; and I now propose to give the results, as they shew, in a very marked manner, the injurious effect, and how great is the loss to the farmer in consequence.

The first portion collected was from a heap of stable-dung, fresh from the stable just before a heavy fall of rain, the accompaniment of a thunder-storm, nearly an inch falling in three hours. The water which ran from the dung-heap was of the colour of a weak infusion of coffee, of sp. gr. 1002, to pure water as 1000. With the peculiar smell of stable-dung, it had a just perceptible smell of ammonia, which was rendered more distinct by the addition of lime. Under the microscope, it was found to contain, besides a fine granular matter, and many minute vegetable fibres and scales, particles resembling grains of pollen, and two or three different kinds of animalcules. Evaporated to dryness, it yielded 2.6 per 1000 of brown matter, which partially deliquesced on exposure to a moist atmosphere; emitted a very faint smell of ammonia when mixed with lime, indicating that, in the process of evaporation, most of the ammoniacal salt had been expelled, and was therefore carbonate of ammonia; and when incinerated afforded as much as 51.6 per cent. of grey ash—48.4 per cent. of the extract having been destroyed by the fire, which may be considered as animal and vegetable matter. The ash was found to contain the sulphuric, phosphoric, and carbonic acids, and chlorine, with potash, soda, lime, and magnesia, chiefly in the form, it may be inferred, of carbonate of potash, phosphate of lime, sulphate of lime, sulphate of magnesia, and common salt. The proportional quantity of the sulphate of lime was large, as was also that of the fixed alkaline salts, whilst that of the phosphate of lime and the magnesian salt was small.

The next specimen examined was from a much larger and older dung-heap, after a fall of 1.12 inch of rain in about twelve hours. The fluid was of a darker brown than the preceding, very similar in its appearance under the microscope, of higher sp. gr., viz., 1008, and yet less rich in ammoniacal salts, for when mixed with lime, it gave only a very faint smell of ammonia; and its extract obtained by evaporation, when mixed with lime, had no smell of the volatile alkali. It yielded, on evaporation, 10.4 per 1000 solid matter, similar generally to that obtained from the first portion in its qualities, abounding, in like manner, in salts, and those of the same description.

The third specimen collected for examination was from the same dung-heap, after a fall of 2.79 inches of rain in twenty-four hours. It differed so little from the preceding, that it is not necessary to describe it particularly. As might have been expected, it was more dilute, its sp. gr. being 1004.

The last specimen I shall notice was one procured from the same dung-heap, after four days of dry weather following the heavy rain last mentioned. It was oozing out slowly in small quantity; was of a dark-brown hue, nearly transparent, and almost destitute of smell. Under the microscope, it exhibited a few particles and fibres, a very few minute crystals, without any animalcules. I had expected to have found it a concentrated infusion of the dung-heap, and, as such, of high specific gravity; but it was otherwise: its specific gravity exceeded very little that of the preceding, and was less than that of the second portion, being only 1005, leading to the conclusion that the manure was nearly exhausted of its soluble matter. The weather during the four days without rain, was comparatively cold for the season (it was in September), with a northerly wind—the thermometer, even by day, below 58°, and at night once or twice approaching the freezing point. This low temperature must have checked or put a stop to fermentation, which, in its turn, might have prevented the further formation of soluble matter. The infusion mixed with lime indicated the presence of ammoniacal salts; it emitted a pretty strong smell of ammonia; and, judging from the effects of other re-agents, its composition was very similar to that of the preceding portions; it probably contained a larger proportion of vegetable matter, humus and humic acid, than the earlier drainings; it gave a very copious precipitate with the acetate of lead.

The bearing and application of these results hardly require to be pointed out. As the drainage of the dung-heap exposed to rain contains some of the best—the chief ingredients of active manure (excepting always the insoluble phosphates), it follows, that the more the dung is exposed—the more it is subjected to the washing and percolation of rain-water—the greater must be its loss, the poorer and more exhausted it must become; and that shelter from rain is essential as a prevention; such a shelter as can only be well secured by a shed, under which the manure, if too dry, may be watered with the liquid that may have run from it, received into a tank; and be subjected to such treatment, from admixture or otherwise, as has been found by experience likely to render it more efficient. These results, moreover, I need hardly remark, are perfectly in accordance with the experience of intelligent farmers, in many instances on record, of the extraordinary fertilizing effects of irrigation with waters —the washings and drainage of the farm-yard and dung-heap.

THE OAKS, AMBLESIDE,
*Oct.* 12. 1844.

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## *On the Occurrence of Mannite in the Laminaria saccharina and other Sea-weeds; also in Mushrooms.*

It appears, from the experiments of Dr John Stenhouse, as contained in the Philosophical Magazine for October 1844, that the Laminaria saccharina contains 12.15 per cent. of Mannite.

Mannite may be easily distinguished from cane-sugar by the following test:—If a little strong sulphuric acid is poured upon the mannite, and a gentle heat is applied, the mannite dissolves without being in the least discoloured, and gives a transparent solution. If the heat is much increased the liquid becomes of a deep-brown colour, but does not lose its transparency. When cane-sugar, on the contrary, is gently heated with sulphuric acid, it is, as is well known, immediately charred with evolution of sulphurous acid gas. From grape-sugar mannite may be likewise easily distinguished. If mannite is boiled with a strong solution of potash or soda, it dissolves without any change of colour; while grape-sugar, when similarly treated, acquires a deep-brown colour. When heated with a solution of potash and some sulphate of copper, mannite completely prevents the precipitation of the oxide of copper; while grape-sugar causes the immediate precipitation of the red oxide of copper.

Besides mannite, the *Laminaria saccharina*, in common with most of the other sea-weed, contains a great deal of peculiar mucilage, which, when dried, has a deep-reddish colour. It differs, however, from ordinary gum; for, when digested with nitric acid, it yields oxalic, but neither mucic nor saccharic acids. I intend subjecting this substance to more minute examination.

*Laminaria digitata.*—Besides the *L. saccharina*, I have also examined some of the other sea-weeds for mannite, and among others the *L. digitata* or common tangle. The aqueous solution of this seaweed is also reddish-brown, and when evaporated, it yields a similar mucilage with the *L. saccharina*, but in much smaller quantity. The *L. digitata* also contains a considerable quantity of mannite, though I should think scarcely half as much as what exists in the *L. saccharina.*

*Halydris siliquosa.*—The next sea-weed examined was the *Halydris siliquosa.* With hot water it forms a very dark-coloured solution, of a bitter and slightly astringent taste. The quantity of mannite contained in it is very great, amounting, I should think, to between 5 and 6 per cent. As already mentioned, mannite forms a great part of the white incrustations which appear on the surface of this sea-weed when dried.

*Alaria esculenta.*—This beautiful sea-weed, which is by no means uncommon on the coasts of Scotland, where, as its name imports, it often serves as an article of food, also contains mannite in considerable abundance.

*Rhodomenia palmata.*—*Rhodomenia palmata*, or common dulse, contains a good deal of a sweet-tasted greenish-coloured mucilage. It also yields a considerable quantity of mannite, amounting probably to 2 or 3 per cent.

*Fucus vesiculosus.*—The *Fucus vesiculosus*, the most common, perhaps, of British algae, contains, I should think, from 1 to 2 per cent. of mannite; and the *Fucus nodosus*, also a very common sea-weed, likewise yields a small but very appreciable quantity of the same principle.

*Fucus serratus.*—This sea-weed also contains a considerable quantity of mannite, less, perhaps, than the *L. digitata*, but more than the *Rhodomenia palmata.* The mannite which the *Fucus serratus* yields is much freer from colouring matter than that from any of the other algae, being nearly colourless from the first.

I could not detect any mannite in the *Ulva latissima* or *Laver*. The experiment was made on a very small scale, and will be repeated on the first opportunity. The *Laver* contains a good deal of a sweet-tasted green-coloured mucilage, similar to that of the *Rhodomenia palmata.*

As mannite has occurred in eight out of nine of the sea-weeds which I have happened to examine, it probably exists in larger or smaller quantity in most sea-weeds, in which it appears to replace the cane and grape sugar, so abundant in many of our land plants. It is evident, also, that mannite occurs much more plentifully in nature than has been hitherto imagined. The following is a list of the algae just described, arranged in order according to the quantity of mannite which they severally contain:—

1. Laminaria saccharina.
2. Halydris siliquosa.
3. Laminaria digitata.
4. Fucus serratus.
5. Alaria esculenta.
6. Rhodomenia palmata.
7. Fucus vesiculosus.
8. Fucus nodosus.

The quantity of mannite in the *L. saccharina* is such that I think mannite might be more economically procured from this sea-weed than from the usual source—manna.*

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*On the Mammalia of the Counties of Aberdeen, Banff, and Kincardine.* By WILLIAM MACGILLIVRAY, A.M., LL.D., Professor of Natural History in Marischal College and University, Aberdeen. (Communicated by the Author.)

(Continued from vol. xxxvii., p. 392.)

2. *Sorex rusticus.* Sorex tetragonurus has the head broader and more convex, and the muzzle proportionally narrower; the feet rather more slender; and the tail proportionally shorter, and more slender. In both, the tail is unequally four-sided, the lower side being broader than the rest; but in Sorex rusticus I have never seen the hairs so worn as they often are in the other.

The following are the measurements of three individuals:—

| | MALE. | | FEMALE. | | FEMALE. | |
|---|---|---|---|---|---|---|
| | In. | l. | In. | l. | In. | l. |
| Entire length, | 4 | 5 | 4 | 6 | 4 | 3 |
| Length of head, | 1 | 0 | 1 | 0 | 1 | 0 |
| Length of tail, | 1 | 7 | 1 | 7 | 1 | 6 |
| Length of fore foot, | 0 | $3\frac{1}{4}$ | 0 | $4\frac{1}{4}$ | 0 | 4 |
| Length of hind foot, | 0 | $5\frac{3}{4}$ | 0 | $6\frac{1}{4}$ | 0 | 7 |
| Skull in length, | 0 | 9 | | | | |
| Skull in breadth, | 0 | $4\frac{1}{4}$ | | | | |

The habits of this species or variety are, in all respects, so far as can be known, the same as those of the other. It is more common in fields and by fences than Sorex tetragonurus, which is the kind usually found with us in wilder and more bushy places, as well as in woods. Our Highland fox, compared with that of the Lowlands, presents exactly similar differences. It is not distinguished by our rustics from the other, both being *Thraw Mice.*

Sorex araneus, Flem. Brit. Anim., 5.

Sorex araneus, Jen. Brit. Vert. Anim., 17.

Sorex rusticus, Jen. Ann. Nat. Hist., i. 423.

3. *Sorex ciliatus.* *Grey-breasted Water Shrew.*

Black above, blackish-grey beneath, throat reddish-brown; a tuft of white hairs on the inner lobe of the ears; feet ciliated; tail as long as the body, not including the head, square, compressed toward the end, ciliated beneath, with a ridge of stiffish hairs, which gradually elongate, and form a pointed tip; upper canine tooth elongated, decurved in the fourth of a circle, obtuse, with a prominent basal lobe; lower canine tooth direct, depressed, slightly ascending at the end, with a faint subbasal lobe; teeth tipped with brownish-red.

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* MM. Knop and Schnederman have detected mannite in the mushroom named *Agaricus piperatus;* other chemists have found the mannite in *Cantharellus esculentus* and *Clavellaria coralloides.*—EDIT.

This species, which is considerably larger than Sorex fodiens, from which it differs also in colour, may yet be described in almost the same terms. The body is subcylindrical, rather full; the head oblong-conical, one-third of the length, excluding the tail, which is of the same length as the body, excluding the head; the snout long, tapering, depressed, projecting far beyond the jaws, emarginate at the tip, grooved beneath; the ears short, rounded, with an internal upper rounded lobe, and another at the lower part; the eyes very small; the feet short, rather strong; the anterior, with the first toe a little shorter than the fifth, the rest nearly equal, but the third longest; the sole bare, with six tubercles; the claws slender, compressed, slightly arched, acute; the hind feet longer, with the first toe much shorter than the fifth, the rest much longer, the second shorter than the third and fourth, which are about equal; the sole bare, with six tubercles, the claws stouter than those of the fore feet; the tarsi and toes are all ciliated with stiffish hairs; the tail is square at the base, gradually compressed at the end, scaly, and covered with short, adpressed hairs, ciliated beneath with a ridge of stiffish oblique hairs, gradually becoming longer, and forming a point, the organ suggesting the idea of an oar.

The snout is black above, dusky flesh-coloured beneath; the eyes black; the fur, which is soft, close, and velvety, like that of a mole, is, on the upper parts, black, with the hairs bluish at the base; on the lower parts black, mixed with grey, and tinged with brown; the throat and lower lip reddish-brown; the long spreading bristles on the snout are black; a tuft of whitish hairs from the upper anterior lobe of the ear; the feet dusky, the marginal hairs tinged with brown, as are those of the tail.

Canine teeth $\frac{1}{1}$, anterior molar $\frac{4}{2}$, molar $\frac{4}{3} = \frac{9}{6} = 30$.

In the upper jaw, the canine tooth bilobate, with the basal lobe compressed, obtuse, the terminal lobe much elongated, obliquely compressed, decurved in the fourth of a circle, obtuse, but thin-edged at the end, curved inward, the two almost meeting near the tip. First small molar tooth anteriorly conical, obtuse, larger than the basal lobe of the canine, and projecting beyond its level; the second similar, but considerably less, and retiring; the third still smaller, and more retiring, but similar; the fourth, minute. The first grinder large, with two anterior external conical, rather acute, prominences; the second larger, and a thin-edged ridge behind, terminating in a slight prominence in contact with the next tooth; a little behind the anterior lobe, internally, is a small lobe, and, nearly in a line with these two, an internal less-elevated lobe, running out behind. The second grinder with three external lobes, two internal terminating the transverse grooves between the outer lobes, and two inner lobes or oblique protuberances within. The third grinder with three external, nearly equal, lobes, two internal lobes terminating the grooves, and two obtuse protuberances within. The fourth grinder very small, transverse, with the crown irregularly concave, and two small prominences, the one anterior and external, the other posterior and thin.

In the lower jaw, the canine tooth nearly horizontal, slender, obliquely compressed, thin-edged, with a slight lobe or festoon near the base, the tip a little ascending, obtuse, but thin-edged. First small molar tooth compressed, thin-edged, with an anterior elevated, obtuse, thin lobe; second compressed, thin-edged, with an anterior elevated, obtuse, thin lobe. First grinder largest, with an anterior, two external, and two internal points; the first external point largest, the second similar. The second and third are much smaller, but similar.

The teeth are white, but with the tips brownish-red; the outermost processes of the first two grinders not tipped with that colour, nor any of those of the last, the red being chiefly confined to the inner processes in the upper grinders, and to the outer in the lower.

| | Female. In. l. |
|---|---|
| Entire length, | 6 2 |
| Length of head, | 1 1 |
| Length of tail, | 2 4 |
| Length of fore foot, | 0 5½ |
| Length of hind foot, | 0 10 |
| Skull in length, | 0 11 |
| Skull in breadth, | 0 5¾ |

It does not appear that much difference exists between Sorex ciliatus and Sorex fodiens, the teeth being the same in number, as well as in form, with some slight differences only in the proportional size of their lobes. The present species, however, is somewhat larger, and differently coloured.

The individual described above, a female, had ten teats. It was found dead in a wood near the Old Bridge of Don, on the 30th of May 1841, by Mr John MacGillivray.

It inhabits woods and thickets with long herbage, banks, meadows, and the sides of rills, ditches, and pools. It swims and dives with ease, runs with considerable speed, burrows in moss and earth, and forms runs or galleries among the herbage. Opportunities of observing its habits have not, however, occurred to me in this district.

Sorex ciliatus, Sowerby, Brit. Miscell., pl. 49.
Sorex remifer. Yarrell, Loud. Mag. Nat. Hist., v. 598.
Sorex remifer. Jen. Brit. Vert. Anim., 18.
Oared shrew. Sorex remifer. Bell, Brit. Quadr., 119.

3. *Sorex fodiens. White-breasted Water Shrew.*

Black above, silvery-white beneath, the colours abruptly defined on the sides; a large triangular patch of black between the thighs and tail; a tuft of white hairs on the inner lobe of the ears (often also a white spot behind each eye); tail about as long as the body, square at the base, compressed toward the end, ciliated beneath with a ridge of stiffish hairs, which form a pointed tip; upper canine tooth elongated, decurved in the fourth of a circle, obtuse, with a prominent basal lobe; lower canine tooth direct, depressed, slightly ascending at the end, with a long, slightly-elevated festoon in its basal half; teeth tipped with brownish-red; young black above, greyish-white beneath; tail rather longer than the body.

This species varies so much in size and colour, as to render it expedient to describe it in its different stages.

The body is subcylindrical, full; the head oblongo-conical, one-third of the length, excluding the tail, which is a little shorter than the body, excluding the head; the snout long, tapering, depressed, projecting far beyond the jaws, distinctly emarginate at the tip, grooved beneath; the ears are very short, rounded, with an internal upper thin, rounded lobe, capable of closing it like a valve, and a very small lobe at the base anteriorly; the eyes very small; the limbs very short, rather strong; the feet rather broad, but the toes slender; the anterior foot, with the first toe, shorter than the fifth, the second much longer, but shorter than the third, which scarcely exceeds the fourth; the sole bare, rugose, with six tubercles; the claws slightly arched, compressed, acute; the hind feet longer, with the first toe much shorter than the fifth, the rest much longer, the second shorter than the third and fourth, which are equal; the sole bare, with six dusky tubercles; the claws rather more slender than those of the fore feet; the tarsi and toes are beautifully fringed with long, close, stiffish, decurved hairs; the tail is square at the base, gradually compressed beyond the first third of its length, higher in that space than in the basal region, and of nearly uniform breadth, tapering only when viewed from above or beneath, scaly, and covered with adpressed hairs, gradually decurved on the sides, and beneath ciliated with a ridge of stiffish oblique hairs, gradually becoming longer, and forming a point at the tip.

The bare tip of the snout black, dusky beneath; but the lips flesh-coloured; the eyes black. The fur, which is close, soft, and velvety, like that of a mole, with extremely slender sparse hairs projecting beyond the general level, is, on all the upper parts, black, with the hairs bluish at the base; immediately above, and a little behind each eye, is a small oblong white spot; and on the upper lobe of the ear is a tuft of white hairs. The lower parts are silvery-white, the two colours distinctly defined along the sides; but between the tail and the interfemoral space is a triangular patch of black, partly, however, intermixed with white hairs. The legs dusky externally; the feet pale-grey above, becoming white on the toes; their bare parts beneath dusky flesh-colour, with the tubercles dusky; the ciliary hairs white, but on the outer side in part dusky; the tail black, the hairs of the median ridge silvery-white.

Canine teeth $\frac{1}{1}$, anterior molar $\frac{4}{2}$, molar $\frac{4}{3} = \frac{9}{6} = 30$.

In the upper jaw, the canine tooth bilobate, with the basal lobe small and compressed, the terminal lobe much elongated, obliquely compressed, decurved in the fourth of a circle, obtuse, but thin-edged at the end, curved inward, the two almost meeting near the tip. First small molar tooth anteriorly conical, obtuse, but thin, and curved inward; second and third, similar, gradually smaller; fourth, minute, but similar. First grinder large, with two anterior external conical, obtuse, prominences; the second larger, and a thin-edged ridge behind, terminating in a slight prominence, a little behind the anterior lobe internally is a small lobe, and nearly in a line with these two, an internal less elevated lobe, running out behind. The second grinder with three external lobes, two internal, terminating the transverse grooves between the outer lobes, and two inner lobes or oblique protuberances within. The third grinder with three external nearly equal lobes, two internal lobes terminating the grooves, and two obtuse protuberances within. Fourth grinder very small, transverse, with the crown irregularly concave, and two small prominences, the one anterior and external, the other posterior and thin.

In the lower jaw, the canine tooth nearly horizontal, slender, obliquely compressed, thin-edged, with an elongated slightly elevated festoon, the tip a little ascending, obtuse, but thin-edged. The first false molar compressed, thin-edged, with an anterior elevated, obtuse, thin lobe; the second a little larger, similar, but with a second small lobe. The first grinder largest, with an anterior, two external, and two internal points, the first external point largest; the second grinder similar; the third much smaller, but similar.

The teeth are white, but with the tips brownish-red, that colour being chiefly confined to the inner processes in the upper grinders, and to the outer in the lower.

The individual from which the above description is taken is an adult male, in perfect pile. It was caught at Knockleith, in Auchterless, and brought to me by my pupil Mr Charles Barclay, on the 7th November 1843.

Another adult individual, a female, sent from near Turriff, by my pupil Miss Murray, in October of the same year, may now be described, as shewing the difference produced by abrasion of the pile, which was much worn, with the ciliæ of the feet and tail quite short and stiff. In the teeth and general characters it exactly resembled the above. The long hairs projecting from the pile nearly all worn off. The fur on all the upper parts black, with the hairs bluish at the base, on the lower parts greyish-white, with a faint tinge of brown on the abdomen; all the hairs above and below greyish-blue at the base. On the throat, at the distance of an inch from the tip of the snout, is a round greyish-blue spot, seeming black by contrast, a quarter of an inch in diameter; at the coming off of the fore-legs, two similar small spots; and a triangular patch of the same between the tail and the interfemoral space; the tail brownish-black, a little paler beneath. These differences appear to depend upon abrasion or decay of the fur. There is a tuft of white on each ear, but no white near the eyes. The number of teats is ten.

The dimensions of the two individuals are here given, together with those of another female and a young male.

| | Male. | | Female. | | Female. | | Young Male. | |
|---|---|---|---|---|---|---|---|---|
| | In. | l. | In. | l. | In. | l. | In. | l. |
| Entire length, . . . . . . | 5 | 4 | 5 | 6 | 5 | 8 | 5 | 0 |
| Length of head, . . . . . | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 0 |
| Length of tail, . . . . . . | 2 | 2 | 2 | 0 | 2 | 3 | 2 | 2 |
| Length of fore-foot, . . . | 0 | 5 | 0 | 5¾ | 0 | 5½ | 0 | 4¼ |
| Length of hind-foot, . . . | 0 | 8¼ | 0 | 8½ | 0 | 8½ | 0 | 7½ |
| Skull in length, . . . . . | 0 | 11½ | ... | | 0 | 11½ | 0 | 10 |
| Skull in breadth, . . . . . | 0 | 5 | ... | | 0 | 5¼ | 0 | 4¾ |

A young male, in perfect pile, caught near Collieston, in September 1843, differs in its proportions. In the old male the body is longer than in the young; and in the old female the body is proportionally longer, and the tail relatively and positively shorter; whereas in the young the tail is longer than in either, in proportion to the size of the body. These circumstances are observed in other Shrews, as well as in Mice.

The body subcylindrical, rather full; the head oblong, conical, one-third of the length, excluding the tail, which is a little longer than the body, excluding the head; the snout long, tapering, considerably depressed, emarginate at the tip, grooved beneath. The ears are very short, rounded, internally lobed. The eyes, limbs, and tail, as in the adult. The fur is close, soft, and rather velvety but not so dense or fine as in the adult. On the upper parts it is brownish-black, on the lower greyish-white, the two colours blended on the sides. The long spreading bristles on the snout are black. A tuft of white hairs from the upper anterior lobe of the ear. The feet dusky, the marginal hairs grey; the hairs of the tail brownish-black, those forming the ridge beneath whitish; the claws greyish-white. The teeth, as already described, white, with the tips brownish-red, except the basal lobe of the upper canine tooth.

This beautiful and lively little creature resides in the neighbourhood of brooks and ditches, where it burrows in the ground, and frequently betakes itself to the water, where it swims and dives with great expertness. It is also met with in fields, often at a great distance from water. Its food consists of insects and worms; and it appears to be very voracious, like the mole, which it resembles in its restless and irritable temperament. The young individual described above, was caught alive by me near a brook on the coast of Slains. On being set free in the manse, it shewed great activity, screamed when annoyed, attempted to bite the finger, and tore voraciously at a piece of flesh put into the glass with it; but not having been comfortably lodged at night, died next day. Although the species is not uncommon with us, its habits render it difficult to be watched, or even found.

Adults exhibit great differences in size, and even in colour; the latter circumstance, however, depending greatly upon the age of the fur. When recent, it is deep black, minutely intermixed with a little grey, or even sometimes here and there whitish hairs; on the lower parts white, which, viewed from before, is glossy and almost pure, but, seen otherwise, is dull, and tinged with grey. When the fur is old and worn, it is more tinged with bluish-grey both above and beneath. The bluish spot on the throat is perhaps the result of abrasion, and on cutting the tips of the hairs on any of the lower parts, the same appearance is produced. Sometimes there is a longitudinal band of dark-grey or blackish, along the middle of the belly, as in an individual found by Dr Irvine, in September 1844.

The adults, then, immediately after moulting, are deep brownish-black above, white beneath, with a tinge of grey, the bases of the hairs being bluish-grey; the two colours abruptly defined on the sides; the ears with white tufts, and in some individuals a small white tuft over each eye.

When the fur is old, worn, and weathered, it has changed to brown, the white is more grey, and sometimes tinged with brown or red, from the soil.

The young are at first dull brownish-black above, dull-grey beneath. Toward the end of autumn, when the pile has been renewed, they are very dark brownish-black above, pale-grey or greyish-white, with a tinge of yellowish-brown, beneath, the two colours not decidedly defined on the sides, and no white tufts on the ears.

Sorex fodiens, Gmel. Syst. Nat., i. 113.

Sorex fodiens, Flem. Brit. Anim., 8.

Sorex fodiens, Jen. Brit. Vert. Anim., 18; Ann. Nat. Hist., i. 425.

Sorex fodiens, Bell, Brit. Quad., 115.

*Fam.* TALPINA. Six incisors above, eight below, closely set; upper canine teeth large, compressed, pointed: molar teeth seven above, all pointed, the posterior three broad, with several points, six below, similarly pointed. Anterior limbs very short, robust, with the foot very broad, the claws large, depressed; posterior limbs short, moderately strong, with compressed, curved, acute claws. Body cylindrical, with fine velvety pile; tail very short.

*Gen.* TALPA. Head depressed, elongated, pointed, snout mobile; eyes minute; no external ears; teeth forty-four.

1. *Talpa europæa. Common Mole.*

Middle upper incisors a third longer than the lateral, and nearly twice as broad; eyelids open; fur greyish black, somewhat tinged with brown beneath.

The mole of Aberdeenshire is the same as that of the south of Scotland, as well as of England. In all the prepared skulls and recent specimens of British moles that I have examined, the incisor teeth of the upper jaw are unequal in size, the outermost tooth on each side being a third shorter than the innermost or central, and not generally much more than half its breadth. Now, the characters of "upper incisors nearly equal," has been assumed as the peculiar distinction between *Talpa europæa* and *Talpa cæca*, which latter has been characterized as having the middle incisors larger than the outer. But Talpa cæca is said to have the eyes covered by the skin, which is not the case with ours. Were the descriptions of authors correct, our mole would be different from either; but, as it is, I have reason to think, after an extended comparison, that our Scottish and English mole is nothing else than Talpa europæa, or, at least, what has been described as such by all British writers.

Although I have prepared a very minute description of the animal, as it occurs with us, I therefore do not think it necessary, on the present occasion, to enter into details respecting the teeth, which are,

Incisors $\frac{3}{4}$, canine teeth $\frac{1}{1}$, anterior molars $\frac{4}{3}$, molars $\frac{3}{3}=\frac{11}{11}=22=44$.

The fur, or pile, is uniform, very fine, soft, without long hairs, unless on the tail, and a few short and very delicate bristles on the snout. The general colour is blackish-grey, viewed against the pile bluish-grey and glossy, the lower parts paler, the lower jaw reddish-brown, the foreneck and fore part of the thorax, and sometimes the shoulders, slightly tinged with the same colour; the hairs of the tail black. The snout flesh-coloured, inclining to pink; the bare parts of the feet pale flesh-coloured, as are the claws. Eyes blackish-grey.

In a male and a female, the œsophagus in length $2\frac{1}{2}$, $2\frac{1}{2}$ inches; the stomach very large, with very thin parietes, and internally villous, of an oblong form, much curved, in its greatest diameter $2\frac{3}{4}$, $2\frac{1}{2}$, in breadth $1\frac{3}{4}$, $1\frac{1}{2}$, its outer curve $5\frac{1}{4}$, 5; the œsophagus enters about the middle, and the pyloric end gradually tapers into the intestine, which measures in length 71, 61, and varies from three-twelfths to one-twelfth in diameter; the colon not enlarged, nor is there any cœcum.

The young are from three to five. In an individual killed on the 31st of May, I found three fœtuses, about half size. It appears that several broods are reared in the season, for young ones have been found in autumn.

The mole changes its fur in May and June. The new pile is at first remarkably glossy, and on the thorax more tinged with brown than afterwards. One obtained on the 30th May 1843, had completed its moult; another procured alive on the 3d of June, had only begun to shed its pile. With us there is little variation in the tints of the fur; although shades of black or grey may be met with, and a white or cream-coloured individual is sometimes seen.

| | Male. | | Female. | | Female. | |
|---|---|---|---|---|---|---|
| | In. | l. | In. | l. | In. | l. |
| Entire length, | 7 | 6 | 6 | 10 | 6 | 5 |
| Length of head, | 1 | 10 | 1 | 8 | 1 | 8 |
| Length of tail, | 1 | 0 | 0 | 11 | 1 | 1 |
| Length of fore foot, | 0 | 9 | 0 | $10\frac{1}{4}$ | 0 | 9 |
| Length of hind foot, | 0 | 9 | 0 | $9\frac{1}{2}$ | 0 | $8\frac{3}{4}$ |

It is generally distributed with us, being, as usual, most abundant in the more fertile lands, but also occurring in barren pastures, and even in the more elevated valleys, although few are met with beyond the limits of cultivation. The mole frequently bears the name of *moddiwarp* or *moddiwort.*

The Carnivora come next; but as among them there are species which require a rather lengthened description, it seems expedient to reserve them and the Rodentia, among which is a new species, for another occasion.

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*On the Phenomena of Evaporation, the Formation, and Suspension of Clouds, &c.* By G. A. ROWELL, Esq. of Oxford. Communicated by the Author.

THE phenomena of evaporation, the formation and suspension of clouds, &c., are so varied, that it is generally allowed that no theory hitherto proposed will explain the subject satisfactorily, and it is difficult to find authors agreeing to the same explanation. The theory adopted by the writer on this subject in the Encyclopædia Britannica (that water is taken up in solution in the air), is generally given up; for although it explains evaporation in air very well, it does not explain the cause of evaporation in vacuo, or account for the formation and suspension of clouds, or how clouds obtain their electricity.

The theory proposed by the late eminent philosopher, Dr Dalton, that evaporation is caused by the absorption of caloric by water, is adopted by Mr Howard and other leading meteorologists, but this theory also fails in a similar way; one objection is, that ice and snow will evaporate when surrounded by air below the freezing temperature; now, as ice is water deprived of its 140 degrees of heat of fluidity, from what source can it derive its caloric to convert it into vapour, when surrounded by a freezing atmosphere?

Again, the great heights at which clouds are sometimes seen, tell against the theory, as the following will shew the enormous expansion of vapour necessary to render it buoyant, and, at the same time, the great reduction of temperature at such heights.

| Heights. | Temperature of Air. | Density of Air. | Expansion of Water to Float. |
|---|---|---|---|
| Level of the sea,..... | + 60° | 1· | 860 |
| 1 Mile,............... | + 43° | 0·7943 | 1083 |
| 2 Miles,.............. | + 26° | 0·6309 | 1363 |
| 3 Miles,.............. | + 9° | 0·5011 | 1716 |
| 4 Miles,.............. | — 8° | 0·3981 | 2160 |
| 5 Miles,.............. | — 25° | 0·3163 | 2719 |

Expansion of steam at 212° is 1800 times.

Five miles is far above the usual height of clouds, but we have undoubted authority that clouds are sometimes seen at that height. But even at three miles high, the expansion of vapour to float must be 1716 times (very near the expansion of steam from boiling water), and the temperature reduced to 23° below the freezing point. This, I believe, will be sufficient proof that the ascent and suspension of vapour, at such heights, must be caused by some agent, which is uninfluenced by heat or cold.

The hypothesis I offer on the subject is, that when expanded by heat, the increase of the surface of particles of water giving them a greater capacity for electricity, they are buoyed up into the air by their coating of electricity; that if condensed near the earth's surface, the extra-quantity of electricity is withdrawn, and the vapour falls as dew, &c.; but if it rises out of the electrical attraction of the earth, and is then condensed, the electricity being insulated, forms an atmosphere around each particle of vapour, which surcharge of electricity not only suspends the vapour by its lightness, but also repels the neighbouring particles of vapour, and prevents the formation of rain; and on the removal (by any cause) of the electricity inclosing the vapourous particles, the repulsion* is removed, and the particles attract each other, and form rain.

* In using the term repulsion, I mean that the particles repel each other to the extent of their electrical coating, *and no farther:* that bodies

Before I endeavour to explain the various phenomena in question, by this hypothesis, I would direct attention to some of the acknowledged properties of electricity, namely: it has no weight, occupies space, and is dependent on the surface rather than the bulk of bodies; and also to the rapid increase of the surface of bodies, *in proportion to their bulk*, as their bulk diminishes; thus, adopting the $\frac{1}{5000}$ part of an inch as the diameter of a particle of vapour, and the $\frac{1}{25}$ part of an inch as the diameter of a drop of rain, it would take 8,000,000 particles of vapour to form one drop of rain; but the surface of the rain drop would only equal that of 40,000 particles of vapour, therefore, the surface and consequent capacity of each particle of the vapour for electricity, is 200 times greater than that of the rain-drop, bulk for bulk; and as we have no means of judging what is the real diameter of a particle of water, it is probable that it is much smaller than the diameter I have adopted, and, therefore, has a much greater capacity for electricity, proportionate to its bulk.

Thus it will be seen, that if electricity coats the surface of bodies, there must be some point at which the surface of a body would be so great in proportion to its bulk, that this coating of imponderable matter would render it buoyant.

I will now endeavour, as briefly as possible, to explain the phenomena by this hypothesis.

As heat expands the particles of water, it increases their capacity for electricity; therefore, all other circumstances being alike, the greater the heat the greater the evaporation.

Evaporation must depend on the surface exposed, and not

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similarly electrified (either positively or negatively) recede from each other to considerable distances, I believe, may be attributed to the influence of surrounding objects; thus, if a globe be charged, it will attract, and be attracted, in all directions; now, if the globe be so fragile, as that this attraction is sufficient to separate it into minute fragments, these having no attraction for each other, would be attracted apart by surrounding objects, and not dispersed through any repulsion amongst themselves. My views may be wrong, but I cannot otherwise account for the collection of particles of vapour into clouds, especially when highly charged, as in thunder-storms.

on the volume of water, as only the particles on the surface of the water can obtain their coating of electricity.

Wind increases evaporation by assisting the particles of vapour to separate from the body of water, thus enabling the particles to obtain their full coating of electricity, which they cannot have while resting on the surface of the water.

Evaporation from ice is owing to the coldness and dryness of the air separating the minute particles at the surface, when obtaining their coating of electricity, they are rendered sufficiently buoyant to be carried off by a brisk wind.

Evaporation from ice, snow, or even water, at very low temperatures, is trifling except during windy weather.

Evaporation in vacuo (*i. e.* under an exhausted receiver) is from the weight of the atmosphere being taken off, when the particles of water are buoyed up one upon another by their electrical coatings.*

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* The following extracts from the *Philosophical Magazine,* January 1842, will shew the agency of electricity in evaporation:—

" The following experiment was made to prove that evaporation would not go on so freely from an insulated vessel as from an uninsulated one:—

" In a warm room, over an oven in daily use, I suspended, by silk threads, two shallow vessels, eight inches and a half in diameter, containing eight ounces of water each; a small copper wire was hung from one vessel to the earth to take off the insulation, both vessels being similarly suspended in every other respect. After being suspended 25 hours, the insulated vessel had lost 2 oz. 11 dwts. and 15 grains; and the other vessel, 3 oz. 6 dwts.; shewing an excess of evaporation from the non-insulated one of 14 dwts. 9 grains.

" I have tried similar experiments with water placed in the rays of the sun, and, on all occasions, the evaporation has been greatest from non-insulated vessels. There is a difficulty in obtaining correct calculations from the above experiments, as it is scarcely possible to keep up complete insulation from electricity; and the vessel of water must have its proportion of electricity when placed in an insulating situation, which will assist the evaporation for some time; but I believe, if complete insulation could be obtained, and a vessel left without any electricity, that no evaporation would go on at moderate temperatures."

It has long been well known that evaporation is increased by water being charged with electricity: this increase was attributed to the particles of water being repelled from the surface, as any light substance is

Vapour, when raised, if condensed near the earth, is then surcharged by the contraction of its surface, and, being attracted to the condensing substance, forms dew; or, if the surcharge escapes to the earth, the vapour is rendered scarcely buoyant, and causes fogs, &c.

When vapour rises to a distance from the earth, and is then condensed, the surcharge of electricity still buoys it up, and, forming an electrical atmosphere round each particle, prevents the formation of clouds or rain until this surcharge escapes; and the more the vapour is expanded on its first rising, the greater will be its charge of electricity, and it will rise to a corresponding height.

The vapour in the region of the clouds is generally, or at all times, condensed, but invisible, from its being so diffused: the breath of animals is condensed and visible, in cold weather, close to the mouth, but invisible at a short distance off, where it is more condensed, but more diffused; and the deep blue of the sky at great elevations, as described by Saussure, Humboldt, and others, makes it probable that the light colour of the sky at lower latitudes is owing to the condensed vapour floating in the air.

The formation of clouds is, in general, not owing to the sudden condensation of the vapour, but from the escape of its electricity, thus allowing the particles to be brought nearer by the attraction of aggregation; and a still further escape of the electricity enables such attraction to overcome the electrical repulsion of the particles, and form rain.

Mountains and high hills cause rain, by conducting the electricity from the clouds and vapour, and not as condensers of vapour.

Rain is also caused by the air between the earth and clouds becoming charged with vapour, and thus conducting the electricity from the vapour above.

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from a charged conductor; but the fact that insulation retards evaporation, shews that electricity is a necessary agent.

The electricity of steam also supports this theory. See Article on the subject in last vol., p. 347.

Extensive fires, volcanoes, &c., cause rain from the smoke and vapour bringing the air into a conducting state.

Pressure is another cause of rain; thus, if a cloud be forming, the accumulation of vapour is from every side, but chiefly above, and clouds are, at times, of great depth; now, every particle of vapour, on joining the cloud, would have its extra-charge of electricity over the particles of the cloud instantly dispersed through the whole mass, and would take its level in the atmosphere according to its density; now, as all the particles in the cloud are of the same density, those particles of vapour which are above the mean line of density would press downwards, and those below that line would re-act on those above; and although the electrical repulsion of the particles be sufficient to prevent rain at the edges and thinnest part of the cloud, the pressure at the greatest depths of the cloud may be sufficient to overcome the repulsion, and form rain.

The concussion caused by a flash of lightning from such a cloud (that is, with its particles pressed nearly into contact) will easily explain the cause of the heavy dash of rain which follows the flash of lightning.

Rain caused by pressure will often take place at much greater elevations than that caused simply by the gradual escape of the electricity of the vapour, which will account for the formation of hail: thus, a cloud is wafted from a warm to a colder region, and although the cold may be sufficient to freeze all the particles of vapour at the exterior of the cloud, the radiation of heat would be prevented from the central part, where the vapour would remain unfrozen. Rain, formed in the middle of such a mass of vapour, would increase in size in falling through the lower part of the cloud; it would be instantly frozen on leaving the cloud, and the drop, formed under such circumstances, being large, would not only remain frozen in falling through the warmer strata of air to the earth, but would also increase in size by attracting to itself other vapour; but the rain or snow falling from the thinner parts of the cloud being in smaller drops, if frozen in the higher regions, would be melted in falling through the warmer air; thus, as is often the case, there is heavy hail and rain falling at the same time from the same cloud.

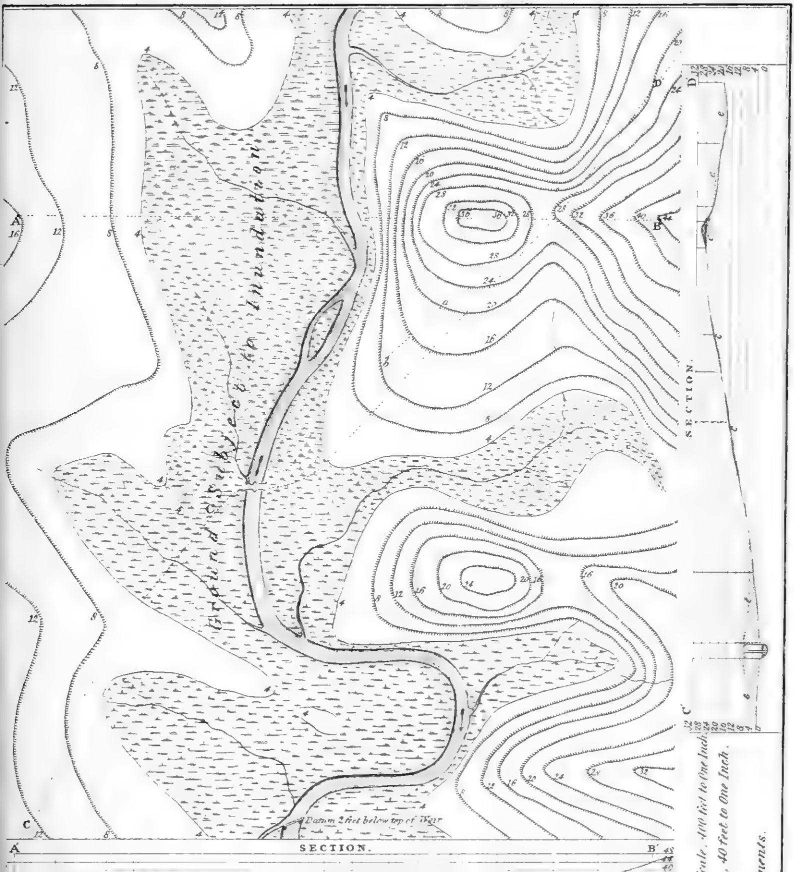
The successive flashes of lightning from the same cloud may be caused by the electricity being pressed out of the cloud when the electric fluid accumulated on the surface would strike off either to the earth or neighbouring clouds: or it may be caused by the formation of rain; thus, it takes 8,000,000 particles of vapour to form one drop of rain, but the capacity for electricity of the rain-drop is only equal to that of 40,000 particles of vapour; therefore, on the formation of every drop of rain, the electricity of 7,960,000 particles of vapour must be dispersed through the remaining vapour, and thus increase the electrical charge of the cloud.

The same reasoning will account for the dispersion of clouds after rain; for if the electricity does not, by some means, escape from the cloud in so great a proportion as the accumulation goes on through the formation of rain, the electricity must increase so as to stop the formation of rain; and may disperse the cloud altogether, through the increased repulsion of the particles of vapour.

The sinking in the barometer previous to and during rain, I ascribe to the rapid escape of electricity from the invisible vapour or clouds, thus causing a partial vacuum in the regions of the clouds, and the air, from its elasticity, rising to fill the vacuum, decreases the pressure on the mercury.

Storms, in most cases, I believe, are from similar causes: the enormous and rapid escape of electricity from clouds during heavy rains, causes a rarefaction of the air in the clouds; the air between the clouds and the earth rushes upwards to fill the rarefied space, and the air at the earth's surface rushes in from all points to gain its equilibrium; and when the excessive rains, which take place at times in tropical climates, are borne in mind, I think the causes explained will be sufficient to account for the most terrific storm.

DIAGRAM TO ILLUSTRATE CAPTAIN VETCH'S EVIDENCE ON THE UTILITY OF CONTOUR LINES ON PLANS.




J. G. Mitchell Sc.

*On the Utility of Contour Lines on Plans.* By Captain VETCH, Royal Engineers.* With a plate.

The Commissioners are desirous of being informed by you what scale and description of survey you consider, from practical experience, to be the most eligible for house and street drainage, and sewerage, and for the regulation of new buildings, or for other public purposes to which a comprehensive survey would be applicable?—The best and most appropriate scale for the several purposes required, I consider to be 88 feet to one inch, or one mile to 60 inches. This will be adequate to shew the position of the sewers, water-pipes, and gas-pipes, and would serve the purposes of valuation, and of setting out improvements. The valuation map of Leeds was constructed upon a scale of 198 feet to an inch, but it proved too small for several purposes, and was afterwards, at some expense, enlarged to a scale of 99 feet to an inch, or double the original size; but the effect of plotting to a smaller scale, and enlarging afterwards, has the effect of magnifying any inaccuracies; whereas if the plan be plotted in the first instance to a large scale, and afterwards reduced, any little inaccuracy will be diminished, or disappear. The Ordnance plans of Dublin and Windsor are on a scale of 88 feet to one inch, and the advantages of that scale for LARGE TOWNS, have become very apparent to me. To the plan of the site of the town, I would propose to add the *cropping out lines* of the different strata, as it appears to me important to mark the soils which are retentive or absorbent, as clay and gravel. I would propose on the plan to trace the water-shed lines, and also the contour lines, or lines of equal altitudes, say at every three or four feet of elevation.

Will you describe more particularly, for the information of non-professional men, the uses of contour lines on surveys? —The ground plan of a town shews the exact dimensions and relative distances of spaces, but it gives no knowledge

* Extracted from Captain Vetch's Evidence, taken before the Parliamentary Commissioners of Inquiry into the state of Large Towns and Populous Districts.

of their absolute heights above a fixed common point or datum, or the relative height between any two sites, on the plan; but when the horizontal plan exhibits these contour lines, drawn, say at every four feet, and marked 0, 4, 8, 12, 16, feet, &c. (Plate I.), we see at one glance all the places situated at these respective elevations above datum, and know their relative heights to each other, and with a little practice, the eye will be able to intercalate (within one foot or less) the intermediate heights between the contour lines; and to facilitate this operation, vertical distances of four feet between the contour lines will prove most advantageous, as most readily admitting of subdividing. The contour lines on the Ordnance plan of Windsor are drawn at every four feet of altitude, and on the low flat ground subject to inundation at every two feet.

The engineer or other person who therefore consults such a map for practical purposes, obtains a correct notion of the height of every part, on the plan, and the declivities or slopes; and for engineering purposes a knowledge of the heights is equally necessary with a knowledge of the distances; and if the plans do not afford him that information, he must commence a number of levellings, to shew what is practicable, and what is not. These levellings occupy much time, expense, and delay in making, and at last only give the engineer the means of judging between the two or three or more lines which he has levelled, while the contour lines enable him to judge of every possible line he may wish to examine or compare.

By means of contour lines, in any street, or lane, or building site, the direction of the fall of the ground is known at sight; and the amount of that fall, in proportion to the distance, may be ascertained between any two points situated on the contour lines. Thus the fall from *a* to *b* on the diagram is known, by the contour lines, to be eight feet; and the distance measured on the plan being 400 feet, the slope would be one foot in 50. An engineer can, therefore, see, without any trial levels, the undulations and descent of each street from one contour line to another, and he knows the amount of cutting or filling, to reduce the street to a level or a regular incline. He knows also what descent the kennels and sewers may have, and how they must join each other, without wasting time and money on a number of trial levels. If the town is situated on the banks of a river, and if the floods of the river rise, say four feet above datum, he will perceive at once the extent of such floods, as shewn by the tinted ground on the diagram, enclosed within the contour lines marked with the number (4) or 4 feet; and the engineer then knows over what extent to provide for such floods, in laying out roads, streets, or drains, &c.

If new streets are to be laid out, the engineer will perceive at once, from such a plan, the declivity and aspect of the building ground, and the best line of drainage adapted for them.

The contour lines being drawn on the map, and identified by corresponding marks on the buildings, serve as a record and reference for all past and future purposes. It is true that if no contour plan exists, the engineer may get what he wants by having recourse to extensive levellings for each particular object; but this expense is generally lost for any future object, or for any other occasion, and thus the same trouble and expense may have to be incurred frequently for levelling the same piece of ground; but having the whole extent of the town and district before him on a contour plan, the engineer can study his subject to better advantage, and observe how improvements can be best and most economically effected. In waiting for trials of level, time is lost, and the Engineer is always loth to employ more time and money on these than can be helped, and he concludes without having the case sufficiently before him.

When levels are executed piece-meal, and at various times, each engineer selects his own datum, and confusion and mistakes are thence likely to occur; so that no cautious engineer would trust to any previous work, but would level up to some fixed point, however distant; but even if otherwise, he might not choose to risk his reputation on the previous levellings of others, of whose qualification he could not judge. But if the levels or contours were executed by the Ordnance Survey, his confidence would be complete.

If contour plans and marks were made under the authority of Government, the facilities and economy afforded by such a previous work would be manifest, and cannot be too highly appreciated, both for the saving of time and money, and for insuring accurate judgment and execution in the works of improvement; and I have no doubt that were such going forward to any extent, the expense of the Ordnance levels and contours would be saved in three years, in the mere employment of surveyors, independent of the errors and expenses that might be entailed by less general and accurate views of the field to be operated on; but, having served for any particular purpose and occasion, the Ordnance contours and levels would be ready for use again and again, and one datum would be established, to which all altitudes would be referred. For the purpose of applying the liquid manure to irrigation, the contour lines would be essential; and at Leeds they would prove particularly serviceable for that purpose, and also for the extension of the buildings, and for the drainage on the low flat part of the town south of the river.

By referring to the diagram plan already noticed, the advantages of contour lines will be more readily perceived. The contour lines are there drawn at every four feet of altitude, above a fixed datum, and have a slight shade on their under side, the more readily to point out the direction of the fall of the ground; and this in some cases is essential, as otherwise it would be difficult to distinguish at sight between an isolated hill and isolated hollow.

From such a contour plan a section may be procured in any direction in a few minutes. Suppose a section is required of the ground between the points A and B, we have merely to draw the line A B on the plan, and a corresponding line A′ B′ on section, and under the last to draw a number of parallel lines at equidistances of four feet, to whatever vertical scale we think most appropriate. On the diagram plan the scale is 400 feet to an inch, and the horizontal scale on the section is the same, but the vertical scale, to render the subject more distinct, is 40 feet to one inch.* The next opera-

* The original diagram has been reduced, which accounts for an apparent discrepancy in the plate.—Edit.

tion is to apply the straight edge of a slip of paper on the line A B (on the plan) and to mark off on the first all the intersections of contour and other lines; this done, the slip of paper is next applied to the section lines A′ B′, to which the marks of intersection are transferred; and from these marks so transferred, perpendicular lines are drawn to the line A′ B′, and the intersection of these last with the parallel lines of the section already drawn, as mentioned above, give the various heights on the section, and nothing further is required than to join these points with lines, to give the outline or profile of the ground, and all this may be done a hundred miles from the spot; but if no such contour map existed, the engineer would have to send a surveyor with instruments to level over the ground, and considerable delay and expense must be incurred.

Again, suppose that it is wanted to lay down a new line of road from C to D, without recourse to a section, the contour lines would shew that the dotted line C D would be very direct, and would give the most gentle ascents and descents, and if it be required to know the amount of these, and the quantity of cutting and filling to reduce the line of a regular surface, and above the influence of floods, we have only to repeat, in regard to a section on the line C D, what has been said in respect to that on the line A B, from which will be shewn the cuttings and embankments necessary for our purpose; the space between the dotted line, and the line of surface indicating the extent of each.

If the contour lines on a plan give such facilities for laying out common roads, these advantages will be still greater, in respect to laying out railways, canals, embankments, and water-conduits.

What do you consider would be the expense of laying down these contour lines?—In conjunction (or rather prior in order) to the contouring, levellings will have to be made to determine with great accuracy the positive heights of a number of points within the town, as has been done by the Ordnance Survey in several towns, and while that process is going on, the contour lines can be added at little additional expense. Thus at Leeds, over a space containing about 120,000 inhabitants, it was estimated that 80 miles of levellings would be required to establish a sufficient number of permanent bench marks in the town, and it was further estimated that these 80 miles of levelling would cost L.200, and the addition of the contour lines L.50; and, reckoning the number of houses at 26,666, the expense would be 2¼d. per house.

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*Remarks on the Advantages and Economy of the Moveable-Derrick Crane, improved and introduced into general use by* WILLIAM WIGHTMAN, Contractor, *in the year* 1837; *but more particularly as applicable in the Construction of Bridges, Piers, Breakwaters, and Naval Architecture.* Communicated to Ed. New Phil. Journal by the Royal Scottish Society of Arts.* With a Plate.

It is well known, that, previous to the year 1837, no other crane was generally known or used in the construction of public works, but the common, or, what might be appropriately called, the gibbet-crane. These differed sometimes a little in form and arrangement of their machinery, but never so much as to alter their principle.

The small figure at A, fig. 3, Plate II., will give a good idea of their general structure, and that which was most in use. They were, however, even in their most approved form, always unwieldy, top-heavy, and difficult and dangerous in fixing up or taking down; so much so, that more accidents occurred from these frequent operations, than from performing their proper work. It will also be easily observed, that their capabilities for lifting or depositing stone, or other material, in the construction of works, soon become exhausted, from the point of suspension being immoveable to or from the fulcrum, and performing only one circle of a radius equal to the length of the cross-beam.

This great defect could, in some measure, be remedied a

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* Read before the Society on 12th April 1844.

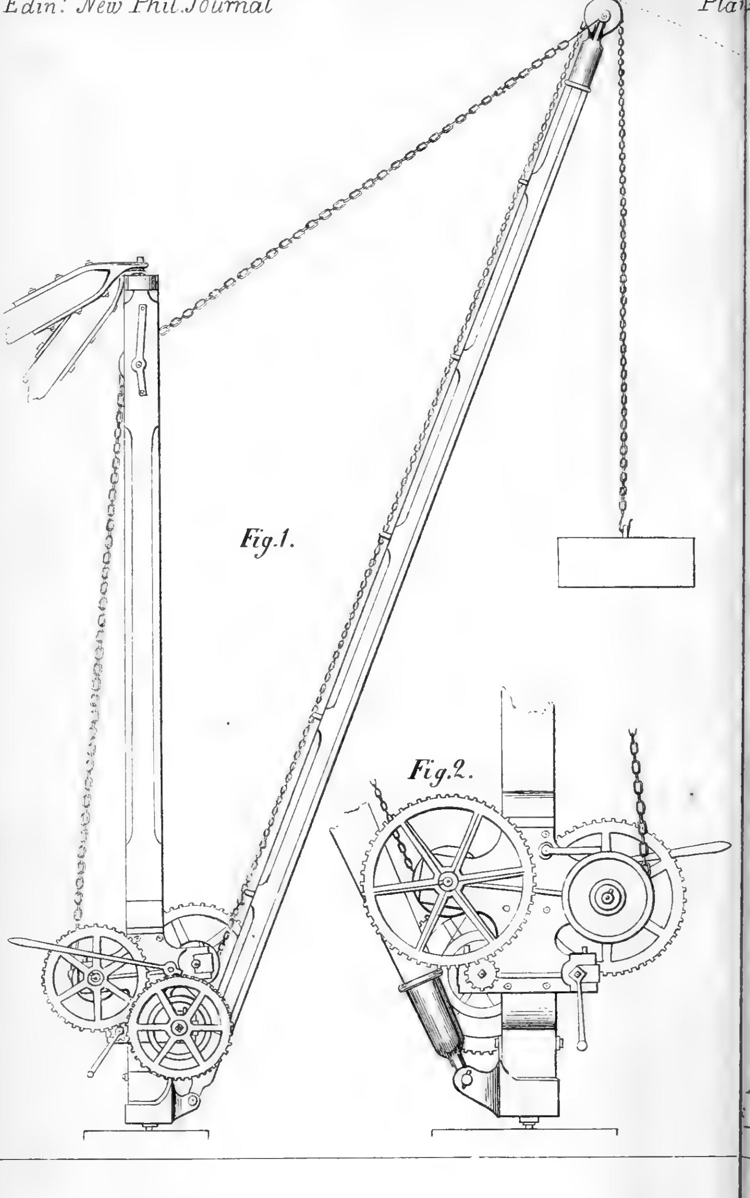
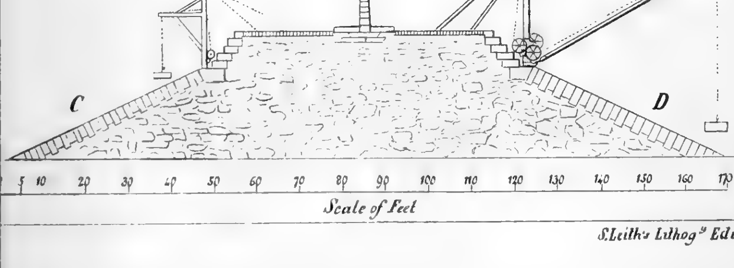


Fig. 1.
Fig. 2.

# Mr. Wightman's Improved Movable Derrick Crane

*Figr. 1. $\frac{2}{10}$ of an inch to the Foot*
*Figr. 2. $\frac{3}{10}$ of an inch to the Foot*

Fig. 3.




S. Leith's Lithogy Edinr.

little, by applying a tackle-fall to the material in suspension, and dragging it by main force from the perpendicular to the place required, or as near to it as could possibly be effected.

From this and the other defects, it will be admitted, that the gibbet-crane was a very imperfect machine for lifting and conveying heavy masses of building, or other material, to or from their ever-varying positions ; and required to be taken down and removed, in most cases, every other day,—thereby incurring great expense and loss of time.

By a reference to the small figure of the improved moveable-derrick crane, fig. 3, B (C D being a cross section of a part of Granton Pier), the inefficiency of the common or gibbet crane for executing such work profitably, compared with the moveable-derrick crane, will be quite obvious ; and shews that some other machine was desirable, possessing greater economy and despatch for depositing the blocks of stone over the whole range of these immense slopes.

On entering with my partners into the contract with His Grace the Duke of Buccleuch for the erection of Granton Pier, the deficiency of the common crane called my attention to various schemes for a remedy, which at last resulted in the construction of the improved moveable-derrick crane, a working model of which is now before you. (Plate II., figs. 1 and 2.)

It may be proper, however, here to state, that, although I never had then either seen or heard of anything of the kind, a crane having a moveable-jib, but with very different and more complicated machinery than mine, was used by Mr Stevenson at the Bell-Rock Lighthouse, upwards of thirty years since : the defects of which, as well as the improvements effected by me, were very clearly pointed out in a paper read before the Society some time since, by Mr James Slight, F.R.S.S.A., engineer, Edinburgh, containing an exposition of the strains to which cranes of various forms are subject ;—for which the honorary medal was awarded to him.

I am sorry to occupy the time of the Society with a mere detail of circumstances ; but I wish to state, as a proof of the extent of existing prejudices against the introduction of many useful improvements, that, after I had, at a great expense, got my first crane built, I consulted with a gentleman of considerable mechanical knowledge and experience as an engineer, who, after examining it, strongly advised me to break it up, without even a trial; and, from my confidence in his opinion, it was put aside a whole month, before I ventured to put it up for trial.

Its decided superiority, easy management, and its capacity for forming an almost infinite variety of concentric circles (so much required in extensive building operations), were, in a short time, so manifest, that I had applications from several most respectable builders, to be allowed the use of the patterns for sets of castings. From this period my improved crane began gradually to come into general use; and I may be permitted to state, that the most of the bridges and viaducts on the Edinburgh and Glasgow Railway were built by its means. I have seen it most successfully applied to ship-building, the derrick being no less than 70 feet in length, and capable of placing a heavy timber plank on any part of a large ship, besides commanding an extensive range of the yard for picking up timber.

Fig. 1. is intended to represent the improved moveable-derrick crane, in its full proportions, as generally used; but as the mast and derrick may be increased or diminished to suit circumstances, there can be no fixed rule for the length of either. I have never used any mast less than 25 feet, or any derrick more than 55 feet; and where they are used for any purposes which require them to be frequently removed, I would recommend that the length of the derrick should not exceed 40 feet (unless the nature of the work require it), and that the derrick should never be lowered to a greater angle from the mast than 65 degrees, as the strain upon the derrick-chain and stays of the mast, even at that angle, becomes very great.

The size of the chain for raising or lowering the derrick is usually of the best cable iron, three quarters and one sixteenth of an inch diameter; and the purchase or lifting chain of the same iron, but eleven sixteenths of an inch in diameter. With these, if judiciously stayed, the crane will lift or deposit, anywhere within its range, a weight of 4 tons. One thing ought to be particularly attended to,—never to allow any workman to guide or shift the machinery without having been trained a little to its management; as the most trifling error, such as neglecting to let down the click of the ratchet-wheel, when throwing out of gearing the handles, after lowering the derrick, might be productive of serious consequences; while, on the other hand, with a little experience and attention, nothing can be more safe.

Fig. 2. exhibits the reverse side of the crane from Fig. 1, but on a little larger scale.

I will not trespass farther on the Society's time than merely to solicit your attention to another useful mode of its application, whereby the contractors for Burntisland Low-Water Pier have been enabled to construct, and carry out seawards, the whole of the timber stageing for working their diving-bell.

The saving in time and expense from this method has been great. The small model is intended to represent one 40 feet length of stageing with the crane in advance, ready for placing another 40 feet length out seawards.

I respectfully beg to state, that I believe no printed description of the improved moveable-derrick crane has ever yet been given to the public; and that it is now, with a few exceptions, unknown in England.

TRINITY CRESCENT, 3*d April* 1844.

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*Report by the Committee of the Royal Scottish Society of Arts on Mr Wightman's Improved Moveable-Derrick Crane.*

*June* 6. 1844.—The Committee have carefully examined the model, drawings, and description of this crane, submitted to them by the Society; and having compared it with other machines of a similar description previously in use, are satisfied that Mr Wightman has introduced very decided improvements in this highly useful engine.

The use of the moveable-jib, or derrick, is not new; but it has now, by these improvements, been reduced to so great a degree of simplicity, as leaves little farther to be done or wished for, to render its operation complete; and by this invention, and particularly by its introduction in the operations of Granton Pier, from whence its use has been extended to other works of a similar kind, and to bridge-building, and must, undoubtedly, become yet more generally extended to these and other engineering works, we think Mr Wightman has rendered an important service to the useful arts, and deserving, thereby, the particular consideration of the Society. The model is a very neat and complete apparatus; and we would recommend the drawings and description to be printed, to which Mr Wightman will probably add a more detailed drawing of the machinery.

(Signed) GEO. BUCHANAN, *Convener.*
JAMES SLIGHT.
WM. GLOVER.

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## *Abstract of a Paper relative to Springs of Water.* By ROBERT WERE FOX.*

Mr Fox began by referring to an interesting lecture recently read before the Royal Polytechnic Society, in the course of which it was suggested that springs of water, especially such as are sometimes found on the highest ground of any locality, might be caused by the pressure of vapour, generated by the heat existing at great depths in the earth.

If it be assumed, he said, that the subterranean temperature increases at the rate of 1° Fahrenheit for every 48 feet of depth, which he considers to be too high a calculation, and taking the mean of this climate at 50°; this rate will give: 160° at 1 mile deep, 270° at 2 miles, 380° at 3 miles, 490° at 4 miles, 930° at 8 miles, and 1370° at 12 miles.

The heat of boiling water occurring at about 1½ mile deep; that producing an expansive force of 2.9 atmospheres at 2 miles; of 50 atmospheres at rather more than 4 miles deep; and Le Roche calculates that the pressure of vapour in contact with water, would exceed 4000 atmospheres at the temperature of 1386° Fahrenheit, and then be nearly equal to the density of water.

The pressure of a column of water at 60° would, at the rate of 34 feet to an atmosphere, equal

| | | | |
|---|---|---|---|
| 155.34 | atmospheres | at 1 mile deep. | |
| 310.68 | ... | at 2 miles deep. | |
| 466.00 | ... | at 3 | ... |
| 621.36 | ... | at 4 | ... |
| 1242.72 | ... | at 8 | ... |
| 1864.00 | ... | at 12 | ... |

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* Read before the Royal Polytechnic Society of Cornwall, on the 7th November 1843.

Since the water would be at the temperature of the earth at the respective depths, and would expand in an increasing ratio as the temperature increased, it is manifest that considerable deductions should be made from these pressures, but to what extent cannot be stated. The forces of water pressure and steam would, on these data, probably equal each other at rather more than 9 miles deep, and the density of the steam be about four times that of water. It is not to be supposed that water can exist, as such, below the zone at which it would become converted into steam, if it reach it at all; although it is possible that the steam may go much deeper; but as its elastic force cannot materially exceed that of the uppermost steam, it must be continually lessening in density as it descends into more heated parts of the earth.

Mr Fox referred to the results of observations in mines, which he had published from time to time, and which, on being tabulated,* seemed to indicate that the heat does not augment in regular progression in descending into the earth, but that it increases in a less ratio than this. Thus, starting from 50°, the mean of this climate, the temperature was: 60° at the mean depth of 59 fathoms, being an increase of 1° in 35.4 feet; 70° at a further depth of 73 fathoms, being an increase of 1° in 43.8 feet; 80° at a still further depth of 107 fathoms, being an increase of 1° in 60.4 feet.—Temperature 80° at the depth of 239 fathoms.

The temperature at given depths has been found to differ much in different localities; a fact not to be wondered at, when we take into account the greater or less facilities afforded by the cracks in the rocks for the circulation of water from greater depths, as well as lesser ones.

If the increase of subterranean heat should continue to be in a diminishing ratio much farther down than has yet been penetrated, it would seem useless to conjecture at what depth the water and steam pressures might balance each other, as that of the former, if present, would be always increasing with the depth; and then the question remains as to the source from which it can be derived to supply any considerable proportion of the existing springs. Mr Fox considers that the sea-water can have no tendency, from pressure only, to flow into the earth, except at its deepest parts, and these are generally very far from land; and that a continued evaporation from it would tend to accumulate salt in the deep fissures, so as to interrupt the process. However this may be, there is good reason to believe that some thermal springs, especially those near volcanoes, may be ejected by vapour. He thinks it possible that some of these outbursts of water may be caused by the pressure of the ocean, which, from its greater

* See Mr Fox's Report on some observations on subterranean temperature—Report of the British Association for 1840, p. 309.

specific gravity, must always tend to raise any spring-water with which it may be connected, to a higher level than itself. He calculates that sea-water 4 miles deep, of the mean temperature of 60° for the whole depth, and specific gravity 1.027, would balance a column of spring-water at 200° of temperature, of more than 4 miles and 1200 feet deep; and 1200 feet of spring-water are equivalent in weight to 450 feet of granite.

In this calculation he has made a large allowance for impurities in solution in the spring-water, to the extent of one-third of the proportion of salt in sea-water, which is at least five times as much as the average state of water taken from the lowest parts of many of our deepest mines would require; and he has assumed the column, descending 4 miles deep in the earth, to have a mean temperature of only 200°; whereas, according to the first table, the temperature stands at 490° at that depth, which would give a much higher mean, and more than he is prepared to admit, for the reasons already given. There may be a large proportion of sea-water at great depths in the earth; but a column of this 4 miles deep would be expanded to about 850 feet more, if its temperature were raised from 60° to 200°.

It is not to be supposed, he adds, that such great effects will any where be seen, because of the vents which the heated water would find at lower levels; even at the bottom of the shallow seas these vents may be sufficient, in most instances, to take off any pressure tending to raise the fresh-water ashore. It will be readily granted that salt water may ooze through the deepest beds of the sea, or, in some parts of these, flow into the earth in greater or less quantities, according to the greater or less resistance it meets with at its entrance, or in its subterranean course. The numerous veins of clay which intersect the crust of the earth, must present formidable obstacles to its rapid progress; and it cannot advance under ordinary circumstances without displacing other water, which can only be done in proportion as the latter finds means of escape. It is evident that at the bottom of seas of inferior depth, the balance must be in favour of the *upward* pressure, for even if the water be as salt as that of the ocean, at considerable depths below its bed, its specific gravity will be diminished by the expansive influence of the subterranean heat, so that it will yield to the superior pressure of the colder sea, and escape wherever it may find the resistance the least; this may, in some instances, be through fissures communicating with the shore, or under nearly horizontal beds of clay through which it cannot find an upward vent till it reaches land, and there, under such circumstances, it might produce springs more or less elevated above the surface of the sea. The force with which the water in Artesian wells sometimes gushes up from great depths, shews us how tenaciously the fluid must be confined down by the superincumbent strata; and the bed of the ocean is also commonly supposed to be for the most part very impermeable to water. Mr Fox conceives it, however, to be highly probable that the greater part of the compressed water under the bed of the sea, may find different vents through it, and that there may be salt water jets at the bottom of the less deep portions of the sea, as well as jets of fresh water which have been discovered in some parts of it.

The water has been found fresh, or only slightly saline, in parts of many mines worked far under the sea; and, on the other hand, Mr Fox has detected common salt in the water of some of our deeper mines situated many miles from the sea; in some water taken from the bottom of Poldice copper mine, he found 24 grains of salt in a pint; also a considerable proportion in water from the United Mines, and some of the water in both these mines is at 98° and 100°, a temperature probably not equalled in any other mine in Cornwall; both circumstances seem to indicate that it ascended from a considerable depth. Many mineral springs also contain much common salt.

Thus it appears that if fresh water in some places penetrates under the bed of the sea, salt water finds its way in others under the land; so that there is every reason to believe that they meet at different depths in the earth, acting and reacting on each other with more or less effect, according to circumstances. And if the obstructions be in some places so great as to limit the percolation even to drops, still there must be a constant tendency to balance the pressures; and the water will escape, if it should find vents in the bed of the ocean, where there is a diminished pressure,—it may be of miles, or only a few fathoms of salt-water. However small the depth of the latter, it will produce a reaction on the water in the earth, which may extend to springs ashore, and raise such of them more or less above the level of the sea as do not find an easier outlet. Thus sea-water, of between 6 and 7 fathoms deep, might raise fresh-water 1 foot above its surface, and so in proportion as the depth is greater; and it may be more than this, if the temperature of the fresh water should much exceed that of the salt.

But the facilities which the bed of the sea, and very low lands may, in some parts, afford for the escape of the compressed water, seem, in Mr Fox's opinion, to be arguments which are more or less unfavourable to the adoption of either the *sea-water* or *vapour* hypothesis, to explain the cause of springs on *high* ground. Nor can such springs as have nearly the same temperature as the climate, be supposed to depend on any deeply-seated force for the supply of an essential proportion of the water that flows from them, because they would then have some of the earth's heat imparted to them; although it is not improbable, that such a force may help to sustain some of them at certain levels.

However this may be, Mr Fox considers that the *endosmose* process which accompanies voltaic action, has its influence on the height and purity of springs, since it readily causes water to pass through the densest clay, against the force of mechanical pressure; and he has succeeded in shewing, that subterranean currents of electricity are capable of producing this effect. The veins of clay in the earth may, therefore, act an important part in filtering the water chemically, as well as mechanically, as they undoubtedly do, in supporting springs at different levels, and in greatly limiting the influx of water into the mines, which, without them, could not be worked much under the surface; so that, although they lie hid in the earth, and comparatively little known, they may be numbered among the adaptations designed to meet the wants of man, by an all-wise and beneficent Creator.

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Since Mr Fox's paper was read, he has partly filled one branch of a U-shaped glass tube with sea-water, and the other branch with spring-water, the two fluids meeting at the bent part of the tube. Under these circumstances, they exhibited no tendency to become mixed; for, after many days, the original difference in the heights of the two columns had not perceptibly altered. The case was the same when water and strong brine were balanced, in like manner, against each other, although the apparatus was heated as much as 200° for some time. Neither did a mixture readily take place between fresh-water and sea-water, in an upright glass vessel. In this instance, the fresh-water was slightly coloured, and carefully poured on the sea-water, when the line of division appeared to be well defined, and became still more so after the vessel, with its contents, had stood some time in water, at rather above 200° Fahr. The heat produced in each fluid upward and downward currents, which were quite independent of those in the other, so that their surfaces of contact were undisturbed.*

Hence it appears, that the freshness of springs, at the surface of the earth, affords no evidence of the non-existence of salt water under them, at considerable depths: while the presence of common salt in some springs, the greater specific gravity of sea-water, and the unbalanced pressure in the deepest parts of the ocean, rather favour such an assumption.

Mr Fox suggests, that the surfaces of deep rivers will, from the inferior specific gravity of their waters, have a tendency to be at a higher level than the sea at their conjunction; and that, as the fresh-water flows down to equalize their levels, the sea-water will have a disposition to pass under the former, to equalize their pressures.

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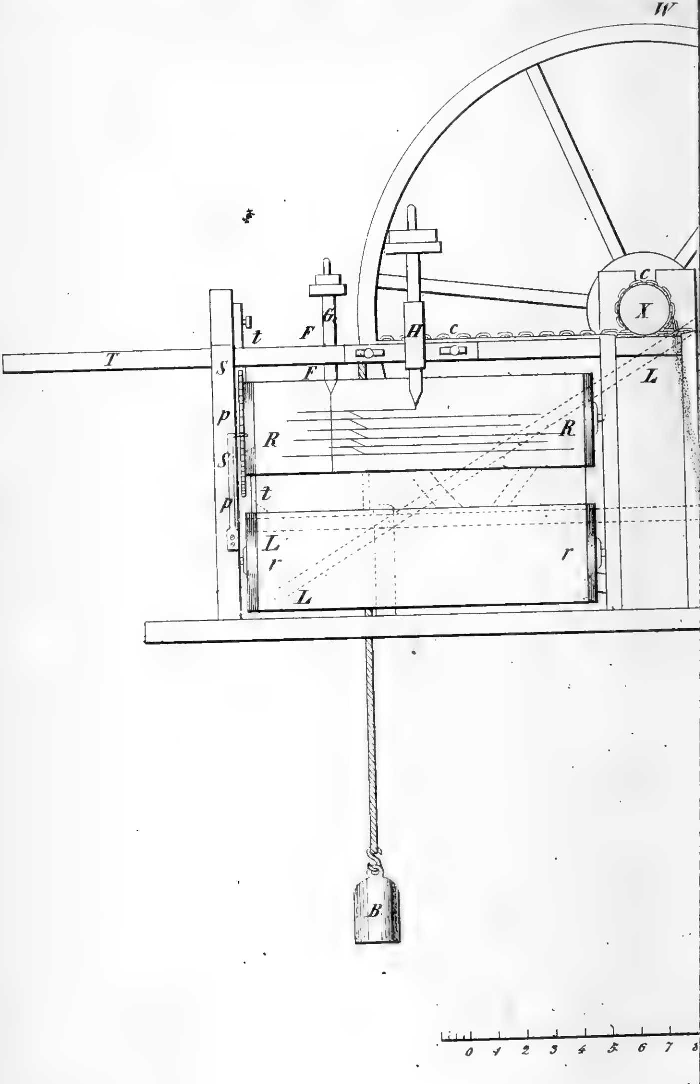
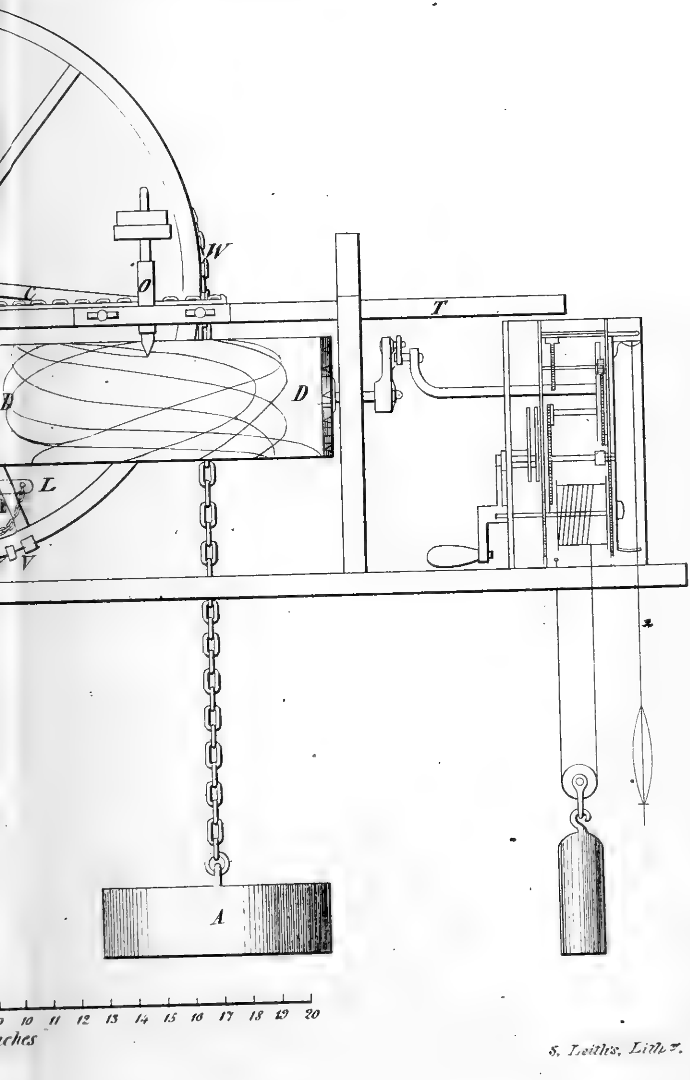
* It was found, after two days, that the upper part of the sea-water had become a little coloured, indicating some tendency, small as it was, in the fluids to combine, owing, doubtless, to an *endosmose* action; for when heated, *two* lines of division appeared, at equal distances from where the first line was,—above and below it,—and the included fluid was less highly coloured than the water, the sea-water remaining without colour.

Mr. Wood's Tid



Gauge.




S. Leith's, Lith.

This operation seems to be reversed in the case of the Mediterranean sea, if, indeed, the inward current at the Straits of Gibraltar has any relation to the superior saltness of that sea. An under-current moving outward, would, in that case, be the natural result.

If an inland sea should undergo a change in its specific gravity, owing to alterations of temperature, or in the proportion of its saline contents, its level would also be changed; and, therefore, these considerations should not be overlooked in investigations of the comparative heights of sea and land, at different periods.

It is, perhaps, worth inquiring, how far the low level of the Caspian Sea may be due to the high specific gravity of its water, which is said to be very saline, and very deep, and its mean temperature is probably low.—*The Eleventh Annual Report of the Royal Polytechnic Society.*

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*Account of a Cheap and Portable Self-Registering Tide-Gauge,* invented by JOHN WOOD, Esq. of Port-Glasgow, and which has been two years in use. With examples of the work done by it. By JOHN SCOTT RUSSELL, Esq., F.R.S.E., F.R.S.S.A. Communicated by the Royal Scottish Society of Arts.* With a Plate.

In the course of the tide researches in which I have for some time been engaged, I have continually felt the want of a simple, cheap, and portable machine for registering tidal phenomena; such a one as might be erected and applied, either temporarily or permanently, without requiring much or close attention in its use, or nice adjustment for its operation. If this were attained, I have felt confident that few harbours of importance would be without a tide-gauge. This is of the greater importance, owing to the present position and aspect of our knowledge of the phenomena of the tides; observations, continuous, simultaneous, and of considerable period, being all that is necessary to afford us the means of placing this complicated subject in a highly respectable position among the accurate sciences.

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* Read before the Royal Scottish Society of Arts, Feb. 12. 1844, and the Silver Medal, value Seven Sovereigns, awarded to Mr WOOD, 11th November 1844.

In practical engineering, the improvement of rivers and harbours, and, in marine surveying, the possession of such an instrument is of no less value than in abstract science.

I have satisfied myself that the machine invented by Mr Wood possesses, or is capable of achieving, all that is desired on this head. I therefore think it my duty, through this Society, to make known the merits and construction of a useful machine, which has its origin in the pure love of scientific truth which animates the mind of its accomplished inventor.

Mr Wood's Self-Registering Tide-Gauge has been at work in Port-Glasgow for about two years. It has no clock-work, nor the barrel D. It registers the height of high and low water for four months without requiring any attention whatever. At the end of that time, a new sheet of paper should be supplied to the machine, the old one removed, and the pencils repaired. Airey's H H, or H H H, will last this period in good order.

On removing the paper, the observer finds a diagram of the tides, on which are simply, and at once, presented the curves of geometrical inequality and the diurnal inequality, &c.

A specimen of the work of the machine is sent herewith. It contains about three months' observations.

The whole machine is portable and light, and may easily be transported. A box less than 18 inches square in the bottom, and about 12 inches deep, contains it.

A (Plate III.) is the wooden float, about 2 lb. weight, suspended on one side of the wheel W W; and on the other side is the counterpoise weight B, of 1 lb., giving a moving power of 1 lb. each way.

T T is a horizontal travelling bar, carrying the register pencils H and O. This bar is made to traverse with the rise and fall of the float, by means of two chains C C C, one end of these chains being attached to the travelling bar, and the other end coiled round the axis X of the wheel W W, round which each chain has one turn and a half when the register pencil is in its mean position. These chains should have a small degree of slackness, to be afterwards allowed for on reckoning the ranges.

X the axis of the wheel W W is to be proportioned so that its diameter shall be smaller than the diameter of the wheel, in the same ratio in which it is desired that the scale of the register shall be smaller than the rise and fall of the tide.

R R and *r r* are two rollers; the under one *r r* is furnished with the paper rolled round it. A stripe from the side of a sheet of drawing paper, 40 inches long and 9½ inches broad, is sufficient for this purpose. The upper roller R R has one end of the paper fixed on it, so as, by revolving, to roll the paper gradually on itself, the roller *r r* being steadied by the presence of a small spring.

S S is a large copper ratchet wheel, detained by the copper pall *p p*, the under surface of which is serrated in a similar way to the wheel with numerous small teeth, and is pressed to the wheel by a small spring; thus the roller R R is detained in any position to which it has been moved.

Motion is given to the roller once in each tide about half ebb. This is effected in the following manner:—One tooth of the ratchet wheel is moved each tide by the ratchet *t t* attached to a vertical bar moving up and down on two guide pins. This bar is loaded to drop with its own weight, and a loaded lever L L raises it once each tide.

The lever L L receives motion from the axle of W W once in each tide, as follows:—The chain C C winds upon the axle X as the tide rises, and is of such a length as to be quite slack at low water, and to become tight at half tide: the lever is then raised, and the ratchet bar falls about one tooth and a-half, so as to be quite free of the wheel. The lever continues to rise till high water, and in falling, at about half ebb, once more raises the ratchet bar, and by it turns the roller R R through one tooth, a stop preventing any further motion. As the tide ebbs further, the lever chain becomes slack, and does not again come into operation until the middle of the following tide.

Behind the travelling bar T T, which carries the Register pencil, is a fixed bar F F, carrying another pencil G, adjustable in position so as to describe, when once adjusted, a *datum* line on the paper, to represent any fixed height that may be referred to as a standard for the height of the tides, and from which the true height of the tides may be measured on the paper.

The scale of the register is given on the stand. But it will be prudent in all cases to determine the scale by experiment on the machine when it has actually been adjusted for use. This will be done by moving the float up and down through a given height, and measuring the line described by the register pencil.

To prevent the machine from suffering injury, there is a stop apparatus attached, of the following kind. A pall is fixed on the stand of the machine, and attached to a chain, which is wound round the axle X; this chain is of such a length as to allow the wheel to travel to its greatest range, either way, without interruption; but should any cause tend to carry the wheel farther, the chain draws up the pall to act on a stop V, on the edge of the wheel; and so farther motion in that direction is prevented.

The machine here described was made at Port-Glasgow, under the superintendence of Mr Wood; and I believe the cost of such a machine, with all its appendages, enclosed in a suitable box, does not exceed forty or fifty shillings sterling.

There are ropes round the large wheel W W in the model; but a simple brass chain might be substituted with advantage, to avoid the expansion of the rope, on that side of the wheel where the *float* is attached.

A plummet is hung at one end of the stand, and a screw at each corner serves for setting the machine level; the ropes getting deranged when this is not attended to.

Mr Wood also further proposes, in those cases where it might not be inconvenient, to connect the machine with a clock, having a cylinder D D, shewn in the plate, attached to the register already described, so as to give a *time*-register as well as a *height*-register.

For this purpose the travelling-bar T T merely carries an additional pencil O called the Time-pencil, which will traverse horizontally as the tide rises and falls. The axis of cylinder D D is placed below the time-pencil, and parallel to the travelling-bar. The cylinder revolves once in twenty-four hours, and is marked by divisions to astronomical time, and revolves so that the point of the pencil is always at true time on the cylinder, while its transverse motion indicates the height of the tide at the corresponding time, and thus describes on the cylinder the form of the tide-wave at that place. The morning tides will thus cover one-half of the cylinder in a fortnight, and the evening tides will cover the other half.

By a simple contrivance, it is proposed to move this cylinder at the end of each fortnight along its axis, so as to serve as long as may be required, without changing the paper.

Motion is given to the cylinder by connecting it with the wheels of the clock.

*January* 22. 1844.

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## *Report by a Committee of the Royal Scottish Society of Arts on a Self-Registering Tide-Gauge, by John Wood, Esq., of Port Glasgow.*

The Committee having carefully examined this gauge, are of opinion that it is a simple and very ingenious invention, and well deserving of the favourable attention of the Society. It exhibits distinctly the rise and fall of the tides every day, by means of a pencil traversing backwards and forwards on a sheet of paper, and tracing out a straight line corresponding in length to the height of the tide; and the paper being wrapped round a cylinder, which advances a step forward in rotation each tide, a series of tides are thus represented by parallel lines, in a manner so as to shew very strikingly, and by regular curves, the different variations of the tide from day to day, and from month to month; and all these curious results are obtained by the single motion of a wheel and axle, with chains or cords, which communicate the motion in a simple manner, from the axle of the wheel to the traversing pencil continuously, and to the cylinder containing the paper at the interval of each tide. From the testimony of Mr Scott Russell, by whom the description of the gauge has been drawn up, it appears that the machine is capable of thus registering the height of high and low water for four months together, without requiring any attention whatever; and at the end of that time it is only necessary to supply a new sheet of paper, and repair the pencils, to enable it to go on for four months longer. We have no doubt, from the specimen of work accompanying the gauge, that this machine is capable of acting with great regularity and precision; and though not perhaps adapted to the minuter accuracy required by many local investigations in navigable rivers, yet from its portability and economy, and facility of erection in different places, we are satisfied it is calculated, with little expense or attention, on the part of the observers, to lead to results of the most valuable description, in elucidating the theory and phenomena of the tides.

GEO. BUCHANAN, *Convener.*
ALEXANDER BRYSON.
WILLIAM GALBRAITH.

EDINBURGH, 10*th June* 1844.

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## *Researches on the Situation of Zones without Rain, and of Deserts.* By M. J. FOURNET, Professor in the Faculty of Sciences of Lyons.

(Concluded from vol. xxxvii., p. 375.)

From the straits of Magellan to the isthmus of Panama, the oceanic coast runs very nearly from south to north, and forms a low plain, which, in general, presents slightly articulated mountainous undulations only at the approach of the chain of the Andes. It is especially between Arequipa and Truxillo that this plain is narrowest, and hence results, probably, the great humidity observable around Lima, compared with the country situated a little to the north or to the south of that place, a humidity whose characters we shall afterwards explain. At present let us see in what manner the principal facts exhibited by this region are connected.

Valparaiso (lat. 33° 7′ south) is situated in the sub-tropical zone of winter rains of the southern hemisphere (May to September). These rains become more and more rare towards Cobija, in the tropic of Capricorn, where they begin to be entirely awanting; a state of matters which continues, more or less, as far as Guayaquil, in 2° of south lat.: there they are abundant during the months of winter, and cease in the middle of May; so that that place is situated in the zone of inter-tropical rains of the southern hemisphere; but, leaving the Gulf of Guayaquil, in the forests of Choco and Esmeraldas, the arrangement rapidly changes, so that to the droughts of Tumbez and of Payta succeed a constant humidity and daily rains.

Lastly, from 5° north to California, rains and fine weather, the seasons of suns and of clouds, again succeed each other very regularly, but in a manner the reverse of Guayaquil; so that the zone of hemi-annual rains so violently stifled in the southern hemisphere, between those of droughts and of perpetual rains, again acquires all its preponderance.

The distribution of the vegetation is, moreover, in perfect harmony with this succession of zones. Thus, around Conception, there are great forests; to this vigorous vegetation, succeeds, near Valparaiso, gloomy brushwood and spare pasture, excepting on the flanks of the mountains towards Santiago, which are, from time to time, carpeted with verdure; every thing indicates a languishing soil, owing to the want of humidity. At Coquimbo the evil increases; the brushwood disappears, and only a few herbs are visible. From this point as far as Guayaquil, over more than an extent of 1600 miles, several vast solitudes are met with without verdure, whose moving sands, scarcely covering the subjacent rock, present a frightful aridity. Thus, from Coquimbo to Copiapo, over a space of a hundred leagues, there are neither towns nor villages, and only a few farm houses. We then come to the *desiertos* of Atacama, where the mules frequently perish from want of grass and of water; thence, beyond Lima, and to the north of Truxillo, occur the *desiertos* of Picera and of Sechura. These plains, however, are here and there intersected by rivers coming from the Cordilleras; some of them are only intermitting, whether from morning to evening, or from one season to another: they fertilize their valleys, and, in some measure, produce oases, among the number of which are those of Arica, of Coquimbo, of Quillota, famous for the quantity of corn they yearly produce; and, lastly, that of Lambaryeque, where there are extensive forests. In the neighbouring districts, where the water cannot be conveniently conducted for the irrigation of the soil, as, for example, around Pisco, the vine is cultivated by planting the stocks in holes, having a depth of four or five feet, because there is there sufficient humidity for their growth. But these facts, derived from remote causes, do not, in any degree, invalidate the generality of the distribution of deserts on the Peruvian coasts; these only cease with a return of the rains towards the impassable forests of Choco, to which succeeds the inter-tropical richness of the isthmus of Panama, and of the coast of Mexico, succeeded, in its turn, by beautiful cacti, and other fine plants of the rocks of California; after which, near the mouth of the Rio-Colorado, there occurs a European flora, developed under the influence of a temperature comparable to that of Valencia and of Italy.

The sub-tropical rainless zone presents, on the Peruvian coast, an immense development in length, as it comprehends about 20° of latitude—an anomaly which, according to Dampier, also extends into the sea for a distance of two or three hundred leagues. This exceptional phenomenon seems to depend on various causes. In the *first* place, this coast is subjected to the almost permanent influence of the south-west and south (Peruvian mistral) winds, which being essentially cold, because they come from the South Pole, are not capable of carrying with them a large proportion of watery vapour from the sea which they traverse; and, moreover, they pass from an icy temperature into warmer and warmer zones, so that they cannot precipitate their humidity.

In the *second* place, this coast is washed by a marine current, which, proceeding from the South Pole towards the equator, brings with it a large quantity of cold water, and is, consequently, incapable of producing an abundant evaporation. This fact is likewise demonstrated by the observations of M. Duperrey, who found that at the port of Lima the temperatures of the sea are lower than those of the land, contrary to what takes place in 12° of south latitude, where there is generally little difference between them.

The immediate neighbourhood of the Andes must also produce during the day ascending breezes, whose action corresponding to that of the ordinary south-west winds, rapidly collects vapours from their summits, thus producing the variable climates of Cusco, of Puno, and of La Paz.

*Lastly*, The clouds driven to the opposite side by the south-east trade-wind, or by the north-east wind which most frequently prevails there, discharge themselves on the Cordilleras, so that they can no longer cause rain to descend on the plains of Peru, whereas the heights are exposed almost every day to alternations of serene and cloudy weather, and to frequent storms.

These causes will doubtless appear sufficient to explain the extension of absolute droughts; but it presents in the details a peculiarity worthy of attention. Although it may be said in a general manner that it never rains at Lima, or at least that there are never rains of large drops, we must, nevertheless, remark, that, during a great portion of the year, the serene atmosphere loses its transparency, becomes troubled, and is covered by a singular vapour, known to the inhabitants under the name of *garrua, garroua, or garruva,* denominations which are also applicable to mild rains of short duration, as well as to the very small rains which occur in 33° N., between California and the Galapagos Islands. Whatever may be the different acceptations of this term, the vapours of the garrua of Lima are so thick, that the sun seen through them with the naked eye assumes the appearance of the moon's disc. They commence in the morning, and extend over the plains in the form of refreshing fogs, which disappear soon after mid-day, and are followed by heavy dews which are precipitated during the night. At other times, and especially during the winter season, they rise like clouds to the height of the mountains of the coast, which they moisten sufficiently to allow of vegetation in places not much exposed to the heat of the sun; lastly, they become converted into more or less violent rains on the flanks of the Cordilleras, at a distance of fifteen or twenty leagues inland, where it becomes possible to obtain harvests. These rains prevail there from December till May, that is to say, during the epoch of the sun's passing the zenith of that hemisphere, so that they coincide with those which present themselves generally between the tropic of Capricorn and the equator, and the phenomena have their normal arrangement, which is the reverse of the seasons of Valparaiso and of Cobija.

This local effect of the garrua of Lima may be explained, as we have already stated, by the greater proximity of the Cordilleras, which there produce a remarkable freshness, especially when compared to the intense heat felt in the bay of All Saints, situated nearly in the same latitude, but at a distance from the high mountains of the Atlantic coasts of Brazil. This freshness, considered in a more general manner, seems, moreover, to be one of the causes of the removal of the zone of droughts towards the equator, so that it acquires an essentially inter-tropical development, contrary to what takes place in Africa and in Old California. By generalizing still farther this indication, we may even say, that in all this aqueous hemisphere, which is colder than the other, the whole of the trade-winds, of the isothermal lines, and of the pluvial zones, tend to approach the North Pole, in such a manner, that the axis of the nearly perpetual rains is not exactly at the equator, but encroaches slightly to the north.

If we penetrate from the coast into the interior of the continent, we cannot expect to find deserts on a surface so greatly varied, nor on the flank of the Andes; but it may nevertheless be of some interest to investigate the distribution of rains over a portion of that region; and in doing this, we shall take advantage of the results obtained by Bouguer and Sobreviala, combined with those for which we have to thank the kindness of MM. D'Orbigny and Auguste de Saint Hilaire.

The clouds collected together by the north-east winds remain, so to speak, stationary on a portion of the eastern flanks of the Andes, at an altitude of nearly 10,000 feet, where they circumscribe the zone of ligneous vegetation; but during the heaviest rains of the rainy season, they become more elevated, and attain a height of 13,000 feet, and give rise to rains, which are distributed in the following manner:—

From Quito (lat. 0° 25′ S.) to Huanuco and Xeuxa (lat. 10′ to 12′ S.), the rains which, towards the equator, are prolonged more or less during five or six months, from November to May, become gradually rarer, so that, at the latter points, the air is dry during the months of December, January, and February; the climate likewise becomes agreeable, but it is accompanied by a want of pastures in the mountains.

To this region rapidly succeed the great elevations and the variable climate of Cusco and of Arequipa (lat. 13° to 16° S.), where rains and storms are of daily occurrence. Towards Chuquisaca and Cochabamba (about latitude 19°), at a height of nearly 10,000 feet, Mr Pentland was exposed to constant rains during his excursions, from the month of January to the 1st of April. Lastly, in the central portion of Chili (lat. 33° S.), the air again becomes very dry, and the sky is constantly free from clouds during our winter; that region, like Valparaiso and Sant-Yago, being situated in the zone of summer rains from May to September, a period of the year which in that hemisphere corresponds to winter.

Descending from these great heights to the lower regions of the eastern base of the Andes, we find (between lat 0° and 13° S.) rains which last during the whole year, so that this band ought to be regarded as forming a lateral appendage to the perpetual rains of the virgin forests of Rio Negro and of the Amazon; hence it results, that from one side to the other, and between the tropic and the equator, we have, according to the parallels and the heights, stations at which it never rains (environs of Lima); others where the rains continue about three months; and, lastly, where they are of daily occurrence.

In this central portion of the continent, the vast regions of La Plata, Buenos Ayres, of Uruguay, and of Paraguay, are everywhere subject to falls of water, which are variable in their duration, in the epoch of their occurrence, and in their abundance. Thus, commencing from Patagonia, and on the Pampas (lat. 35° S.), they take place regularly, but are not abundant, and they only occur during the months of June, July, and August, which there constitute the winter. In Corrientes, and especially at Assumption, in Paraguay (lat. 30° to 25° S.), they are more or less abundant at all seasons. Lastly, in the warm region, commencing from 20° S. as far as the line of Moxos and Chiquitos (Brazil), it rains during the six months comprised between October and March. This regularity subsists on the plateau of Brazil, in the districts of St Paul, of Minas Geraes, and of Goyaz, where the rains commence between the middle of September and the middle of October, and last five months. At Vallarica they are very heavy in January and February, and they vary according to the height; on the banks of the San Francisco they cease in January. The vegetation follows the progress of these udometric and thermometric variations. The soil of Patagonia is extremely arid, and is covered with *landes* analogous to those of Gascony; towards the north, in the Pampas, there are meadows; still further to the north there are thick forests; and, lastly, the rich intertropical vegetation is met with. According to M. d'Orbigny, a portion of these results is to be attributed to the preponderance of the winds, which on that side of the Andes have a north and north-east direction, the reverse of their direction on the oceanic coast. We have still to examine the cause of this opposite parallelism of the atmospheric currents of the two slopes of the Andes.

On the Atlantic coast the distribution of rains is still more anomalous, as may be seen by the following details, derived from the observations of Dampier, Frezier, Piron, Vignal, Martius, Jacquemont, Saint Hilaire, and D'Orbigny.

At Buenos Ayres and Montevideo (lat. 33° S.), the atmospherical variations are considerable; the same is the case at Rio Janeiro (lat 23° S.), where there are no fixed epochs for the rains, although the most violent fall from October to March, whereas they are inconsiderable in June, July, and August. It results from this statement that the latter place may be included in the intertropical climate of the southern hemisphere; regarding it, however, as complicated by an accidental circumstance which occurs as far as Olinda (lat. 8° S.). At Bahia (All Saints, lat. 13° S.) the rains fall from March or April to September, becoming torrential in the middle of summer, contrary to what should take place in the intertropical region of that hemisphere. It is to be remarked, moreover, that the ordinary south-east winds only prevail on the east coasts during the rainy seasons, between March and September, after which they are replaced during the droughts by north-east winds, thus giving rise to a sort of monsoon. There is nothing less constant than the periodical return of the land and sea breezes; the sea breezes often prevail at

Rio Janeiro for several days in succession, and are followed by perfect calms; the land breezes only blow in steady, fine weather, and the smallest atmospheric disturbances are sufficient to put an end to them; lastly, a vast number of local winds occur during the day, often in very violent gusts, at the mouth of all the creeks, and near all the projecting capes of the bay. Now, it is to be observed, that the sierra of Espinhaco commands all that part of the coast; its vicinity, therefore, individualises in some measure its meteorology, and it is thus that this local exception, by which the first navigators were so much struck, is explained, if not altogether removed. But between Cape Blanco and Cape de Norte, at the extremity of the Cordillera of the Guyanas, is situated the opening of the basin of the Amazon, opposite to which the general laws follow their course; that is to say, the rains prevail in winter from October till April, conformably to what takes place in the whole of the intertropical region of the southern hemisphere, and these are followed by the equatorial rains of Guyana, at seasons more distinctly marked than they are at Choco and on the banks of the Rio Negro; four annual epochs being distinguished, two of droughts, and two of rains.

The numerous details into which we have entered, indicating for this eastern portion of the South American continent encroachments analogous to those which have been pointed out in the North American continent, render the existence of deserts, properly so called, altogether impossible. If deserts were formed according to the same laws which regulate those of Africa, or of the western coasts of the New World, we ought to find traces of them in the latitudes of Paraguay; but rains are abundant there. It is necessary to ascend the ridge of the Andes between 15° and 5° S. lat., in the parallels of Pisco and of Payta, to find the less considerable rains of Huanuco, and of Xeuxa; then we have, at the line of separation of the waters of the Amazon and of the Paraguay, the famous *Campos Pariecys*, a vast sandy plateau, almost devoid of vegetation, and which may be compared to the Chamo or Gobi of Mongolia; lastly, still further to the east, the basins of San Francisco, the provinces of Goyaz, of Pernambuco, and of Bahiaqui, exhibit here and there in their *Sertuos*, hills of moving sand mixed with cultivation, and this whole series indicates not a state of absolute aridity, but simply the facility with which the savannahs may assume the physiognomy of deserts.

To recapitulate; the New World may be regarded as divided by the Andes into two systems, characterised by their configuration, as well as by their meteorology. The western portion is very narrow, but of a simple structure; whereas the other is broad, deeply articulated, and irregularly elevated; the first presents all the great phenomena which may be considered as the immediate results of the solar influence on the second: they tend to become effaced in the series of partial causes, and especially in the effects of the superposition of periodical rains. The most important consequence of this irregularity is the annihilation of absolute deserts, and it is thus that an extreme uniformity of surface, which, at the first glance, would seem to be an element of prosperity, from the facility it affords for communication, becomes, on the contrary, one of the most formidable obstacles which nature interposes to civilization.

By shewing that an absolute want of rain is necessary to constitute the absolute aridity of a desert,—that the latter is nothing else but the reflection of a dry atmosphere,—we have only answered one part of the question. We see, indeed, that the cause of which we are in search is essentially to be sought for in the atmosphere; but we have not explained why it does not rain between the two intertropical and subtropical zones; we must, therefore, enter into some details on this subject.

The intertropical rains commence at each place at the time the sun reaches its greatest altitude, because then, under the influence of ascending columns of air, the breezes of the trade-winds become uncertain; and for them there are substituted calms interrupted by the winds which blow from the heteronymous pole. There is thus produced, at that time, an unequal distribution of heat, the result of which is the condensation of the aqueous vapour dissolved in the air.

The hiemal rains take place, on the other hand, in the corresponding zone whenever, in consequence of the increased distance of the sun, the atmospheric refrigeration arrives at a certain point.

This being the case, we can easily understand that between these two inverse regions, and at places to which the sun approaches most nearly, that is to say, towards the tropic, there may be a persistence of heat sufficient to maintain in solution the vapours transported by the influence of the trade-winds, so that there will be an absence of rains, and a simultaneous production of deserts, at least, if orographical causes do not produce local coolings, or if special winds, by their alternate play, do not give rise to disturbances in the normal arrangement. Examples in support of this are sufficiently numerous; and if we endeavour to apply to Asia data resulting from the phenomena of Africa and America, we shall immediately find that that continent cannot contain deserts, properly so called, or, at all events, absolute deserts, such as the Sahara.

A meridian passing along the eastern coast of Africa, in some measure divides the globe into two hemispheres: the one, the western, in which the trade-winds prevail, and the other, the eastern or Asiatic, forming the domain of the monsoons; but these latter, from what has been said of the coast of Brazil, do not appear to be capable of producing permanent droughts, for such can only be the result of the uniformity of the trade-winds.

As, however, a series of deserts is generally indicated in that part of the world, it is of consequence to define them properly, in order that they may be reduced to their just value.

The distribution of these deserts may be considered in two points of view. According to the one, they would commence opposite the Sahara, and would be prolonged in a straight line towards the east, following the tropic of Cancer, over a part of Arabia, of Syria, of Persia, and of India, where they would be interrupted by the edges of the plateau of the Deccan. Over this extent of country, in which they are almost contiguous to one another, they would only be interrupted for a short space by the Red Sea, by the Persian Gulf, or by the mountains of Kurdistan and of Persian India, and their total length, from the Atlantic to India, would be about 2100 leagues; that is to say, about a fourth of the terrestrial circumference under the tropic.

According to the other method of viewing the facts, their axis from Arabia, as far as Chinese Mongolia, where there is the Schamoon-Gobi, would be parallel to the coast of the Indo-Chinese seas, and would run from north-west to south-east, like the axis of the great soulevement of Central Asia. In this case, we must add to the length already given, the five hundred leagues attributed to the Gobi; lat. 47° N. would be reached, and the deserts would penetrate considerably into the temperate zone, which, in that part of Asia, is subject to much more violent climates than Europe,—a circumstance essential to be remarked in the discussion of the facts presented to us by these different places.

In the whole of Syria and Arabia, the deserts comprised between Aleppo, Bassora, Rostak, Mecca, and Damascus, appear, at the first glance, to expand from the heights of Yemen, of Hadramaout, and of Mahra, or from the 16th to the 36th degree N., and the dryness of that surface is well known; but we can divide it into two portions, the one northern and the other southern, separated by the Nedsjed, a varied oasis covered with pastures, watered by springs, and inhabited by numerous tribes, to which succeed, on the one hand, the country of Bahrein, rich in dates and wine, and on the other, the district of Lahsa (*l'Alisa*), watered by a river which falls into the Persian Gulf, and which is only a torrent liable to be dried up during the summer.

The northern portion, known under the name of Barria, or of Bar-Abad, and which may be designated by the collective name of the Syro-Arabian desert, receives, especially towards the northern limit, more or less abundant rains in winter, during the months of December and January. These rains cause the existence of a particular Flora, and various tribes occupy the savannahs, which are surrounded by naked and arid tracts. It would be incorrect, therefore, to consider this as a desert, or *mer-sans-eau*, properly so called, although it sometimes happens that an entire year passes without rain, even in the Nedsjed, where famines are thus produced. It results from this, that absolute dryness is hardly to be found, except towards the southern extremity of the Arabian peninsula, comprised between the 14th and 23d degrees N.

The latter is commanded, towards the coast of the Gulf of Aden and the Sea of Oman, by the mountains of Hadramaout, whose heights do not exceed from 5000 to 5700 feet, and from which are derived, on the one hand, the branch of Yemen, running along the Red Sea, and on the other, the branch which, starting from Mahra, turns abruptly towards the entrance of the Persian Gulf, and follows, on the coast of Batna, a south-east and north-west direction, between Ras-al-Had and Ras-Muskadom (lat. 22° 23′ to 26° 25′ N.). This chain has still, according to the measurements of Lieutenant Wellsted, a height of 3000 or 3500 feet, and all these elevations are such as must necessarily give rise to the formation of rains. The mountains of Hadramaout are also well watered; and between the latter and those of Yemen, the plains of Beled-el-Djol, which are sometimes fertile and sometimes arid, present streams which preserve their water during the whole year, in consequence of the rains of the neighbouring mountains. The Nedsjeran receives heavy rains, which fall without interruption during the months of December, January, and February, while the heights of Yemen, some of whose summits receive snow every year, are, on the contrary, fertilized by regular rains corresponding to the summer monsoon, and which commence about the middle of June and end in September; this season is called *Mattar-el-Kharif*. There is also another, which continues from the month of February till April, and which receives the name of *Mattar-el-Seïf;* the more distinctly it is characterised, the more abundant is the harvest. These rains do not, however, present that continuity which exists between the tropics, for the sky is rarely clouded during twenty-four hours in succession, and the remainder of the year passes without the smallest cloud being visible for months together.

At the foot of these rainy heights, there is met with, on the narrow band of coast of the Red Sea, the sandy Tehama, which contains so little fertile soil; and where the rains are so little abundant, that the inhabitants, with the exception of those who devote themselves to commerce, are all poor; and this region extends over the south-western portion of the peninsula, as far as the dry, treeless, stony plains of the environs of Aden. It must not, however, be concluded that there is an absolute absence of rain, for the two seasons of Kharif and Seïf are distinctly marked at Hez; we know, moreover, that at Mocha the south-west winds, which prevail from April to August, bring with them some rains during the squalls and gusts. Their rarity in this region seems to be caused by the attraction of the clouds to the neighbouring mountains; for on the Tehama there are whole days during which the sky is constantly serene, while it is raining without intermission on the heights.

The phenomena in question are reproduced, but in an inverse order, on the eastern coast of Arabia, where rains prevail on the fertile mountains of Oman during the winter monsoon. As in the Nedsjeran, and, probably, as in the whole interior of the peninsula, this season, which lasts from the commencement of November to the middle of February, has received the name of *Schitt*, and the rains are then sufficiently abundant to produce impetuous torrents; while, at the foot of the mountains, at Mascat as in the Tehama, there are hardly seven or eight falls of rain in the course of the year.

It must be evident, therefore, that true deserts are to be sought for neither on the eastern nor the western side of Arabia; and the same may be said of the southern coast, where rains fall in the months of February, March, and April, during one of the derangements caused by the monsoons, periods which are always critical, owing to the tempests to which they give rise. Where, then, shall we seek for the deserts? On the vast coast plateau of Mahra? but nomadic tribes traverse it in all directions; steppes are, therefore, distinctly characterized: there thus only remains for us the central portion of southern Arabia, forming what is termed the Great Desert of Ahkof, and comprised between Nedsjed, Yemen, and Oman; but this is a *terra incognita*, in regard to which we possess no other information but the emphatic recitals of the Arabs, to whom the words plains and deserts are nearly synonymous, and according to whom, this plateau was formerly a terrestrial paradise, inhabited by impious giants named Aadites, who were exterminated by a deluge of sand; but this mythological tradition, or a similar one, is to be met with in all the sandy portions of Asia, where, nevertheless, there are characteristic rains; so that it is of no value in the question.

Before quitting this region, it is proper to observe, that the inverse pluvial arrangement of the two coasts of Arabia exists also in India, round the chain of the Ghauts. There we find alternately the coast of Malabar, like the western coast of the Yemen, watered, during the prevalence of the south-west and south-east winds; while the coast of Coromandel, like that of Oman, is subject to the rains of the north-east winds of winter; and if we wish to generalize still further, we find on the western coast of the Red Sea the island of Dahalac, and the chain of the Mokattam, inundated by the winter rains, although the monsoons there deviate slightly from north-west to south-east, in consequence of the position of that basin.

Persia, which is essentially continental, presents to us a structure and a geographical position, quite different from those of the Arabian peninsula; its south-eastern portion, which alone we have to consider, touches to the south the Indian Sea, while to the west, the Persian Gulf slightly encroaches on it. It constitutes a plateau, having a height of 2200 feet towards its centre, around Yezde and the lake of Zareh; but commanded, at its circumference, to the north by the prolongation of the Elbrouz and of the Paropamisus, whose known altitudes are at least 2600 feet; to the west, by the region of Teheran, of Ispahan, and of Schiraz, rising to a height of from 3800 to 4400 feet; to the south, by the littoral and imposing terrace of Beloochistan; and, lastly, to the east, by the considerable heights of Affghanistan, which, near Candahar, Kwettah, and Khelat, attain successively the heights of 3400, 5500, and 5700 feet. Lastly, we must notice its being placed entirely to the north of the tropic, which, of itself, would be sufficient to make us presume with certainty that deserts without water must be excluded from it.

Nevertheless, five principal deserts have been enumerated by authors, of which the one separating Khorassan from the Irac-Adjemi, termed the Great Salt Desert, or Kuwir, is, of itself, said to be upwards of 300 miles in length, and 170 miles in breadth; their whole amount, forming $\frac{3}{10}$ of the superficies of the country, is comprised between 25° and 36° N., from Beloochistan as far as the chain of Elbrouz; the latter, which separates the plateau of Iran from the vast hollow of Touran, does not constitute an absolute limit towards the north, for moving sands displace rivers between the Caspian Sea and the Lake of Aral. But, without occupying ourselves with this sort of appendage of the steppes of Kirghise or of Ischim, let us confine our investigations to the southern portion of the region.

On the plateau of Iran, there are, first of all, the deserts of Khorassan and of Naubendam, above which, it may be said, that during the summer no cloud is to be seen; the dews are so slight, that paper is not moistened during the night, and polished iron is not at all rusted. Vast plains, in the midst of which is included the oasis of Yezd (*i. e.* light), the last refuge of the worshippers of fire, present only a dry surface, covered with a crust of salt, which cracks under the feet, and nourishes saline plants. But whatever may be the dryness of that region, there is no absence of rain; for at Ispahan (lat. 32° 40′ N.), where the winter commences in November and continues until March, there are falls of rain so abundant, that the earth is penetrated by it to a depth of more than a yard; and there are, moreover, four or five pretty considerable falls of snow. The most violent rains occur in March and April; they are accompanied by hail; and, at that epoch, strong winds announce the return of the droughts.

In the same latitude, the mountains of Khorassan are covered with a thick coating of snow during the winter, while rain inundates the subjacent plains; so that the whole of this zone presents the same conditions as the Syro-Arabian desert, of which it forms the prolongation towards the east; but it, at the same time, exhibits a greater intensity of cold.

We have next the desert of Kerman, situated to the SE. of

Yezd, and likewise covered with salt and sand, in the centre of which is placed the oasis of Khubis, a real garden of fruit trees; besides, the whole of Kerman is rich in all sorts of vegetable productions, which flourish wherever irrigations can be established.

In Farsistan, which is in the immediate neighbourhood of the Persian Gulf, the herbage is renewed between January and May, after the rains, and the agreeable and fertile plain of Schiraz (Lat. 29° 52′), is subjected to the same conditions. The mountains which surround it are also frequently enveloped in clouds; and the melting of the snow, which takes place in spring, gives rise occasionally to disastrous floods.

Further to the south, between 26° and 27° N., in Laristan, on the shores of the Persian Gulf, the heats become greater; and it is there that the maritime strip of land is met with, whose high temperature has caused it to receive the name of *Kermasir*. Bender-Abassi and the island of Ormus are both notorious for their intolerable climate, their malaria, their saline soil, and the deficiency of trees and plants; but it is there that the town of Laar is placed, in a plain surrounded by a belt of hills; and whose soil, although sandy, is covered with palms and orange trees. It is provided with cisterns and reservoirs, in which a drinkable water is collected, after the winter rains have sufficiently removed the salt from the soil. It is there also, between Schiraz and Laar, that the plain of Dadiran is situated, which, traversed by a river abounding in fish, and possessing a more moderate temperature, serves as a refuge for Europeans, exhausted by the local heats of Ormus. There is thus, in the whole of this region, rather an excess of heat than an absolute want of rain; although it sometimes happens that there is no rain at certain points during two or three consecutive years, a circumstance which takes place more especially in Bender-Abassi.

Positive data regarding the rainy reason are awanting as to a portion of Kohistan, and of the varied interior of Beloochistan; nevertheless, if, on the one hand, we know that Pottinger, during a journey of five days, between Sarawan and Kullugan, did not find anything else but hills and downs of moving sand, destitute of vegetation, it must, on the other hand, be added, that Toun, one of the towns of that region, is situated in a district rich in corn; and that, in the parts of Beloochistan where water is not awanting, the soil produces fine forests, various grains, dates, almonds, sugar, cotton, and indigo, a variety of cultivation which necessarily infers falls of rain. We know, moreover, that rivers of the second order are lost in the sands, or are dried up during the summer, of which the heats are excessive at certain points; so that we must necessarily admit the existence of hiemal rains. Regarding the north and the east of Beloochistan, more precise data establish the fact, that the seasons are regulated nearly as in Europe, with the exception of the summers being warmer and the winters less rigorous; although it must be remarked, that snow falls at Khelat, near Sarassan. The territory of Candahar is the most fertile possible. Lastly, on the maritime shore, the monsoons give rise to a rainy season, whose result is the termination of the heats which commence in March and last till October. There is, therefore, no surface of any extent in the whole region, which can be compared to the African Sahara.

The chains of Salomon and of Brahu (Brahnick) separate Beloochistan and Affghanistan from the low country of the Indus, which flanks their eastern side. There Scinde is situated, the resemblance of which to Egypt has struck more than one traveller. Its level plain, watered by a fine river which fertilizes its banks, is bounded to the right by a mass of steril mountains, which are rendered inhospitable by their soil and their climate; to the left, an immense desert of upwards of 600 miles in length, extends from Attock to the district of Cutch, situated on the gulf of the same name, and it sends off branches to the western regions. It is thus, that the opening which separates the mountains of Salomon and Brahu, Candahar and Scinde, is occupied by a naked plain, whose sterility is sufficiently indicated by its name of Detschi-bi-doulet or *desert of poverty, plateau without prosperity.* But although these countries are covered with hills of sand, although they recall all the horrors of the Arabian deserts, and although they even checked the audacity of Alexander, it does not follow that they are absolutely devoid of rain and all vegetation. Thus, the savannahs are pretty numerous in the northern districts, and marshes and jungles fringe the banks of the river. On the road from Ruderpour to Almorah, prickly reeds and resinous trees are met with; in Scinde there are springs and melons: the inhabitants of Beykanir, to the south of Djeypour, have everywhere cisterns to supply the deficiency occasioned by the aridity of their soil; lastly, to the east, Delhi, Agra, and the mountainous country of Khotak, are distinguished in a more positive manner by their periodical rains, commencing with storms at the end of May, especially abundant in July and August, and then becoming less abundant in September; and it is to be remarked, that these regions, situated in the same latitudes, are moreover extratropical, extending from 23° to 34° N., being in this respect similar to Affghanistan, Beloochistan, and Persia. As to the remainder of intertropical India, interposed as it is between seas and alpine mountains, it cannot, of course, present any thing else but a climate composed of alternations of droughts and violent rains; thus fogs, heavy falls of rain, and violent showers of large hailstones are more dreadful in that country than anywhere else.

There now remains no other great desert in Asia but the Sehama, which, situated between 30° and 47° N., does not necessarily come under our consideration. However, as it is generally included along with the tracts already mentioned, we think it right to enter into some details on the subject.

Its height in the eastern portion, between Zakil-Dak and Olon Bainchen, hardly exceeds 3650 feet, according to the measurement of Bunge, and its mean altitude is not more than 2500 feet; while to the west of the lake of Lob, its height is scarcely 1200 feet. But this plain is traversed from east to west by the two great systems of mountains of Kouenloun and Thian-Chan, which tend to modify its temperature; it is divided, moreover, into two halves, an eastern and a western, by a less barren narrow tract of country. The following is the manner in which the climates, the soils, and the vegetations vary, from east to west, over a great portion of this enormous surface:—The kingdom of Kachgar, on the eastern side of the chain of Bolor, contains much sand, and but little land suitable for cultivation; but the latter produces hemp, grapes, corn, and rice. The climate is temperate, and winds and rains occur regularly, although the latter are so little abundant as to be sometimes entirely awanting, and it becomes necessary to have recourse to irrigations for agricultural purposes. The same is the case between Yar-Kand, Khotan, and the lake of Lob, nearly in the same latitude as Lisbon: snow is rare, and the sandy portions only present here and there a herbaceous vegetation, in the midst of which are to be seen some stunted thickets, some wild apricot trees, and false acacias. Lastly, towards the eastern extremity, near Erghi, the plain is covered with reeds and plants identical with those growing on the shores of the Caspian sea. It must be added, that, in the centre of the Gobi, a series of lakes is met with, in which rivers of considerable size lose themselves; and that the sands which occur in this tract of country are considered by the Mongols as the remains of an inland sea, although its importance must not be exaggerated, inasmuch as a portion of the surface is rocky. Among the lakes alluded to, the most important are: to the north, those of Baba-Kul, Bastu-Noor, Barkul, and Turgut; to the west, those of Lop-Noor, Gash-Noor, and Chas-So; and to the east, those of Tabsun-Noor, Siao-Serteng, and Kharra: still further to the east the country becomes essentially sandy, contains no river, and approaches the Sahara in character. On the northern side of the chain of Thian-Chan, between Ourocontsi and Illi, there are rains, and near Ouromtsi, the snow which falls during the winter covers the surface to a depth of ten feet, and is of course still more abundant in the chain itself.

A Chinese work, obtained by Humboldt, states, that around Tourfan (lat. 43° 30′, the same as that of Montpellier and Narbonne), "the heat is excessive in summer. A parasol of fire covers the vault of heaven, and burning winds traverse the circumference of the country. On the sandy mountain, which extends to the south-east like a girdle, neither plants nor trees are to be seen; in winter, there are neither extreme colds nor great falls of snow: the fertile and well watered soil produces wheat, lint, sweet melons, water melons, and grapes; but to the south, nothing is to be seen but *gobi*, or plains of sand, on which asses and wild horses are found in herds of tens and hundreds."

This great concavity, however, may in fact be compared less to an absolute desert than to a steppe, differing, in respect of its southern position, from the Russian and Siberian steppes: storms occur on its borders in June and July, and snow falls in winter; sometimes even the vegetation of the middle sandy portion, after being destroyed by the prolonged suspension of rains, is developed with vigour when they again abound; so that in all this we can only see the tendency which the savannahs of all parts of the world have to pass into the state of deserts.

Opposite Asia we find only one great island, New Holland, placed in the same parallels as Arabia and Hindostan; but its interior being as yet unknown, the absence of rivers, and the dryness of the winds over the whole extent of its coasts, are the only probabilities which can be offered in support of the absence of great masses of water in the central portions. For the rest, the climate is variable.

The following are the chief results which may be deduced from the consideration of this subject, viz.:—

1*st*, That we must distinguish, in reference to tropical rains, two great atmospheric divisions; the one subjected to the trade-winds, and the other to the monsoons.

2*d*, That the latter does not admit of absolute deserts, because the alternate play of the monsoons always gives rise to rains.

3*d*, That, nevertheless, the effects of tropical heat, favoured by some accessory causes, such as certain breezes, a naturally poor soil, and the absence of springs and of rivers, may there produce small local deserts, or at least a great general aridity (Tehama, Ormus, Beloochistan, Scinde, and Gobi).

4*th*, That in the division subject to the trade-winds, the low lands of uniform structure, and situated between the zones of the intertropical rains and of the subtropical rains, do not receive any rain, and are, consequently, characterized by an absolute dryness (Sahara, Agoa, Lower California, and the Peruvian coast).

5*th*, That a great elevation of the surface, in the form of a plateau, may produce the approximation of the two regions of estival and hiemal rains in such a manner that they manifest themselves consecutively in one and the same country (the northern portion of the Mexican plateau).

6*th*, *Lastly*, that a great irregularity of the surface may completely disturb the normal arrangement, by causing rains out of the usual season, even between the tropics (the coast of Brazil, New Orleans, &c., &c.).

Before concluding this memoir, it may be useful to explain more particularly the meaning of some expressions we have employed, or that are made use of by the inhabitants of countries more or less resembling deserts.

The words *savannahs* and *pampas* are employed, the one in the south of South America, the other in the south of North America, to designate slightly undulating and for the most part grassy plains. They are great prairies ; but the *pampas* correspond more exactly to dry savannahs, and for wet savannahs there is an equivalent term, viz., *Canadas.* The *steppes* of the Russians, the *yaïla* of the Persians, in a like manner, designate flat plains which are dry and at the same time grassy ; and the *llanos* of the north of South America, as well as the *karroo* of southern Africa, only differ from them by being liable to become more completely arid in the seasons of the droughts.

The *gobi* or *cobi* of the Mongols are sandy deserts ; but the term is applied generally, in northern Asia, to all steppes devoid of water, while the name of *Khangaï* is given to the portions which are watered, and are covered with vegetation. The *cha-mo* of the Chinese is, properly speaking, the *sea of sand*, a true *lande* ; but this expression is not applied to the portion beyond Hami, so that the preceding distinctions are sufficient to shew that the words cobi and cha-mo, taken in a collective sense by geographers, ought not to be applied to all the space ordinarily designated in this manner, because its different portions have received different names, according to their characters.

In northern Africa, the terms *Sahel* and *Sahara* are also applied to great flat spaces, whose distinction depends on their constituent elements, which are sandy and moving in the former, and pebbly or stony (as in the plain of the Crau in the south of France), in the latter. Nevertheless, the meaning of these expressions varies: thus the sahel is also a district swept by the wind, or the shore of the sea; and the sahara, a place exposed to the sun: lastly, the sahara is used to designate a desert where nothing grows, or, on the contrary, a desert with pastures. Some epithets are likewise employed to express local peculiarities; thus *sahara-bila-ma,* and *sahara-ul-aski,* mean the *desert without water,* and *the complete desert.* As to more circumscribed spaces, if their nakedness is complete, they receive the name of *ozaoad;* if they present some dry herbs, they are termed *azgar*; and, lastly, if a moderate temperature prevails, they are designated by the name of *haïr.*

A plateau is expressed among the Persians by the name of *pestchi-refi,* and among the Arabians by that of *dacca;* lastly, in northern Africa, mountainous and rugged regions, entirely bare, or with valleys covered by vegetation, receive the name of *harusch;* the *garrigues* of Languedoc sometimes convey an idea of their nature.*

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## *An Account of Electrical Experiments.* By Mr R. Adie, Liverpool. (Communicated by the Author.)

In the following experiments my object is, through them, to give evidence to shew, that the arrangement commonly called the water battery, depends for its action on the formation of a metallic oxide; that this oxide is formed from the oxygen of our atmosphere, and not from decomposed water; that the action of the battery ceases when the atmosphere is shut off from it; and that the electromotive force of the currents derived from the water battery, and from the ordinary acid battery, are nearly the same, although in

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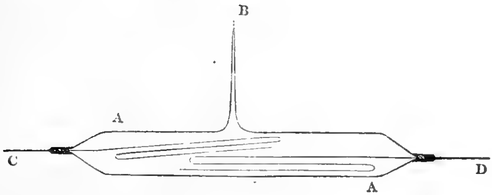
* From the *Annales de Chimie et de Physique* for May and June 1844.

the latter, water is abundantly decomposed, to supply oxygen for the composition of a metallic oxide.

Pure water free from air, or air perfectly dry, are well known not to act on the oxidizable metals zinc and iron at ordinary temperatures. It is also well known that water, as soon as it absorbs a small quantity of air, immediately begins to oxidize them. In order to ascertain if this was the case when these metals were combined with platina, silver, and copper, after the usual manner of galvanic pairs, I prepared various couples and placed them in glass tubes, filled with recently boiled pure water, and hermetically sealed. These remained for weeks without shewing any oxidation. One tube contained 6 zinc and copper couples, and there was no trace of action. A tube was next filled with recently boiled salt and water, and a silver and iron couple; still no change: yet a similar couple placed in distilled water within an hour from the time of its distillation, but which had not been boiled previous to filling like the other tubes, for the first six hours gave distinct evidence of the composition of an oxide. A silver and iron couple was then placed in a tube filled half with water, half with air; for the first week there was an abundant deposit of the hydrated peroxide of iron, then the dusky green protoxide began to form. After three weeks the tube was opened under water, when there appeared to be about one-sixth of the air absorbed. Had any water been decomposed by this couple, the evolved hydrogen would have produced a pressure in the sealed tube. A copper and iron couple was placed in a well-stoppered phial, and the fitness of the phial for the experiment tested, by filling it with pure boiled water to see that there was no action; it was then opened under recently boiled water, and half filled with pure nitrogen; this shewed no change. A similar experiment was performed with oxygen, which immediately commenced the rapid formation of the hydrated peroxide of iron. In all these experiments the oxidation was strictly limited by the supply of oxygen in the tubes, and when great care was taken to exclude it there was no action, not even when the tubes were exposed for several days to a bright sun.

The development of an electrical current, when measured by the deposit from the oxidizable metal, was in the above experiments entirely dependent on the presence of the oxygen of the atmosphere, but I felt desirous of proving this by the measurement of the electrical current itself. A small zinc and platina couple was connected with the galvanometer, and two phials prepared, one containing recently collected rain-water, the other, the same water well boiled, and the air excluded while cooling. On dipping the couple into the unboiled rain-water, the galvanometer indicated three and a half degrees; then performing the same experiment with the boiled water the deflection was only from half a degree to a degree.

The next experiment was to prepare a battery which could be hermetically sealed and opened to the air at pleasure. The annexed figure represents a cell constructed with this view :




AA. A piece of ordinary glass test tube.
B. A long capillary point.
C. A piece of pure silver wire bent in two or three folds before insertion, to give surface, then fused air-tight into the end of the glass tube.
D. A similar piece of iron wire.

When the tube AA is filled with pure water, and sealed at B, there is a slight oxidation shewn through the first twelve hours, caused by the air absorbed in filling; for this form requires two or three heatings before it is filled. A voltameter with sheathed copper poles* and filled with acidulated water, shewed this action when connected with the wires C and D; the bells of hydrogen were seen slowly to rise one by one: after twelve hours no gas could be seen, it continued perfectly inactive for some time. The orifice B was opened, and within twelve hours there was a steady current decomposing water. As I considered this as the test experiment, I wished to have the electrical force in excess, for which a four-cell battery was constructed, each cell exactly like the one above; these were connected as a four pair series, and a small sheathed glass platina pole voltameter attached. When first made I could, with a magnifier, detect the slow formation of beads of gas which rose at intervals of several minutes each. In twelve hours this action disappeared, and the battery remained perfectly inactive for some time; the atmosphere was admitted by the capillary points, and in six hours the voltameter shewed the passage of a current. The effect increased for nearly two days, when there was, considering the size of the plates, a rapid decomposition in the voltameter; the orifices were now closed. By this time the water in the cells had absorbed a quantity of air, which kept the battery in action for six days after the supply from the atmosphere was shut off; but when its oxygen was exhausted the current disappeared, and the battery was again inactive. While experimenting with these cells I constantly experienced

* See *Edinburgh New Philosophical Journal*, vol. xxxv. p. 352.

a feeling of surprise from the close resemblance their action bore to the respiration of the lower classes of animals. In this arrangement of inorganic matter an electrical current is as much dependent on a supply of air for its maintenance, as the lives of plants or animals are. Still, it should be borne in mind that, beyond the simple fact noticed, there is no further evidence of parallelism.

Three pairs of the water battery are sufficient to decompose acidulated water with platina poles, and one pair serves to do so with copper poles. The battery excited by diluted sulphuric acid also requires three pairs to decompose water. Professor Grove has shewn that twenty-six pairs of his composition of water battery are necessary to perform the same decomposition, while three pairs acting only by their oxidation of zinc, are equally effective. Taking these things into consideration, it appears to me, that for the great source of the galvanic current we must look to the composition of a metallic oxide, for which the presence of water is essential, although it is not always decomposed.

On turning over in my mind the action of water on a galvanic couple, and comparing it with the gas battery, I was led to expect that if the most oxidizable metal of the former arrangement be removed, and its place supplied with one of the hydrogen tubes of Professor Grove's battery, that the principle of the action would be unchanged. In lieu of the composition of the oxide of zinc, on the zinc plate, there should be the formation of water on the platina plate; the hydrogen being drawn from that contained in the tube, and the oxygen from the supply absorbed by the water from the atmosphere. A trial proved this view to be correct; the slip of platina in the hydrogen gas was the generating metal to a plate of either copper, silver, or platina, immersed in water holding oxygen in solution. I found the size of the conducting plate to possess much influence over the action; a large plate of silverfoil gave more electricity than a slip of platina corresponding in size to the generating plate. Pieces of copper of large dimensions are too apt to give opposite currents.

When the above experiment shewed that the oxygen tube of the gas battery could be dispensed with, I wished to try its value as a sustaining arrangement. For this purpose it is necessary to cement inside the hydrogen tube a piece of zinc, unconnected with the platina; then as the gas is consumed the acidulated water rises till it comes in contact with the zinc, when a fresh supply of hydrogen is obtained. A tube so prepared placed over a shallow vessel containing a piece of silverfoil for a conducting plate, gave an enduring action; and the electrical current derived from this single pair of composition of water plates, freely decomposed the argent cyanide of potassium. To avoid the sulphate of zinc being dissolved in the fluid in the battery cell, I have used an inverted U tube where the hydrogen is generated in a separate vessel; but the first method answers sufficiently for an experiment. The water can be easily changed without stopping the action, and it is simpler in its parts.

Through Mr Crosse's experiments the sustaining power of the water battery is well known. Those in the present communication shew the necessity of supplying this battery with water containing as much dissolved oxygen as possible. There are many situations in the vicinity of surface streams, or of mill-dams, where the requisite water is at command; and it is only there that the value of the water battery, for telegraphic or metallurgic purposes, can be fairly ascertained.

I have stated above that strong brine did not at all act on iron when the atmosphere was thoroughly excluded. This fact may by many be thought sufficient to prove that the salt and water battery does not differ from the pure water battery in the principle of its action. But as I wished to take as little as possible on trust, I repeated all the chief experiments given, substituting sea water, or brine, in the place of fresh water. It is unnecessary to go into these repetitions, as they all confirm the first results detailed above: and the proof has since been rendered still more satisfactory, by placing a small zinc and silver couple under the receiver of an air-pump, with wires passing through a shell-lac top to connect to the galvanometer. Such a battery, whether excited by distilled water or by sea water, soon loses its action when the air has been well exhausted by the air-pump: to do so requires 36 hours. As soon as the air is readmitted, a slight deflection of the galvanometer is immediately observed, but the rise in action is very slow, so long as the receiver is kept over the vessel holding the water. When the water battery is first subjected to a diminution of pressure, the air rises rapidly through the water, which keeps the latter in a state of continual motion. This, like shaking by mechanical means, very often produces an increase in the action, which, however, is only of a temporary nature; for as the water loses its air, the deflection of the needles of the galvanometer sinks rapidly.

The carbonic acid dissolved in water exposed to the atmosphere, can have little, or perhaps no effect in these experiments; for when water, sparkling with the rapid escape of this gas, is used to excite a zinc and silver couple, the action is not quite equal to the result produced by rain or sea water.

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## *On Fireproof Warehouses.* By William Fairbairn, Esq., Civil-Engineer.

The serious nature of the late fires at Liverpool, Manchester, and other large towns, has induced an inquiry into the causes of these disasters, with a view to avert their progress, and to adopt measures for the better security of property, and the prevention of a calamity so injurious to the public as well as individual interests. In no other description of building have the effects of fire been so severely felt, nor have the provisions necessary for its suppression been so disregarded, as in warehouses used for the stowage of commercial produce in maritime towns.

In the manufacturing districts the same apathy has not prevailed; for, in most places, fireproof buildings have been introduced, and, notwithstanding their complete success, it is surprising that the same system has not been adopted in the construction of warehouses and other buildings appropriated to the reception of merchandise. When we consider the extent and immense value of property contained in these edifices, it can scarcely be conceived that such a state of things should exist; and, more particularly, amongst a body of men the most active and intelligent in Europe. Such, however, is the case; and we have only to enumerate a few examples to shew, that a disregard of consequences, or a culpable ignorance of existing improvements, has pervaded the mercantile community for a number of years. This should not be, as the buildings in which the manufactures of cotton, flax, silk, and wool, are carried on, are, with few exceptions, almost entirely fireproof; and upwards of thirty years have elapsed since iron beams, iron columns, and brick arches, were first introduced in the construction of factories, as a security against fire. These facts ought not to have escaped the observation of the British merchant; and yet, in the face of so many examples, with one single exception,* it is only within the last few months that a noncombustible material has been used in the construction of the immense magazines of Liverpool. In other parts of the empire the same laxity of application exists, but the effort so happily made at the port of Liverpool, will, it is hoped, extend itself to the metropolis and every sea-port in the kingdom. For these objects, and for the guidance of those

* Messrs Jevons constructed a fireproof warehouse on the New Quay ten years ago.

who may feel disposed to adopt measures for saving a large rate of insurance, and for the further protection of their property, I would respectfully submit the following observations for consideration :—

On the subject of fireproof structures we have few examples in the ages of antiquity; and provided we except the monuments of the early Egyptians, and some of the public edifices of the Greeks and Romans, there are but few instances of buildings so erected as to afford any security against the ravages of fire. During the middle ages, some of the Gothic churches and cathedrals were constructed almost entirely of stone;* and, with these exceptions, there appears no evidence of an existing knowledge as to the benefits arising from the use of an entirely fireproof structure. Probably a want of cast-iron, and the consequent ignorance of its use, was an insurmountable barrier to the development of the fireproof system; but, in the present age, these difficulties do not exist, and to neglect the means thus so liberally supplied for the protection of life and property, would augur a want of discernment incompatible with the spirit and enterprise of the age. Latterly, the extension of commerce, and the great value of property which is daily consigned to the keeping of individuals and companies, have produced a different feeling; and, viewing the present engagements of merchants, with the amount of transfer from one hand to another, it is no longer matter of surprise that measures, calculated for the better security of property, should be imperatively called for, and *that* in every instance where it is exposed to risk.

The general character of warehouses has, for ages, been the same; the roofs and floors invariably being constructed of timber, with strong girders and wooden props; and these have, in most cases, been so injudiciously placed as to cause considerable injury to the structure on every occasion when great weights have to be supported. On referring to the greater number of these erections, it will be found that the

* The cathedral of Milan is constructed *entirely* of marble and glass.

props which support the floors have their ends placed immediately under the main beam; and these being successively supported upon each other, with the main beam intervening, the result is, that the fibres of the girders are thus completely crushed, particularly in the lower floors, by the superincumbent weight, and, in many cases, the beams are almost squeezed in two from the immense pressure to which they are subjected. Even in this imperfect construction, the necessary precaution of wooden caps has not, in all cases, been adopted; and until the introduction of iron columns, with heads and bases covering a large surface of the beam, the timbers were, in many instances, seriously injured.

The use of iron columns, although an improvement upon the old system of building, is, nevertheless, no security against fire, and it is obvious that no guarantee can be given so long as the structure is chiefly composed of timber, and the openings imperfectly closed by wooden doors and shutters. From this it is evident that, in order to give perfect security, warehouses must be constructed upon different principles, which may be enumerated as follows, viz.:—

1. The whole of the building to be composed of non-combustible materials, such as iron, stone, or bricks.

2. In order to prevent fire, whether arising from accident or spontaneous combustion, every opening or crevice communicating with the external atmosphere to be closed.

3. An isolated stone or iron staircase (well protected on every side by brick or stone walls) to be attached to every story, and the staircase to be furnished with a line of water pipes communicating with the mains in the street, and ascending to the top of the building.

4. In a range of stores, the different warehouses to be divided by strong partition walls, in no case less than 18 inches thick, and no more openings to be made than are absolutely necessary for the admission of goods and light.

5. That the iron columns, beams, and brick arches, be of strength sufficient not only to support a continuous dead pressure, but to resist the force of impact to which they are subject by the falling of heavy goods upon the floors.

Lastly, That in order to prevent accident from intense heat melting the columns, in the event of fire, in any of the rooms, a current of cold air be introduced into the hollow of the columns from an arched tunnel under the floors.

Adopting the foregoing divisions of the subject, it will be requisite to consider them separately.

*First,* The whole of the building to be composed of non-combustible material, such as iron, stone, or brick.

In the choice of material, much will depend upon locality, and the cheapness at which it can be obtained. In this country the best fireproof buildings are generally composed of brick or stone, with iron beams and columns properly framed and held together by rods built into the walls, and brick arches for the floors: these arches are supported by and spring from the lower flanges of each beam, and are thus extended in succession on each floor from one end of the building to the other. These arches may be formed either in a longitudinal direction in the line of the building, or transversely, as circumstances may admit. The floors are generally laid with stone flags or tiles upon the arches, after they are properly levelled and filled up at the haunches with a concrete of lime, sand, and ashes. The flags or tiles, being well and solidly bedded in mortar, form a durable and excellent floor. In buildings for particular objects, it is sometimes necessary to have wooden floors, and, where found necessary, the boards are generally nailed in the usual way to sleepers embedded in the lime-concrete as before described, *or, what is probably better, with a pavement of wooden blocks.*

This description of building, when properly constructed and surmounted by an iron roof, is perfectly impervious to the action of fire; and provided due regard be paid to the selection of a careful superintendent, both owners and occupants may rest satisfied as to the safety of the property.

*Secondly,* In order to prevent fire, whether arising from accident or spontaneous combustion, every opening or crevice communicating with the external atmosphere to be closed.

These are points which should never be neglected in fireproof buildings. In warehouses, in particular, it is of vital importance; because in rooms or floors where combustible material is stored, nothing tends so much to the security of the building and its contents as a power to shut out and prevent the admission of air. For this purpose an iron or stone staircase, surrounded by brick or stone walls, and communicating with the different floors by iron doors, should always be attached. This staircase should be easy of approach from without, with a covered opening at the top, and windows at each landing, in order to effect free ventilation, and a ready communication with every part of the building. Warehouses constructed upon this principle will effect almost perfect security, and, in the event of fire, will enable persons not only to approach the locality, but, in case of the casual admission of atmospheric air, the room might be shut up and the flames smothered till an effectual remedy was at hand. For these objects I would strongly recommend the iron doors, frames, and shutters, as constructed and used by Messrs Samuel and James Holme, of Liverpool, to be fixed in every room. These doors are made of double sheet-iron plates, rivetted to a skeleton frame, with a stratum of air between, which, acting as a non-conductor, is admirably adapted to the purpose for which they are intended.

*Thirdly*, An isolated stone or iron staircase, well protected on every side by brick or stone walls, to be attached to every story, and the staircase to be furnished with a line of water pipes communicating with the main in the street, and ascending to the top of the building.

Under the second division we have already treated of the staircase, and the necessity which exists for having it perfectly distinct from other parts of the building: exclusive of this separation, it will be found still more secure by having a copious supply of water always at command. That supply should not only exist in the street mains, but should communicate with every landing by a brass cock and hose, till it terminates in a cistern with a valve on the top of the roof. This cistern should be of such capacity as would insure a sufficient supply of water in case of accident to the pipes in the street. The pipes, leather hose, and the requisite discharge of cocks, screw-keys, &c., should be kept in good repair, and the hose and screw-keys hung up at every landing ready for use. These precautions will give additional security to parties bonding goods, as also to the owner of the property in which they are deposited. In addition to the above, it will be advisable that all the cocks, hose, and screw-keys be made of one size, and the same as those used by the Fire Brigade of the town. Before closing this part of the subject, I would observe, that an exceedingly simple and ingenious apparatus for extinguishing fire has been adopted by Joseph Jones, Esq., of Wallshaw, near Oldham. It consists of a thin copper globe, of nine inches diameter, perforated full of small holes, and suspended from the ceiling of the different rooms, either in a mill or a warehouse. Each rose is (in case of need) supplied with water by lines of pipes communicating with the mains in the street. In this form Mr Jones is not only in a position to discharge a flood of water into each separate room, but from the peculiar shape of the rose, he is enabled (with a pressure of 200 feet acting upon the apertures) to disperse it to a distance of upwards of 40 feet in very direction. This is a certain and effectual method for extinguishing fire, and might easily be adopted in almost any important structure in large towns, where a supply of water and the necessary pressure can be obtained. Another important feature of this application is the facility and rapidity with which fires can be extinguished. The cocks are all on the outside of the building, and being carefully locked up and marked with numbers corresponding with the different rooms, there is less risk of delay and confusion when an accident occurs.

*Fourthly*, In a range of stores, the different warehouses to be divided by strong partition walls, and no more openings to be made than are absolutely necessary for the admission of goods and light.

These precautions become more apparent in every case where large piles of buildings are erected contiguous to each other, and where risk from fire is incurred in the communication of one part of the building with another. The Metropolitan Building Act has provided against accidents of this kind, by the insertion of a clause wherein these precautions are insisted upon, and by the introduction of partition walls, which divide the houses, the utmost security is afforded to that description of property. In contiguous buildings, these partitions have their full value; and it not unfrequently occurs that the property on each side has been saved from conflagration when a centre building has been completely destroyed: hence the necessity of complete separation in every case where the buildings are contiguous. In the construction of warehouses these precautions are the more important, from the increased value of the property therein deposited, and the greater risk to which, in some particular cases, they are subject. All warehouses should, therefore, be carefully separated from each other; and in forming the partition walls, it might be a great improvement to have an open space of two inches up the middle, with proper binders, for the purpose of ventilation—as air, being a non-conductor, would, in case of fire, prevent the walls from being overheated, and afford a free communication with the atmosphere by the ascending current of air. They should also be built to some height above the roof, in order to prevent the possibility of communication with the adjoining stories, and to effect a complete separation of the different compartments into which they are divided.*

To render the different flats or rooms of warehouses secure, it is a desideratum to have as few openings in them as possible. The plan adopted in those of Mr Brancker's, in Dublin-street, Liverpool, appears to be not only well calculated for the admission and transmission of goods on each side, but having no more windows than are absolutely necessary for the admission of sufficient light to effect the deposition and removal of merchandise, they are exceedingly well adapted for the double purpose of convenience and security. In every situation, the iron doors and iron window shutters already described should be used.

It will be observed, that the security afforded by the iron doors and shutters will be of no use, unless they be closed and fastened every night before the warehouse is shut up.

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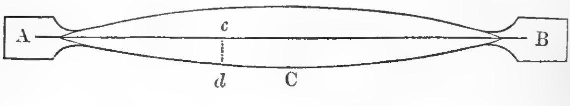
* The Liverpool Building Act has now rendered it compulsory that parapet walls shall be built up 5 feet above the gutters.

*Fifthly,* That the iron coloumns, beams and brick arches, be of strength sufficient not only to support a continuous dead pressure, but to resist the force of impact to which they may be subject, by the falling of heavy goods upon the floors.

This is one of the most important considerations connected with the security and construction of warehouses ; and in order to remove every doubt as to the stability of such a structure, I must refer to my highly-talented and respected friend, Eaton Hodgkinson, Esq., F.R.S., one of the first authorities in this or any other country on the strength of materials. To that gentleman the public are indebted for a series of theoretical and practical experiments on the strength of beams and pillars, of the utmost value to architects, builders, and engineers. Any person choosing to make himself acquainted with the principles of Mr Hodgkinson's experiments, and the results deduced therefrom, will find no difficulty in constructing beams and columns of the strongest form, and at the same time insuring the proportional and requisite strength, accompanied with a great saving in material in all parts of the structure. On this part of the subject it will be necessary to observe, first, on the structure of beams, that until the publication of Mr Hodgkinson's experiments, practical men were almost entirely without rule, or any satisfactory theory on which to found their calculations on the form and distribution of the material. Now the subject is well understood, not only as regards the strength which is wanted, but also the best and strongest form for resisting the different strains to which they are subjected. In warehouses containing goods, these strains are more varied than in factories. In the former, the floors are often loaded to a great extent with solid dense material ; at other times with light bales ; and the lower floors are frequently piled with casks containing mineral substances, which produce not only a great amount of dead pressure upon the beams, but incur the risk of some of the heavier weights falling from some height upon the floor, and thus endangering the security of the structure by the fracture of the beam. These accidents are probably not frequent, but they should be guarded against ; and the beams, arches, and columns should not only be calculated to resist the greatest load when operated upon by a dead weight, but the effects of impact produced by a body falling through a given space upon the floor. These calculations should apply to the two first floors of every warehouse, as the heavier description of goods are almost invariably deposited in the lower stories.

Mr Hodgkinson, in searching experimentally for the strongest section, found that the old practice of making beams with equal ribs—such as recommended by former writers—exceedingly defective; he proved a proportional between the top and bottom flanges, and the strain being less towards the ends of the flanges, it was reduced to the parabolic form, in order to give equal strengths throughout the whole length of the beams. This was an important discovery, and as warehouse and factory beams are intended to be equally strong in every part, and to sustain the load uniformly distributed, it is necessary to adopt the parabola in the form of the ribs, and to mark their relative properties with the body of the beam, and with each other. In discussing these proportions, Mr Hodgkinson demonstrates the curvature of the ribs as follows:—

"Suppose the bottom ribs to be formed of two equal parabolas, the vertex of one of them, A C B, being at C;




when by the nature of the curve, any ordinate *d c* is as A *c* × B *c*; the strength of the bottom rib, therefore, and consequently that of the beam at that place, will be as this rectangle. It is shewn, too, by writers on the strength of materials, that the rectangle A *c* × B *c* is the proportion of strength which a beam ought to have to bear equally the same weight every where, or a weight laid uniformly over it."

From this it would appear that the forms laid down by Mr Hodgkinson were rightly devised, and a great saving, not less than 3-10ths, effected in the quantity of material used.

Having pointed out the strongest form of beams as applied to fireproof buildings, it will be necessary in this place to refer to their strength, and to inquire into the nature of the strains to which they are subject. It has already been stated, that iron beams in warehouses have two distinct forces to contend against, that of direct pressure and the force of impact; with the former there is no difficulty, but the latter involves a proposition on which mathematicians are not agreed. For practical purposes we may, however, suppose a case, such as a large cask of molasses, or box of heavy mineral substance, equal to one ton = 2240 lbs., falling from a height of six feet upon the floor. Now, according to the laws of gravity, a body falling from a state of rest acquires an increase of velocity, in a second of time, equal to 32 feet, and during that period falls through a space of 16 feet: this accelerated velocity is as the square roots of the distances, and a falling body having acquired a velocity of 8 feet in the first foot of its descent, and 6 feet being the height from which a weight of one ton is supposed to fall,

We have $\sqrt{6} = 2.449 \times 8 = 19.592$ for the velocity in a descent of 6 feet.

Then, $19.592 \times 2240 = 43{,}886$ lbs., or nearly 20 tons, as the momentum with which the body impinges on the floor. In the present state of our knowledge, this momentum cannot probably be taken as the measure of the force of impact, but we may fairly estimate the latter as exceeding that of momentum; and having these forces to resist, it will be necessary to guard against them, and to make the beams, columns, and arches in the lower floors, of such strength as will resist the blow, and neutralize its effect upon the floor.

Although the iron beams and arches of a fireproof floor may be sufficiently elastic to resist an impinging force, such as above described, it is still advisable to adopt other precautions, such as the bedding of timber along the top of the arches,* or to form the two lower floors entirely of wooden

* Since the above was written, I have been informed that the Act of

boards (three-inch plank), securely nailed to sleepers embedded in concrete: this plan would give additional security, by the transmission of the impinging force over a larger surface; and, under these circumstances, the concussion would be made, in the first instance, on a soft elastic substance, before it could act upon the more rigid materials of iron beams and brick arches.

In order, however, to remove all doubts as to security, it will be advisable to have stronger iron beams and columns in the two lower floors; and having computed these strengths, they will probably be found nearly correct in the ratio of 12 to 9. If, on this data, we take the breaking weight of a beam, as suitable to the upper stories of a warehouse, at 22 tons, those of the lower stories would require to be 29.32, or nearly 30 tons; and the columns, although less liable to fracture, will, nevertheless, be greatly improved by the introduction of a proportionate thickness of metal.

Having, to the best of our ability, established the fact of perfect security in the use of iron beams and arches, the next point of inquiry will be as to the strength and proportion of the columns; but before treating of this part of the subject, it may be proper to advert to the tie-rods, which are built into the walls and arches, and should unite the walls and girders as a species of net work. These tie-rods are of great value, as they resist the strain of the arches, which, acting through their line of tension, not only secure the walls from being thrust out, but also retain the beams in the position best adapted to sustain the load. The usual practice in these districts is to leave five lines of $\frac{3}{4}$-square rods in a width of 30 feet; two lines are imbedded in the wall, and the remaining three built into the arches. This is considered a perfectly secure building; but it must be borne in mind that cotton mills are not subjected to heavy loads, and instead of five tie-rods of $\frac{3}{4}$-inch square, a warehouse should have seven lines of rods, each $1\frac{1}{4}$-inch square. This will give a sectional

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Parliament for the regulation of fireproof buildings does not admit of any timber whatever. In such case, I would advise the beams so to be made one-half stronger.

area of about 11 inches in 30 feet, which, taken at 25 tons to the square inch, will give a resisting tensile force of 275 tons. In factories, the resisting powers of the tie-rods seldom exceed 100 to 110 tons, which is under 4 tons to the foot, whereas the resisting forces in warehouses should not be less than from 9 to 10 tons to the square foot.

In the construction of fireproof buildings, it is not only necessary to secure the ends of the beams by extension rods embedded in the walls, but the arch-plates, or "Skewbacks," at each end should also be built into the wall; and this plate, as well as the ends of the beams, slightly raised above the level of the column, in order to allow for the settling of the walls, which invariably takes place as the weight increases in their ascent.

For the strongest form and best position of columns supporting heavy weights, we must again refer to Mr Hodgkinson as the very first authority. In his valuable treatise on the strength of pillars of cast-iron and other materials, published in the *Philosophical Transactions*, Part II., for 1840, and for which he received the gold medal of the Royal Society, will be found some of the most interesting and most useful experiments yet given to the public.

From these researches it will be necessary to make some extracts, in order to ascertain the laws connecting the strength of cast-iron pillars with their dimensions, and to determine the best and strongest form adapted to the support of heavy weights. The first experiments were made upon solid uniform pillars, mostly cylindrical, with their ends rounded, in order that the force might pass through the axis; the next were of the same dimensions, with flat ends at right angles; and others again with one end rounded, and the other flat to the axis. They were broken at various lengths, from five feet to one inch (some with discs turned flat), and form a series of most interesting results. The pillars with discs gave a small increase of strength above those with flat ends, but the approach to equality between the strength of pillars with discs, and those of the same diameter, *and half the length*, with ends rounded, was nearly alike.

The conclusion, as Mr Hodgkinson observes, is, therefore, "that a long uniform cast-iron pillar, with its ends firmly fixed (whether by means of discs or otherwise), has the same power to resist breaking as a pillar of the same diameter and half the length, with the ends rounded, or turned, so that the force would pass through the axis."

Mr Hodgkinson, in the first experiments, gave the strength of cast-iron pillars, with both their ends rounded, and both flat; subsequently he experimented upon those with one end rounded and the other flat, and in some cases with discs, and their results being placed between those from the pillars, with round and flat ends, gave the strength in a constant ratio, as under:—

| Pillars. | Breaking Weight in lbs. | | | | |
|---|---|---|---|---|---|
| Both ends rounded, . . | 143 | 3017 | 7009 | 7009 | 16493 |
| One end rounded and one flat, | 256 | 6278 | 13499 | 13565 | 13557 |
| Both ends flat, . . . . | 487 | 9007 | 20310 | 22475 | —— |

"The pillars in each vertical column in this abstract are of the same length and diameter; the strengths, therefore, in three different cases, reading downwards, are as 1, 2, 3 nearly, the middle being in arithmetical mean between the other two."

Mr Hodgkinson, therefore, found, by other experiments upon timber, wrought iron, steel, &c., that those, as well as every other sort and description of material, followed (as regards their strengths) the same laws, and that the strength of a pillar with one end round and the other flat is always an arithmetical mean between the strength of pillars of the same dimensions with both ends rounded and both flat.

These are facts which should on no account be mistaken in the construction of fireproof buildings; and it will be well to impress them forcibly upon the public mind, that the principle is the same, however much they may vary in their ratio of strength.

In treating of the strength of columns, I have endeavoured to establish principles which are not generally known, but which are proved to be fixed and determined laws affecting the increase or diminution of strength according as the ends are made round or flat.

In order, therefore, to avoid error in the construction of buildings adapted for the support of heavy weights, it will be of some value to know, that the strength of pillars can be increased according as their ends are shaped, in the numerical ratio of 1, 2, 3.

Having investigated the subject at some length, it may be necessary, before closing the report, to advert to a circumstance which appears to excite alarm, and increase the fears of individuals, respecting the safety of iron beams and brick arches as a perfectly fireproof structure. It has been alleged, that in case of fire in any of the lower rooms in a warehouse, that the intense heat generated by rapid combustion might melt the iron columns, and bring the whole edifice to the ground.* This is a possible, but a very improbable case, as an event of this kind could never happen provided the precautions enforced and inculcated in this inquiry be duly and properly observed. It is true that negligence of construction on one hand, and want of care in the management on the other, might entail risk and loss to an enormous extent; but

* There is only one instance which has come to my knowledge of a fireproof building being injured by the melting of the columns, and that was at the works of Messrs Sharp, Roberts, and Co., in Manchester, where the pillars were fixed between the boilers of the steam-engine, and having a large quantity of wood piled round them on the top of the boiler, for the purpose of drying, the heat became so intense as to cause them to bend, and ultimately break. In this case, the front of the boiler-house was open, with a thorough draft direct across the building, which generated a most intense heat, and caused the whole room to act as a reverberating furnace. Viewing the subject in this light, it cannot be considered analogous to a warehouse efficiently secured against the admission of atmospheric air.

it is no argument to say, that a warehouse built like a funnel, and provided with all the elements of conflagration, is attended with risk, when it is well known that a perfectly secure and perfectly sound fireproof building can be erected free from all the perils above enumerated.

In my own mind, there is not the shadow of a doubt as to the security of such a structure; and I do not hesitate to assert, that a well-built and properly arranged fireproof warehouse can not only be constructed, but may be made to entail upon the commercial and manufacturing communities of this country an important and lasting benefit.

WM. FAIRBAIRN.*

MANCHESTER, *June* 3. 1844.

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*On Fluorine in Recent and Fossil Bones, and the sources from whence it is derived.* By J. MIDDLETON, Esq.†

Having been for some time past engaged in investigations, not yet matured, on the absolute and relative quantities of fluorine in fossil bones, I was readily led to inquire into its presence, or otherwise, in recent bones. The high authority of Berzelius had indeed satisfied me on this subject; and I might not have felt a motive to examination for myself, had I not lately heard the fact doubted and disputed before the Chemical Society, and elsewhere, with an earnestness which could only proceed from conviction. The readiness with which the authorities of the University College acceded to my request for materials, as well for this as for my more laborious investigations, left me no difficulty, and deserves my best acknowledgments.

I easily obtained conclusive evidence of the presence of fluorine in the following portions of the human skeleton, the

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* From a printed Report "On the Construction of Fireproof Buildings;" communicated to us by the Author.

† Communicated to the Philosophical Magazine by the Chemical Society, having been read May 6, 1844. On the subject of this paper, see the author's previous one, p. 285, and also Dr Daubeny's, p. 288, of preceding volume of this Journal.

bones operated upon being from the dissecting room :—the *occiput*, the *vertebræ*, the *humerus*, the *femur*, the *teeth*, the femur of a fœtus of 6½ months.

I examined also the arm, including the scapula, of a fœtus of 3½ months, but could obtain no evidence of the presence of fluorine in it ; a result which, considering the small quantity of osseous matter involved, was perhaps to have been looked for.

I determined also the presence of fluorine in the entosternal bones of the sternum of a recent tortoise.

Any one who may continue to entertain doubt on this subject, and whose object is the recognition and discovery of truth, may readily convince himself by using the means employed by me. I broke a portion of the bones to be examined into small fragments, and subjected them to the action of concentrated sulphuric acid, in a platinum crucible, covered, as is usual in such operations, by a plate of glass, endued with an etched coating of wax. I applied the flame of a spirit lamp from time to time, so moderating the heat as to sustain action of the acid upon the materials without projection upward of the substances against the glass. I prevent the melting of the wax by keeping a muslin rag, moist with alcohol, upon its upper surface. The time occupied by each experiment was between five and ten minutes.

Through these and other investigations above alluded to, I have ascertained the presence of fluorine in the organic remains of Carnivora, Herbivora, Reptilia, Pisces, as also in the recent bones of Men and Reptiles. The increase of fluorine in fossil bones is apparently greater in proportion to the remoteness of the period at which they lived, where the character of entombment is similar. These facts, taken conjointly, seemed to me to need, for their explanation, a more general source of fluorine than has been heretofore, I believe, supposed. It occurred to me, that ordinary water might be the vehicle ; and if so, the presence of fluorine in recent bones would not only be accounted for, but also its accumulation in fossil bones, being filtered from the moisture circulating in the earth's crust. In order to ascertain whether facts would be found to sustain this view, I examined the following substances :—*First*, A deposit, chiefly of sulphate of lime, from as it appeared, a chloride of calcium vat, and found it to contain fluorine, though in small quantity. As it was suggested to me, however, that glass retorts, used for the distillation of hydrochloric acid has been known to be thereby corroded, I did not attach much weight to the result, although I drew encouragement from it.

*Second*, A deposit, formed in a wooden conduit pipe in a coal mine, procured for me by my friend Dr Falconer, and found it to contain a still greater proportion of fluorine than the former.

*Third*, A stalactitic deposit, said to have been formed in an aqueduct in France. It was of a pure white colour, and made up of very thin and scaly concentric layers, being at the same time very incompact ; it contained no fluorine.

*Fourth*, A stalactitic deposit from a cave in old red sandstone, furnished to me by Mr Arnott, to whom, for this and for other assistance in my investigations, I am much indebted. This I found to contain fluoride of calcium to the extent of about 9 per cent. The stalactite consisted chiefly of carbonate of lime.

*Fifth*, The crust formed on the inside of a kettle used for the boiling of water. This I found to afford faint but distinct proof of the presence of fluorine.

*Lastly*, A fragment of a vein of sulphate of barytes, found in the sandstone above mentioned. This also contained fluorine, though in much less proportion than the stalactite of the fourth experiment.

The above are the only substances, sufficiently diverse in their origin, which I have had an opportunity of examining ; and the facts I have elicited from them seem to confirm the justness of my theory of the prime sources of fluorine in bones. It follows, as a necessary corollary, that it exists in most, if not all vegetables, though perhaps in minuteness of quantity, that may enable it often to elude detection.—(*Philosophical Magazine.* Third Series, Vol. xxv., No. 166, p. 260.)

# *Contributions towards Establishing the General Character of the Fossil Plants of the genus Sigillaria.* By WILLIAM KING, Esq., Curator of the Museum of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. With Two Plates. (Communicated by the Author.)

(Concluded from page 75, vol. xxxvii.)

The most weighty objections that may be urged against *Stigmaria* being the root of *Sigillaria*, have been advanced by Brongniart; they consist of the presence of a pith in the former, and of the spiral arrangement of its fibrils. But the last character, it would appear, is often seen in aquatic plants; and as regards the first it has been observed in the roots of several Zamias.* Coming from so distinguished a botanist, the correctness of these statements cannot, for a moment, be doubted; perhaps, however, it is but anticipating the like expression of others, if I signify my regret at Brongniart not having named the plants which are furnished with spirally arranged fibrils.†

But, admitting that no existing plant possesses fibrils which are disposed in a spiral manner, it surely cannot be supposed, that any one acquainted with the anomalies of organization which palæontology is continually revealing, can look upon the fact involved in this admission as in the least invalidating the conclusion at which we have arrived.

Having brought our description of the external characters of *Stigmaria* to a close, our next object will be, to give an account of its internal structure; but as the histology of one or two plants of the carboniferous epoch is calculated to clear up some dubious points in this structure, it is, perhaps, the best plan to take them first into consideration. The plants here alluded to, are *Lepidodendron* and *Anabathra pulcherrima*.

The details which Witham, Lindley, Hutton, and Brongniart, have severally published, in elucidation of the anatomy of *Lepidodendron*, render a lengthy description of this character unnecessary.

Proceeding from the periphery to the centre, the stem of *Lepidodendron* may, in brief terms, be stated to consist of, first, a thin cuticle;

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* *Vide* Brongniart's Observations on the Internal Structure of *Sigillaria elegans*.

† Some arguments were inserted here in my MS., to shew, that in *Stigmaria* there are combined the *form* of a true radix, and the *spiral arrangement of the fibrils* of a rhizome: this notion is now abandoned. It was also my intention to have entered somewhat into detail respecting the superficial characters of this fossil; but this has been deferred for the present.

second, a double parenchymous zone; third, a hollow vascular cylinder; and fourth, a pith. It has been customary to consider the axis or pith as eccentrically situated, but from certain reasons which have been given in a former part of these contributions, I am disposed to think that this was not a character of the plant when living: the central situation of the pith will therefore be assumed in the following description.

The cuticle, according to some sections, orignally published by Witham, Lindley, and Hutton, is thin, and consists of a form of prosenchymous tissue, being elongated longitudinally, and arranged in a radial manner transversely.

In a section of Lepidodendron, an inch and three-eighths in diameter, the outer part of the double parenchymous zone is a quarter of an inch in thickness: it is composed of a tissue which bears a close resemblance to the parenchyma of the petiole of the Spread-Eagle Fern, (*Pteris aquilina.*) The cells are large, so much so, as to be observed by a common magnifier: on the transverse section they are either round or polygonal, in the last form; the sides of the figure are in general equal. On the longitudinal section the cells are somewhat elongated: they in general taper off rather suddenly at both ends, so as to terminate in an obtuse cone, and they display a tendency to arrange themselves in linear series. The inner part of the zone is about half as broad again as the outer one; judging from some which are here and there displayed, its constituent cells appear to be much smaller and more delicate than the last: they are somewhat of the same form on the transverse section; but on the longitudinal one they are quadrangular, and they run decidedly in linear series. The tissue of this part is very rarely preserved; its character has therefore not been made out so satisfactorily as could be desired. Brongniart, in his restoration of the double zone, represents its cells of the same form longitudinally as they are transversely, which certainly is not the case in any of my sections.

The hollow vascular cylinder, which is a little less than an eighth of an inch in thickness, is composed of polygonal tubes, having no order in their arrangement, except that which pertains to difference in diameter. These tubes have the whole of their walls transversely marked with fine lines or bars, similar to thosewhich characterise the vessels of the medullary sheath of *Sigillaria elegans*: those which are situated on the inner part of the cylinder are as large again in diameter as the cells composing the outer part of the double zone; but they become gradually smaller in the outward direction, until within a short distance of the outer side of the cylinder, and there they become, all on a sudden, considerably reduced. In no part does the vascular cylinder exhibit the least appearance of lateral openings.

From the outside of the vascular cylinder, and at certain points, arise a number of cords which pass into the leaves: they are made up of the smallest sized vessels. The outer part of the double zone is furnished with a number of openings, which serve as passages for these leaf cords;

they have an oval form, are an eighth of an inch in length, in the longitudinal direction of the stem, and are disposed in a spiral order; they are now vacant, but there is little doubt of their having been originally filled with prolongations of the delicate cellular tissue which formed the inner part of the zone. The leaf cords occupy the inferior part of the vascular passages.

The pith, according to Brongniart, is composed of largish fusiform cells.

It is unnecessary to discuss in this paper the situation which *Lepidodendron* holds in the vegetable kingdom: all that is required for our present purpose is, to bear in mind the very singular characters of its medullary sheath or vascular cylinder, which is rather large, and without any openings by which the tissue of the pith could communicate with that of the double zone. It must also be attended to, that this plant possesses no ligneous tissue, arranged in a radial manner, as we have seen in *Sigillaria elegans.*

Let us, in the next place, consider that remarkable fossil which Mr Witham was the first to make known, under the name of *Anabathra pulcherrima.*

At the time when *Anabathra* was described, few botanists had attended to the *minute differences* in vegetable tissue, which form so conspicuous a feature in the phytological works of the present day: hence a few errors have been committed in drawing up the description which has been published of this fossil. Some of these errors have been rectified by M. Brongniart in his "Observations on the Internal Structure of *Sigillaria elegans*;" but as there are others which this gentleman had not the means of correcting, I have been induced to enter into the following description more minutely than would have been otherwise necessary. It requires also to be stated, that, with the view of enabling me to become acquainted with the internal structure of fossil plants in general, Mr Witham has, in the most handsome manner, placed in my hands the whole of his invaluable collection of sections, among which there is an instructive suite of Anabathras. To this gentleman, for so marked an act of kindness, there is certainly due from me an expression of very deep obligation.

Before commencing to describe the tissues of *Anabathra,* it is necessary to make a slight reference to the state in which Mr Witham's specimen existed, when first discovered. It was invested with an irregular coat of mineral matter, in which were observed numerous small portions of vegetable tissue, intermixed with what appear to be twigs. Mr Witham has represented this coat, charged with its vegetable fragments, in Plate VIII., figure 7, of his "Internal Structure of Fossil Plants." The matrix, as it ought rather to be called, was in immediate contact with the tissue of what, we shall presently see, is the ligneous zone of the fossil, a circumstance which prevents us coming to any conclusion as to the thickness of its bark; for instance, whether it was thin, like that of most of the Conifers, or thick, as is the case with the Sigillarias, the Cycases, and the Cactuses. Mr Witham, in his description, says, that the specimen when complete, was a tapering body, several inches in length, rounded at the extremity, and resembling the termination of a stem or branch. In another part it is stated that the specimen, divested of its envelope, was compressed, so as to have one diameter about a half greater than the other. "At the lower part the large diameter was upwards of two inches; and at the extremity one diameter is about half an inch, the other nearly a fourth."* I may observe, that the sections at present before me answer to these and the intermediate sizes. If we were certain that *Anabathra* possessed a thick bark, there is something in the description just quoted which would induce one to suppose that this fossil was a short fleshy plant, resembling some of the Cactuses. Let it be understood, however, that I am far from thinking that this was the case. Mr Witham states, that the specimen presented the appearance of natural joints, at the distance of about two inches, and that its surface was slightly striated in the longitudinal direction. I mention these circumstances merely to give it as my opinion, that the striated appearance was caused by the very elongated tubes of the ligneous zone, and that the joints were simply transverse cracks.

A very singular result has been brought about by mineralization, in Mr Witham's specimen. A large portion of the radiated tissue has been destroyed: what remains is contained in a narrow marginal strip, and in numerous isolated pea-shaped bodies imbedded in a crystalline matrix, and situated inwardly to the latter. The reader is therefore requested to fill up in imagination all the vacant spaces which are represented in figs. 2 and 3, of Plate IV., with the same kind of tissue as that which forms the marginal strip and the isolated bodies. To aid this, a transverse restoration of the vascular and the ligneous system is given in figure 1, which is a little above the natural size.

*Anabathra pulcherrima* is undoubtedly a Dicotyledonous plant. It possesses a broad ligneous zone (*a*, fig. 1. Plate IV.),—a large medullary sheath in the shape of a hollow cylinder (*b*),—and, apparently a large pith (*c*).

The ligneous tissue consists of very elongated tubes, which are occasionally quadrilateral, but generally hexagonal: they are arranged in radiating series, and are remarkably regular in diameter, throughout the thickness of the zone, till within the precincts of the vascular cylinder, where they become considerably reduced. The apertures caused by sectionising these tubes, are distinctly seen with a common magnifier. Their length appears to be considerable, since a longitudinal section nearly half an inch long shews none of the tubes with both terminations (*vide* figs. 3 and 4.) The whole of their walls are marked with fine transverse

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* Witham on the "Internal Structure of Fossil Vegetables," pp. 39 and 40.

lines or bars, which, in general, are parallel to each other, but occasionally they divide, as is represented in fig. 5. All the tubes have their walls of a uniform thickness, so that *Anabathra* displays no appearance of the concentric rings which are found in the wood of ordinary exogenous trees. The ligneous zone appears to have been intersected by numerous narrow medullary rays, judging from the interspaces which are marked *d* in figures 2 and 4.

The vascular cylinder is composed of elongated tubes, which, on the transverse section, are irregularly angular, and somewhat variable in their proportion. Those of the greatest diameter are a little larger than the tubes composing the marginal strip of the ligneous zone, and they constitute the inner four-fifths of the cylinder; while the smallest, into which the others gradually pass, occupy the remaining or outer portion. At the margin of the cylinder, the vessels have become so diminished in size, as to resemble the small ligneous tubes which immediately circumscribe them; occasionally a small vessel is to be seen among the larger ones. With the exception of their being placed somewhat according to size, as just stated, the tubes of the medullary sheath possess no order in their arrangement. The tissue of this part appears to be shorter than that of the ligneous zone, as there are several terminations displayed on a longitudinal section (*vide b*, fig. 3); but I am strongly inclined to believe that the shortness is more apparent than real: it ought rather to be said, that the tubes, in their longitudinal direction, are very flexuous, and twisted around each other. This circumstance, by causing a longitudinal section to display certain of the tubes obliquely cut, and others deviating from each side of the plane of the section, it is conceived, would produce the appearance as if these cuts and deviations were so many terminations.* The walls of the tubes are marked with transverse lines or bars, which differ somewhat from those on the ligneous tissue, inasmuch as they are closer to each other, and they are often seen coming in contact, which gives them an anastomosed appearance (*vide* fig. 6, Plate IV.). In none of the large vascular tubes are the lines so disposed as to form a spiral, either broken or continuous: probably this is the case in the smallest but the section, is not sufficiently thin to allow of its being seen. The vascular cylinder is in close contact with the ligneous zone; and in no part does it display the least appearance of openings or medullary rays.

The pith appears to have been composed of fusiform cells, analogous to those which Brongniart describes as belonging to the corresponding part of *Lepidodendron*. It may be doubted, however, that what I have considered as forming a portion of the pith of *Anabathra*, did, in reality,

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* May not the shortness of the vessels composing the medullary sheath and the leaf cords of *Sigillaria elegans*, be more apparent than real, and the appearance be produced as suggested in the text?

belong to this part, since it is simply a portion of fusiform tissue crossing the centre of one of the transverse sections.

Reverting to the ligneous tissue, and adverting to the longitudinal section represented in figure 4, plate IV., which is at right angles to the medullary rays, and through the marginal strip, our attention must now be directed to those large openings (*e*) which form so prominent a feature. There are only two represented, owing to a greater number requiring more space than could be allowed for the figure: it consequently requires to be stated that they are arranged in a spiral manner. Mr Witham described these openings as containing the medullary rays, which is not the case, because what has been probably taken for cellular tissue, is, in reality, a bundle of small vessels (*f*), similar to those which occupy the outer part of the medullary sheath. Although the longitudinal sections do not exhibit any of these bundles springing from the vascular cylinder, their proximity to this part, in some transverse sections (see fig. 2), together with the fact just stated, leave no room to doubt as to their having constituted the leaf cords of the plant. According to Mr Morris, it would appear that Dr Brown had ascertained this point some time since.* Owing to one of the openings or vascular passages having been intersected in a portion of its course through the ligneous zone, as shewn in the longitudinal section parallel to the medullary rays, which is represented in figure 3, Plate IV., we have displayed in a very instructive manner, a leaf cord or vascular bundle (*f*) traversing at right angles the ligneous tissue: a similar bundle is exhibited in the transverse section, fig. 2. These two sections prove that the leaf cords curve but very slightly in their passage through the ligneous zone, as they proceed horizontally for a considerable distance. From the passages being in part vacant (*vide* fig. 4), it may reasonably be supposed that the cords were accompanied in their course with a portion of cellular tissue.

We may now be permitted to say a few words on the comparative anatomy of *Anabathra*. No one can escape being struck with the similarity which this plant possesses in some points of its structure to *Sigillaria* and *Lepidodendron*. The width of the ligneous zone is certainly greater in *Anabathra* than in *Sigillaria*, but there scarcely appears to be a shade of difference in the character of its constituent tissue in either plant; while between *Lepidodendron* and *Anabathra* there is in their vascular cylinder the closest resemblance. It is, therefore, clear that these three plants are nearly related to each other.

The resemblance between *Anabathra* and *Lepidodendron* in their vascular cylinder, has induced Brongniart to hazard a question to the effect —May the latter not be the young branch, and the former the stem, of

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* Transactions of the Geological Society, 2d series, vol. v., description of Plate XXXVIII.

one and the same plant? "The hypothesis involved in this question," says its author, "appears, however, to have little probability in its favour, in consequence of there being none of the prolongations on the outer part of the vascular cylinder of *Anabathra* which are visible on the corresponding part of *Lepidodendron.*" The prolongations here alluded to, are those portions of the leaf cords which are on the point of curving off from the cylinder, to the margin of which they give a sinuous appearance. Mr Witham's transverse sections of *Anabathra* certainly do not shew any sinuosities. Brongniart's objection is, therefore, so far a valid one; but it seems to me that, before *Lepidodendron* can be considered as the branch of *Anabathra,* there is required to be known an example of a Dicotyledonous tree having young branches without any radially arranged ligneous tissue.

*Sigillaria elegans* possesses in its anatomy a peculiarity of considerable interest, in a physiological point of view: it is furnished with a medullary sheath, which, there is strong reason to believe, existed, to a certain degree, independently of the ligneous zone. But whatever doubt might stand in the way of such a peculiarity possessing itself of our entire conviction, so far as *Sigillaria* is concerned, it is clearly demonstrated by what is observable in *Lepidodendron* and *Anabathra,* inasmuch as, in the former, the vascular cylinder has performed its function without the presence of the ligneous zone of the latter: add to this, that, in *Anabathra,* although these two parts are in immediate contact with each other, the differences which have been pointed out in their respective tissues, further prove that they represent independent systems. It will now be seen on what grounds the distinction has been made in this paper between the vascular and the ligneous part of the fossils which have been mentioned.

With the materials which we now possess connected with the internal structure of co-existing forms, it will readily be admitted, that we are better prepared to commence our proposed examination of the histology of *Stigmaria.*

Lindley and Hutton were the first to make us acquainted with the anatomy of this fossil, and, subsequently, Brongniart and Morris have each contributed towards elucidating it.

A transverse section of a Stigmaria having its tissue preserved, usually exhibits the appearances shewn in figure 1, Plate V. The letter *d* refers to a broad zone filled with mineral matter which has replaced the original (cellular) tissue of the plant: the wedge-shaped bundles marked *a b,* are composed of very elongated hexagonal or quadrilateral tubes, whose walls are marked with transverse lines or bars, in general parallel to each other, but occasionally approximating at certain points, so as to produce a reticulated appearance (Brongniart): these tubes are arranged in lines radiating from the centre of the fossil: *c* refers to spaces which separate the bundles from each other; they are now filled with the same mineral substance as that of the outer zone, but there is no doubt of their having been originally occupied with cellular tissue: the part marked *e* is also filled with mineral matter. Such is a brief outline of the internal structure of *Stigmaria*. On a general comparison with some recent plants, especially the Cactuses, this fossil does not offer much disparity. In these we have a similar broad zone (the bark), a similar hollow cylinder of wedge-shaped bundles (the wood), and a similar central part (the pith); but these are all the points of agreement, as the ligneous system of the Cactuses does not consist of a uniform tissue, nor are the walls of this tissue marked with lines, as in *Stigmaria* (Brongniart). *Sigillaria elegans,* too, somewhat resembles this plant in the general aspect of a transverse section. The characters of the tissues in both, it will be seen, are in agreement, but *Stigmaria* is entirely divested of the circle of apparently isolated bundles which lies within the ligneous cylinder of *Sigillaria*.

Fragments of *Stigmaria* are often found having the same outline as that of the specimen which has been figured: like this, they have their pith, bark, and radiating interspaces, occupied with mineral matter; but instead of there being any remains of tissue in the wedge-shaped bundles of the cylinder, there are nothing but vacant spaces. The difference between these two kinds of specimens has evidently been caused in the following manner: in the kind first described, the soft cellular tissue composing the pith, the bark, and the radiating interspaces or plates, as they may be more conveniently termed, rotted out, simultaneously with its being replaced by mechanically induced mineral matter in the shape of mud, which hardened soon after its deposition; on the contrary, the tissue of the cylinder, owing to its firmer texture, resisted decomposition: it remained fixed in its original place by means of the outer zone, the central part, and the radiating plates, and, through some cause or other, the whole of the tubes and their delicate markings became mineralised, or electrotyped as it were; and thus we have preserved one of the most interesting objects of microscopic investigation. The other specimens were subject to the same changes up to a certain point—to the consolidation of the mechanical deposit; but after this had taken place, instead of the tubes becoming electrotyped, they rotted out like the cellular tissue; nor was their place afterwards filled up with any mineral matter, either chemical or mechanical: hence the vacant spaces which now remain.

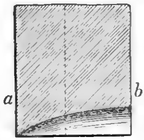
It is fortunate that we have the remains of *Stigmaria* in the state last described, since they enable us to investigate a doubtful point in the internal structure of this fossil.

Brongniart, in his explanation of the sections illustrative of *Stigmaria*, which are added to his "Observations on the Internal Structure of *Sigillaria elegans*," speaks of the radiating plates or "spaces," as "corresponding to the great medullary rays." Lindley and Hutton, in the "Fossil Flora," (Vol. iii. p. 48), write to the same effect. Let us for a moment stop to inquire into the nature of medullary rays. According to Professor Lindley, "they are composed of muriform cellular tissue, often not consisting of more than a single layer of cellules; but sometimes, as in *Aristolochias*, the number of layers is very considerable." "No vascular tissue is ever found in the medullary rays, unless those curious plates described by Griffith in the wood of *Phytocrene gigantea,* in which vessels exist, should prove to belong to the medullary system."* Should botanists agree to restrict the term *medullary ray* to those vertical plates of cellular tissue which intersect the ligneous cylinder, and which are unaccompanied with vascular tissue, the radiating plates of *Stigmaria* cannot be so termed, as they inclose the vascular cords which pass into the external appendages.

By making longitudinal divisions through the cylinder of those specimens of *Stigmaria* which do not possess any tissue, we discover that the radiating plates are about half an inch in length in the longitudinal direction of the fossil; that they are placed rather obliquely, and disposed in a nearly spiral manner; and that they thin off at one end to a fine edge, while the opposite one is divided, or rather grooved, along its entire horizontal extent. I have endeavoured to represent the form of a plate, and a groove in the annexed figures:—†

Fig. 1.

Fig. 2.




Referring to Brongniart's section of *Stigmaria*, we learn that the cylinder is intersected by a number of oval-shaped spaces, each of which incloses the vascular bundle or cord belonging to one of the external appendages or fibrils.‡ Mr Morris' figure, representing an oblique section of the same part at right angles to the radiating plates, shews similar oval-shaped spaces inclosing a cord.§ Now, if in imagination we destroy the whole of the tissue, and fill up the oval-shaped spaces of these figures with mineral matter, we produce a number of radiating plates, with a groove precisely like those which have been figured. This brief notice is perhaps sufficient to shew that the radiating plates were origi-

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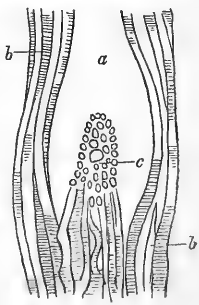
* Introduction to Botany. 3d edit. p. 92.

† Fig. 2 represents a side view of a plate having one of the divisions removed, to shew that the groove deepens as we pass from the inner (*a*), to the outer side (*b*). Figure 1 represents a longitudinal section of another plate corresponding to the dotted line in figure 2.

‡ "Observations," &c., Plate V., figs. 2, 6, and 7. In the annexed figure, which is a reduced copy of figure 6, one of the spaces (*a*) surrounded with tubular tissue, (*b*) is represented as well as the bundle (*c*.)




§ Geological Transactions, 2d series, vol. 5, Plate XXXVIII. fig. 3, *a*.

nally spaces, which, in addition to a large portion of cellular tissue, contained the vessels that passed into the external appendages; the term *medullary ray* is, therefore, inapplicable to them, and as a substitute that of *vascular passage* is proposed.*

In none of the longitudinal sections which have been published of *Stigmaria* are the fibril cords represented passing through the entire thickness of the cylinder, as the groove of the radiating plates indicates. I was in hopes of procuring some sections exhibiting this character, but I have not yet succeeded: nevertheless, a compressed specimen in my collection, containing an impression of the cylinder, is of considerable value in the absence of such sections: the tissue has disappeared, but the impression remains, which is so complete that the arrangement of the tubes is clearly exhibited. Most of the tubes run perpendicularly up the cylinder, as represented by *a*, *b* in fig. 2, Plate V., but occasionally they are seen curving away from the place originally occupied by the pith *c*, in the manner shewn at *f*. There can be no doubt that the curving tubes constitute the fibril cords of this specimen.

In connection with these cords two or three questions arise, which require a little of our attention. What do they originate from? Do they strike off from the tissue of which the principal part of the cylinder is composed? or do they belong to an independent system, as is the case with their analogues in *Anabathra?* From his description of the figures which represent the internal structure of *Stigmaria*, it may be supposed that Brongniart adopts the view involved in our second question; for, in speaking of the fibril or vascular cords, it is stated that they separate themselves from the tissue of the cylinder. Notwithstanding the weight of this opinion, coming, as it does, from so eminent an authority, I may be pardoned hazarding one that is totally different, to the effect, that the cords belong to a system distinct from the tissue which forms the principal part of the cylinder. There can be no great objection, it is presumed, to take as granted that *Stigmaria* is the root of *Sigillaria*. Now the sections which have been published of the last plant clearly shew that its circle of apparently isolated bundles is distinct from the enclosing cylinder; and it is equally obvious that the former constitutes the medullary sheath, and the latter the ligneous system. If a distinction of this kind exists in the stem, why, it may be asked, ought not the same distinction to prevail in the root? Again, the leaf cords of *Sigillaria*, as admitted by Brongniart, evidently spring from the medullary sheath, and not from the radiated cylinder,—why then may not the fibril cords of *Stigmaria* be independent of the radiated cylinder which they traverse? But it may be urged that this fossil does not shew

* The short tabular description given by Brongniart of the anatomy of *Sempervivum*, ("Observations," p. 438), induces me to think that the name here used will not be objected to; since it is stated that the plant is "without medullary rays, but offers some *spaces for the passage of the vascular bundles of the leaves*."

any distinct medullary sheath as in *Sigillaria*. This is granted, but there seems to be no difficulty in the way of the vessels of such a sheath being so mixed with the tissue of the ligneous cylinder, that is, on its inner side, and consequently falling into the radial arrangement of the latter, as to loose all appearance of individuality, or, in other words, be prevented shewing themselves under a distinctive form. This I strongly suspect is the case with the vessels of the vascular system of *Stigmaria*: the fact of the fibril cords having originated on the inner side of the cylinder, as shewn by the groove of the radiating plates, forms, in my opinion, a strong argument in favour of this supposition.* And it seems to be further supported by three transverse sections of this fossil at present before me, in each of which the vessels are somewhat irregularly arranged on the inner side of the wedge-shaped bundles: in fact, there is displayed the same want of regularity in the radial arrangement as characterises the tissues situated on the inner side of the ligneous zone of some Conifers, that is, where the spiral vessels are mixed with the discigerous tubes.†

From what has now been stated, the following general character of the histology of *Stigmaria* is proposed; and, with the view of aiding our description, an enlarged restoration of the cylinder, exhibiting its constituent parts, is given in fig. 3, Plate V.

The tissues of *Stigmaria* are of three kinds,—vascular, ligneous, and parenchymous.

The vascular tissue enters into the composition of the inner part (*a*) of the cylinder;‡ the ligneous composes the remaining portion, *b*; and the parenchymous forms those parts of the fossil which have been previously named the "broad zone" and the "centre" (*c* and *d*, fig. 1, Plate V.): the two former parts represent the medullary sheath and the wood —the vascular and the ligneous system; while the two latter represent the pith and the bark—the parenchymous system. The tissue of the ligneous system consists of very enlongated tubes, which, on the transverse section, are arranged in lines radiating from the pith, while in the longitudinal sense, they follow an oblique undulating course: their walls

* The width of the cords in fig. 2, Plate V., appears to militate against their having originated on the inner side of the cylinder; but it may be observed, that the cords were probably made up, as is usually the case in other plants, of a mixture of vascular and woody tissue. In this case, the vascular tissue may have occupied but a small portion of the inner side of a cord.

† Perhaps the longitudinal section of *Stigmaria* represented in the "Fossil Flora," (Vol. iii., Plate 166, fig. 2), will throw some light on this point. It is much to be desired that a more detailed account of this section were published.

‡ The line on the inner side of the cylinder in the restoration is merely given to indicate the situation of the vascular tissue.

are marked with transverse bars or lines which frequently run parallel to each other, but occasionally they anastomose so as to form reticulations. The tissue of the vascular system, on a general view, resembles the ligneous—consisting of transversely-barred elongated tubes. The vascular and the ligneous tissue are intermixed, which causes the former to follow to a certain extent the radial arrangement of the latter. The ligneo-vascular cylinder, as it may appropriately be termed, is furnished with a number of oblique spirally arranged oval-shaped spaces (*e*), which communicate with the pith on the one hand, and with the bark on the other, and which are principally occupied with cellular tissue.* From the vascular portion of the cylinder, numerous bundles (*f*) strike off, and pass through the cylinder, by means of the spaces, into the external appendages. Besides the vascular passages, as the oval-shaped spaces may be termed, the ligneo-vascular cylinder is intersected by a small number of thin cellular plates, which are clearly medullary rays (Brongniart).

If the general character just given should ultimately prove to be correct, it will follow that the principal difference between *Sigillaria* and *Stigmaria* is, not in the absence of the medullary sheath in the latter, as Brongniart supposes, but simply in the vessels of this sheath being intermixed with those which compose the ligneous system.

The remaining portion of these contributions will be devoted to a consideration of the place which *Sigillaria* occupies in the vegetable kingdom.

Previously to his discovery of its internal structure, Brongniart maintained that *Sigillaria* proximated to the tree ferns: this view, it is well known, was founded on external characters. The discovery alluded to, however, brought about a complete change in his opinion, so that he is now in favour of *Sigillaria* being allied to the Cycadeous Gymnosperms. The resemblance between the markings on its ligneous tissue and those which characterise certain of the vessels of *Zamia integrifolia*, and the similarity existing between the cylinder, as regards relativeness of size to other parts, of both plants, are considered as strongly in favour of the last opinion. From the strong presumptive evidences which have already been adduced, in support of certain forms of *Neuropteris* having constituted the foliage of *Sigillaria*, it would appear, however, that the earlier view of Brongniart ought not to be so hastily rejected. Most of the arguments which have been advanced in the "Végétaux Fossiles" in support of the view that *Sigillaria* is allied to the tree-ferns, are, in my opinion, as effective as ever, notwithstanding the cycadeous affinities of its internal structure, and the counter arguments which have been advanced by the authors of the "Fossil Flora." We will now pause

* Owing to these openings or spaces, it is easy to conceive, that, if the vascular tissue were separated from the ligneous, the medullary sheath would be in the form of a netted cylinder.

for a while to consider a point in the anatomy of this genus. It possesses a medullary sheath, in the shape of a circle of apparently isolated bundles, situated inwardly, but in proximity to the ligneous zone: the bundles are composed of elongated tubes, which, in their markings, are intermediate to the true spiral vessels of Exogens, and the scalariform tissue of certain Endogens, such as Ferns. A medullary sheath of this kind appears to be unknown amongst either recent or fossil plants, not even excepting the Zamias, to which *Sigillaria* possesses some affinity.

The Monocotyledons, such as Palms, possess a number of apparently isolated bundles, which are generally very numerous, and disposed without much order throughout the diameter of the stem. The only plants of this class in which the bundles are less numerous, and more regularly distributed, are Ferns. These may be deferred for the present, as they will have to be referred to in another place.

None of the longitudinal sections which Brongniart has given of *Sigillaria elegans* afford us an insight as to the longitudinal arrangement of the bundles of the medullary sheath. Now, in order to obtain this, we are compelled to examine the corresponding part of some allied plants: for example, the Coniferous Gymnosperms, and the Vascular Cryptogams.*

By dividing in the longitudinal sense a young shoot of any ordinary Conifer, and extracting the pith, the woody cylinder is made to exhibit its inner side, which, by using a common magnifier, will be seen to be furnished with a number of very elongated oval-shaped openings, which are caused by the fibres being separated into bundles, alternately disuniting and approximating; in fact, the inside of the cylinder has the appearance of net-work with very elongated meshes: and if the tissue of the entire cylinder be submitted to the microscope, it will be seen that there are two kinds, namely, spiral vessels and discigerous tubes, and that the latter form the whole of the cylinder, with the exception of its inner side, which principally consists of the former: it will also be seen that the openings or meshes are filled with parenchyma, and that they afford a passage for the bundles of fibrous tissue, which pass into the leaves. From these facts we have ascertained what is well known in the anatomy of a Conifer, that the few inwardly situated spiral vessels constitute the medullary sheath, while the more numerous discigerous tubes form the ligneous system; but we have also learnt that the meshes are the same as the vascular passages of *Stigmaria* and *Anabathra*, and that the medullary sheath is in the form of a netted cylinder. As regards the meshes, they need only be alluded to, because of their shewing that what has hitherto been considered a singular character in the first of

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* My inability to procure any portion of an American Zamia must be accepted as the reason why the Coniferous section of the Gymnosperms has only been examined.

these fossils, is common to a large division of the vegetable kingdom; and as respects the netted form of the vascular cylinder, it will presently be seen that we have become possessed of a means that will aid us in our present investigations.

Let us now examine those Monocotyledons in which the bundles are less numerous than usual, and more regularly arranged than ordinary. A transverse section of the axis of a Fern, whether creeping or arborescent, exposes a number of apparently isolated bundles arranged in a circle, and imbedded in a mass of cellular tissue, (*vide* fig. 4, *a*, Plate V.) These bundles are composed of what are generally termed scalariform vessels, and of a fibrous form of parenchyma which envelops the former in the manner of a sheath. As these bundles are in connexion with the leaves, and are evidently analogous in function to those which form the medullary sheath of exogenous plants, they may be safely considered as constituting the vascular system.

For a considerable time I was at a loss to know the exact longitudinal arrangement of the vascular bundles in the stem of a tree-fern. After many attempts to procure a specimen sufficiently long for the purpose, and after consulting a number of botanical works, I was on the point of relinquishing the inquiry, possessed of no other information than that incidently given by Brongniart, to-wit, that "the bundles anastomose at certain distances," ("Observations") when it occurred to me that *Aspidium Filix Mas* might afford all the information that was desired. This led me to dissect the rhizome of the fern just named. By this means, I ascertained that although the bundles appear to be isolated on the transverse section, as represented in fig. 4, Plate V., they are in reality all connected with each other at regular distances in the longitudinal sense, so as to form a netted cylinder, remarkably regular in its meshes. Fig. 5, Plate V., represents a portion of this cylinder rather enlarged, which I succeeded in clearing of its matrix of cellular tissue, after exhausting somewhat more than an ordinary degree of patience. As previously stated, I have not been able to study the longitudinal arrangement of the bundles of the trunk of a tree-fern; but I have little or no doubt that it is the same as in *Aspidium Filix Mas*. Probably in some arborescent forms of rapid growth, the meshes are narrower, more irregular, and very much elongated, which will cause the vascular cylinder to have very little of a latticed appearance.

Reflecting on the fact of which we have just come in possession, that the bundles of the vascular system of Ferns and Conifers are connected with each other at certain points, so as to form a netted cylinder, more or less decided, it seems but fair to infer, that the apparently isolated bundles composing the medullary sheath of *Sigillaria elegans* are similarly connected; and, owing to their regularity on the transverse section, it may also be inferred, that they form a similarly constructed cylinder. It is difficult to conceive any objection to such a conclusion.

The researches of Brongniart shew, that of all existing plants the Ferns approach the nearest to *Sigillaria*, as regards the markings on the walls of the tubular tissue. Our own researches as to the foliage of this fossil, it will be remembered, carried us close up to the same plants. Associating these results with the conclusion we arrived at in the last paragraph, it seems to be a legitimate inference—allowing for certain modifications *consequent on the union*, that we have in this fossil the vascular system of a Fern, *united* to the radially arranged ligneous zone of certain Cycases. The genus *Sigillaria* may, therefore, be concluded to be intermediate to the highest vascular Cryptogams, and the Cycadeous Gymnosperms.

It is very much to be regretted, that, as yet, we possess no positive evidence regarding the fructification of *Sigillaria*: it is only required to have some knowledge on this point to enable us to decide whether this fossil proximated more to the Ferns than to the Zamias.

With reference to the habit of *Sigillaria*, various considerations warrant the belief that it was essentially aquatic. The loose spongy nature of the soil in which this plant grew is clearly shewn by its massive root-branches extending to such enormous distances, and its innumerable fibrils spreading out in so regular a manner. Its possessing organs so characterised, and its growing in such a soil, clearly combine to prove that *Sigillaria* not only lived in situations extremely liable to inundations, but that it had powerful floods or freshets to contend against.

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If, in imagination, the reader will delineate a channelled stem of any height between twelve and a hundred feet,*—crowned with a pendant fern-like foliage,—furnished with wide-spreading thickly fibrilled roots, —and growing in some densely wooded swamp or "bottom" of an ancient Mississippi, I am strongly persuaded that he will have formed a tolerably close restoration of a Sigillaria vegetating in its true habitat. * * * * * I trust that at some future period it will be in my power either to modify this restoration, or render it more complete.†

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* Since the first part of these "Contributions" was published, I have learned that Mr Richard C. Taylor, formerly of this country, has discovered some stems of *Sigillaria* in the Schuylkill coal-field, which cannot have been less than a hundred feet in height. *Vide* "Celebration of the Hundredth Anniversary" of the American Philosophical Society, p. 149–150.

† Mr Binney, who, it will be remembered, announced, at the Cork Meeting of the British Association, his discovery of a specimen of *Sigillaria* with roots which agree with *Stigmaria*, has subsequently published an interesting account on the same subject in the London Philosophical Magazine, (March 1844). It is singular,—and perhaps some will even lay hold of the circumstance, as being rather against the view which Mr Binney and myself advocate,—that in those specimens which exhibit a stem attached to a well developed root, although there can be no doubt as to the latter being *Stigmaria*, yet it is not so clear that the

## EXPLANATION OF THE PLATES.

### Plate I., Vol. 36, p. 21.

Fig. 1. Diagram representing a transverse section of *Sigillaria elegans*, copied from Brongniart; *a, a, a,* the bark; *b,* the ligneous cylinder; *c,* the medullary sheath; *c,* bundles of tissue supposed to pass from the medullary sheath into the leaves; *d,* the pith.

Fig. 2. Outline of the surface of a portion of the stem of one of the North Biddick Sigillarias, preserved in the Newcastle Museum; *a,* the ribs; *b,* the furrows.

Figs. 3, 4, and 5, represent the mode in which five different appearances may be produced by one specimen of *Sigillaria.*

Fig. 6. Portion of a rib of *Sigillaria,* shewing the leaf scar *a,* the vascular scars *b,* and the remains of the axillary bud *c.*

### Plate IV., Vol. 36, p. 290.

Fig. 1. Cuticle of the larch, representing the ribbed appearance produced by the elongation and the arrangement of the leaf bases *a.*

Figs. 2, 3, (Plate V,). and 4, exhibit the direction of the spiral in different specimens of *Lepidodendron.*

Fig. 2 *x.* Lozenge of Lepidodendron, shewing the axillary bud *a.*

Fig. 5. Portion of the cuticle of *Abies Webbiana,* which shews the way in which the ribs of *Sigillaria* have been produced. I am indebted to Mr Thornhill, the Librarian of the Literary and Philosophical Society of Newcastle, for the beautifully correct drawings from which this and the adjoining figure were copied, besides several suggestions in Botany, which have been of considerable advantage to me in drawing up these "Contributions."

### Plate V, Vol. 36, p. 290.

Fig. 6. Portion of a Sigillaria shewing the direction of the spiral, and the way in which the ribs have been produced.

Fig. 7. Veining of the leaflets of *Otopteris pectiniformis.*

Fig. 8. Veining of the leaflets of *Palæozamia pecten.*

Fig. 9. Veining of the leaflets of *Pecopteris nervosa ?*

### Plate IV., Vol. 38.

Fig. 1. Transverse section of the vascular cylinder and the ligneous zone of *Anabathra pulcherrima,* divested of the bark, as seen by a low magnifier; *a,* ligneous zone; *b,* vascular cylinder; *c,* part occupied by the pith; *f,* leaf cords.

Fig. 2. Transverse ection of the same parts very much magnified; *a,* tissue of the ligneous zone; *b,* tissue of the vascular cylinder; *c,* space occupied by the pith; *d,* medullary rays; *f,* leaf cords.

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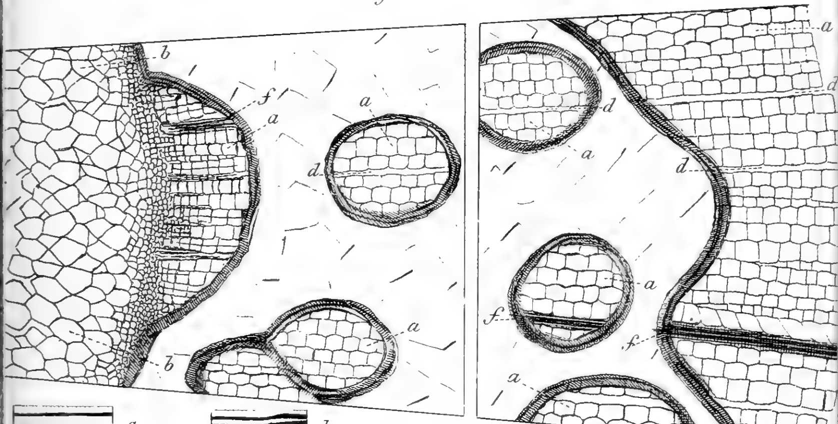
former is *Sigillaria:* the No. 3 specimen is evidently in this predicament; it is the case with the one found in Kenilworth pit, and it appears to be the same with one of the Dixonfold fossils.

*Fig. 2.*



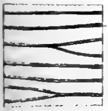




*Fig. 5.*

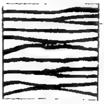



*Fig. 6.*

*Fig. 3.*

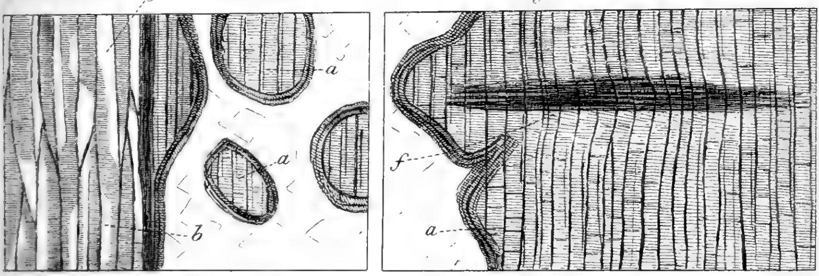



*Fig. 4.*

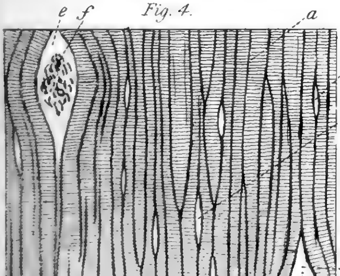
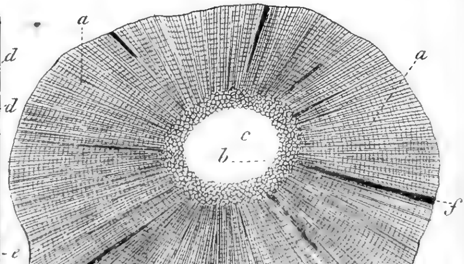



*Fig. 1.*




W. K. del^t. J. G. Mitchell, Sc.

*Fig. 1.*

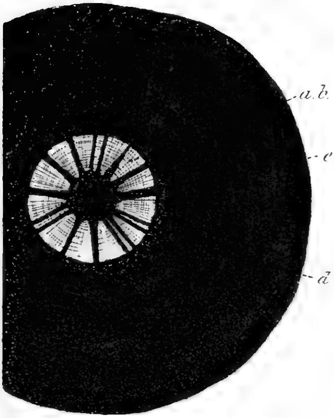



*Fig. 2.*

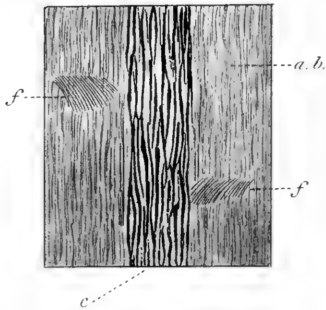



*Fig. 4.*

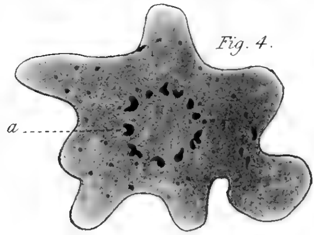



*Fig. 3.*

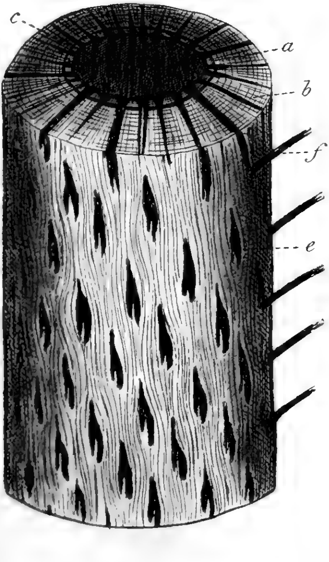



*Fig. 5.*

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Fig. 3. The same parts on the longitudinal section parallel to the medullary rays. The letters have the same reference as in the last figure. In consequence of there not being sufficient room in the plate, the median part of the two last sections is not represented; its tissue is in pea-shaped bundles.

Fig. 4. Tubes of the ligneous zone, on the longitudinal section, parallel to the bark; *d*, sections of medullary rays; *e*, vascular passages; *f*, leaf cords.

Fig. 5. Portion of a ligneous tube, exposing the lines or bars with which its walls are furnished, still more magnified.

Fig. 6 exhibits the form and arrangement of the bars which characterise the walls of the vascular tubes.

PLATE V., VOL. 38.

Fig. 1. Transverse section of *Stigmaria*; *a b*, the ligneo-vascular axis; *c*, the pith; *d*, the bark; *e*, the vascular passages.

Fig. 2. Impression of the tissues composing the ligneo-vascular axis of *Stigmaria*; *f*, fibril cords intersecting the axis *a b*; *c*, the pith.

Fig. 3. Restoration of the ligneo-vascular axis of *Stigmaria* enlarged; *a* represents the position of the vascular part relatively to the ligneous portion *b*; *c*, the pith; *e*, the vascular passages; *f*, the fibril cords.

Fig. 4. Transverse section of the rhizome of *Aspidium Filix Mas*, shewing the circular arrangement of the bundles of the vascular system.

Fig. 5. Enlarged longitudinal view of a portion of the netted cylinder or vascular system of *Aspidium Filix Mas.*

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## *Report of a Remarkable Appearance of the Aurora Borealis below the Clouds.* By the REV. JAMES FARQUHARSON, LL.D., F.R.S., Minister of the Parish of Alford.

*Alford, February* 24. 1842.—Saw, at 11 P.M., a remarkable aurora borealis between the observer and lofty stratus clouds. The density of the clouds, the great brilliancy of the meteor, its considerable continuance, its renewed display, and the extent of space it occupied, left no doubt of the reality of the phenomenon.

After a day, during which the whole heavens had been mostly shrouded by a uniform cloud, with a gentle wind at NW., the sky, after sunset, became partially clear, and the thermometer descended to 34°, with calm; barometer 28·89 inches. At 11 P.M. a very brilliant display of pencils of aurora (streamers) was seen at W. by S., in a limited space about 10° broad, and 15° or 20° high, a little above the visible horizon; and a separated display of the same, much wider, and of nearly the same height, but not quite so brilliant, in another limited space, at NW. It was instantly seen that, in both spaces, the bright meteor was between the eye and lofty stratus clouds. These clouds extended in long parallel belts, some of them 10° or 15° broad, some broader, with narrow intervals of clear sky between them, in a direction from NW. to SE. This arrangement was clearly seen in all the western part of the sky, although there existed under these clouds thinner fleecy irregular ones, which here and there obscured it for short distances. These lower irregular clouds prevailed more in the eastern part of the sky; but there, also, the arrangement of the belts of stratus was recognised through their intervals. One of the irregular thin clouds lay over the moon, then nearly south, and nearly at full; and its consistency was such as to obscure the dark spaces on her disc, although not its circular outline. The lofty stratus clouds were, in some parts at least, of much denser consistency, as was proved by their totally obscuring some very brilliant falling stars, which passed behind them, as will be afterwards described.

The exhibition of pencils of aurora at the W. by S. space was of unusual brilliancy, and the corruscations incessant, as they brightened up, and faded, and suddenly disappeared, and were renewed, successively. The colour at the lower extremity was a lively minium red, but only for a short way up; the upper part being of the common greenish-yellow. They crossed, angularly, the lofty cloud nearest to the western horizon, which was narrow, and were clearly seen upon its face, and stretching their extremities into the clear sky on each side of it. Even the feeblest of them maintained its continuity, and its peculiar tinge of colour, over both the thinner edges and denser middle part of the stratus. About five minutes after it was first seen, this aurora became extinct; but in the course of three or four minutes was suddenly renewed, with a slight shift to the southward, in as great or even greater brilliancy. In the mean time, the aurora at the NW. space exhibited like appearances and colours; red at the lower extremities of the brilliant pencils, and greenish-yellow upwards. The space here occupied by the pencils or streamers was much broader, and the lights less condensed into one place, disappearing in some compartments, and extending to others alternately. They played over several belts of the stratus clouds, and intervening clear spaces of sky; and were seen, without diminution of lustre or change of tinge, on the face of the former. At both sides of this space, there were some of the thin irregular lower clouds, behind which some of the pencils passed sometimes at one or other of their extremities, sometimes at their middle part. In such cases, their continuity instantly disappeared; for although the light of the more brilliant ones shone through these clouds, it was only in a white nebulous form, without any parallelism of rays, as seen in the pencils when not so obscure.

About twenty minutes after the aurora was first seen, dense clouds with curled edges were rather thickly formed over both the spaces occupied by it, of larger extent than they were; and although the observations were continued till half-past 12 o'clock, the meteor was not again seen in the same spaces; but about a quarter to 12 o'clock, a comparatively small space of bright nebulous aurora, without defined pencils, was seen very near the horizon, at WNW. That too disappeared; and in the mean time, the clouds in all parts of the sky, by degrees, dissolved; the lofty stratus ones more slowly than the others. At half-past 12 o'clock only a few remained at the SE., when the observations were discontinued.

During the continuance of the aurora, two bright shooting stars descended above the space at NW., in paths parallel to the streamers; that is, to the dipping needle. They were of slow motion, and became invisible when passing over the belts of stratus clouds, but emerged again after passing them. At a quarter to 12 o'clock, a shooting star as large as Venus, at her greatest elongation, shot from near the zenith, a little to the eastward of the magnetic meridian, and descended in a path parallel to that circle, disappearing while passing behind some stratus clouds, but not quite, while doing so, behind some low irregular ones that lay in its course. Its motion was slow, and fitfully interrupted.

*February* 25.—Clear sky in the morning. Unusually abundant spiculæ of hoar-frost over all the ground, and whitening the hills to their summits, like a shower of snow. Register thermometer through the night at 29°.—(*Philosophical Transactions of the Royal Society, London, for the year* 1842, part i. p. 87.)

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*On a Species of Teredo found in Cork-floats, on the Coast of Aberdeenshire.* By WILLIAM MACGILLIVRAY, A.M., LL.D., Professor of Natural History in Marischal College and University. (Communicated by the Author.)

On the eastern coasts of the middle division of Scotland, timber perforated by Teredines is so very seldom met with, that, after a diligent search continued for many months, I had almost despaired of obtaining any species of these very interesting animals, when, in September 1844, having had the pleasure of making acquaintance with Lieutenant Paterson, of the Coast Guard, at Slains, I was informed by him, in answer to my inquiries, that he had found a spar on the rocks there which was full of them in the living state, and which he had used to repair a fence near his house. The species which had perforated this piece of wood, of large size, the holes being sufficient to admit *Helix hortensis*, I find to be different from *Teredo navalis*, as described by Deshayes and others; but not having been able to detect its palmules, I refrain at present from saying anything further respecting it. Previous to this time, however, in March 1843, after a storm, having found on the sands near Don mouth, a piece of a cork net-float, having a small specimen of *Lepas sulcata* upon it, I was agreeably surprised, several months after, when a little boy, who had been looking at it, shewed me a small white tube, which I found to be that of a Teredo. On cutting up the cork I met with several others, in some of which the shell was found entire. Unfortunately, however, the palmules, of the importance of which I was not then aware, were not detected, so that an imperfect description only could have been given. In November 1844, I renewed the search, and after a strong gale of easterly wind, continued for several days, found, on the beach near Aberdeen, several pieces of cork, on examining which I detected a great number of small live Teredines. The animals being minute, it was difficult at first to observe all their parts, but by cutting up the cork, this was at length in some measure accomplished.

The largest perforations are an inch and a quarter in length, scarcely a twelfth of an inch in diameter at the inner or larger end, slowly narrowing toward the other or outer end, which communicates with the exterior by a circular aperture resembling the puncture of a small insect pin. The holes are tortuous, as usual, and appear to have been formed by circular movements, as their surface presents alternate shallow grooves and slight ridges, not spiral, but annular. The calcareous lining of the cavity thus formed is a scarcely perceptible film, transparent, hyaline white, very minutely uneven, or bullato-rugose, on the inner surface, evanescent at the larger end, but generally of considerable thickness, and white at the outer. Sometimes, however, it is distinct, and white, although very thin.

The animal fills the tube entirely, presenting the appearance of a subcylindrical, bluish-white, semi-transparent worm. At the anterior extremity, which is abrupt, are seen the circular convex extremity of the foot, and above it the transverse aperture of the mouth, furnished with slender, adherent labial palpi. The bivalve shell, situated there, forms a circular hoop, as usual. At the posterior extremity of the mantle or envelope, are two lateral palmules, placed at the commencement of the two separated, unequal, retractile siphons, and, by meeting, capable of closing the cavity, when the siphons are drawn in. The viscera, partially visible through the mantle, occupy more than a third of the whole length; and beyond them are continued the narrow, elongated, coherent branchiæ.

The shell, of two very thin, diaphanous, white valves, forms a kind of ring, broad on one side, on the back of the animal, abruptly narrowed at the middle, and tapering to the other side, where they meet by a rounded point. They are in contact above, or on the back, at the hinge, which resembles that of a pholas, but without accessory piece. Each valve is semicircularly curved, and, as in the other species, may be described by comparing it to a valve of *Pholas crispata*, extremely shortened in its antero-posterior direction, and lengthened from the umbo to the ventral portion, which runs out into a narrow process. Although very minute, its markings are very distinct, and extremely beautiful. From a rounded glossy supra-umbonal prominence, having an anterior faint plait, the frontal margin, directed forwards and laterally, is a little concave, and divergent; the anterior outline forms an acute angle with it, proceeding directly backwards, and is then directed downwards at a right angle. The dorsal margin, at first concave, rises into a prominence, and then forms a very thin-edged rounded, reflexed lobe, beyond which the outline is directed downwards and forwards to the anterior point of union of the valves. Viewed from before, the ring thus formed is sub-rhomboidal, with a sinus above, formed by the separation of the frontal margins, and occupied by a strong transverse muscle. Seen from behind, it is roundish-ovate, narrowed above. On each valve externally, from behind the umbo to the ventral margin, is a distinct convex ridge, accompanied by a shallow groove; anterior to which, on the angular upper and anterior part, are about twenty-five striæ or lamellæ, parallel to the lower margin of this part, and continued behind into much finer lines, occupying the very narrow space between the ridge and the anterior margin. Behind the ridge, the valves are faintly striated parallel to the margin. In fact, in this, as in all the other species known to me, all the striæ are so arranged, as they are also in the Pholades. The interior is glossy, and presents under each umbo a very long, arcuate, linear process, considerably flattened, resembling a fine bristle, and extending nearly to half the diameter of the ring. The palmules are large, very broadly pyriform, subobcordate, very thin, concave, tapering rapidly into a styliform pedicle, and having on their inner face a longitudinal ridge, not medial, continuous with the pedicle.

The species of Teredo are very inadequately described by most authors; and it is probable that several species are confounded under one name. It is unnecessary to compare this species with any of those hitherto described, as none of them appear to approximate closely to it; nor, if they did, would it be practicable to compare them intelligibly without describing them anew. I have to add, that in one specimen I found a spicular dissepiment at the small end of the tube between the siphons. The minute species now brought into notice may be characterized thus:

*Teredo subericola. Cork-boring Teredo.*

Minute, about an inch and a quarter in length, scarcely a twelfth of an inch in diameter; with the valves hyaline-white, thin, very fragile, anteriorly rectangularly sinuate, posteriorly with a rounded reflexed lobe, inferiorly tapering into a very narrow, linear-oblong, obtuse process; the infra-umbonal tooth filiform, arcuate; the palmules broadly obcordato-pyriform, concave, with a submedial ridge, and tapering into a styliform pedicle.

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## *An Inquiry into the Distinctive Characteristics of the Aboriginal Race of America.* By Samuel George Morton, M.D., Author of Crania Americana, Crania Ægyptiaca, &c.

Ethnography,—the analysis and classification of the races of men,*—is essentially a modern science. At a time when Nature in her other departments, had been investigated with equal zeal and success, this alone remained comparatively neglected; and of the various authors who have attempted its exposition during the past and present centuries, too many have been content with closet theories, in which facts are perverted to sustain some baseless conjecture. Hence, it has been aptly remarked, that Asia is the country of fables, Africa of monsters, and America of systems, to those who prefer hypothesis to truth.

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* Ethnography may be divided into three branches—1. Physical or Organic Ethnography; 2. Philological Ethnography; and, 3. Historical Ethnography.

The intellectual genius of antiquity justly excites our admiration and homage; but in vain we search its records for the physical traits of some of the most celebrated nations of past time. It is even yet gravely disputed whether the ancient Egyptians belonged to the Caucasian race or to the Negro; and was it not for the light which now dawns upon us from their monuments and their tombs, this question might remain for ever undecided. The present age, however, is marked by a noble zeal for these inquiries, which are daily making man more conversant with the organic structure, the mental character, and the national affinities, of the various and widely scattered tribes of the human family.

Among these, the aboriginal inhabitants of America claim our especial attention. This vast theatre has been thronged, from immemorial time, by numberless tribes which lived only to destroy, and be in turn destroyed, without leaving a trace of their sojourn on the face of the earth. Contrasted with these were a few civilized communities, whose monuments awaken our surprise without unfolding their history; and he who would unravel their mysteries may be compared, in the language of the poets, to a man standing by the stream of time, and striving to rescue from its waters the wrecked and shattered fragments which float onward to oblivion.

It is not my present intention even to enumerate the many theories which have been advanced in reference to the origin of the American nations; although I may, in the sequel, inquire whether their genealogy can be traced to the Polynesians or Mongolians, Hindoos, Jews, or Egyptians. Nor shall I attempt to analyse the views of certain philosophers who imagine that they have found not only a variety of races, but several *species* of men, among the aborigines of this continent. It is chiefly my intention to produce a few of the more strikingly characteristic traits of these people, to sustain the position that all the American nations, excepting the Esquimaux, are of one race, and that this race is peculiar, and distinct from all others.

1. *Physical Characteristics.* It is an adage among travellers that he who has seen one tribe of Indians, has seen all,

so much do the individuals of this race resemble each other, notwithstanding their immense geographical distribution, and those differences of climate which embrace the extremes of heat and cold. The half-clad Fuegian, shrinking from his dreary winter, has the same characteristic lineaments, though in an exaggerated degree, as the Indians of the tropical plains ; and these again resemble the tribes which inhabit the region west of the Rocky Mountains, those of the great valley of the Mississippi, and those again which skirt the Esquimaux on the north. All possess alike the long, lank, black hair, the brown or cinnamon-coloured skin, the heavy brow, the dull and sleepy eye, the full and compressed lips, and the salient but dilated nose. These traits, moreover, are equally common to the savage and civilized nations ; whether they inhabit the margins of rivers and feed on fish, or rove the forest and subsist on the spoils of the chase.

It cannot be questioned that physical diversities do occur, equally singular and inexplicable, as seen in different shades of colour, varying from a fair tint to a complexion almost black ; and this, too, under circumstances in which climate can have little or no influence. So, also, in reference to stature, the differences are remarkable in entire tribes which, moreover, are geographically proximate to each other. These facts, however, are mere exceptions to a general rule, and do not alter the peculiar physiognomy of the Indian, which is as undeviatingly characteristic as that of the Negro ; for whether we see him in the athletic Charib or the stunted Chayma, in the dark Californian or the fair Borroa, he is an Indian still, and cannot be mistaken for a being of any other race.

The same conformity of organization is not less obvious in the osteological structure of these people, as seen in the squared or rounded head, the flattened or vertical occiput, the high cheek-bones, the ponderous maxillæ, the large quadrangular orbits, and the low receding forehead. I have had opportunity to compare nearly four hundred crania, derived from tribes inhabiting almost every region of both Americas, and have been astonished to find how the preceding characters, in greater or less degree, pervade them all.

This remark is equally applicable to the ancient and modern nations of our continent; for the oldest skulls from the Peruvian cemeteries, the tombs of Mexico and the mounds of our own country, are of the same type as the heads of the most savage existing tribes. Their physical organization proves the origin of one to have been equally the origin of all. The various civilized nations are to this day represented by their lineal descendants who inhabit their ancestral seats, and differ in no exterior respect from the wild and uncultivated Indians; at the same time, in evidence of their lineage, Clavigero, and other historians inform us, that the Mexicans and Peruvians yet possess a latent mental superiority which has not been subdued by three centuries of despotism. And again, with respect to the royal personages and other privileged classes, there is indubitable evidence that they were of the same native stock, and presented no distinctive attributes excepting those of a social or political character.

The observations of Molina and Humboldt are sometimes quoted in disproof of this pervading uniformity of physical characters. Molina says that the difference between an inhabitant of Chili and a Peruvian is not less than between an Italian and a German; to which Humboldt adds, that the American race contains nations whose features differ as essentially from one another as those of the Circassians, Moors, and Persians. But all these people are of one and the same *race*, and readily recognised as such, notwithstanding their differences of feature and complexion;* and the American nations present a precisely parallel case.

I was at one time inclined to the opinion that the ancient Peruvians, who inhabited the islands and confines of the Lake Titicaca, presented a congenital form of the head entirely different from that which characterizes the great American race; nor could I at first bring myself to believe that their wonderfully narrow and elongated crania, resulted solely from artificial compression applied to the rounded head of the Indian. That such, however, is the fact has been indisputably proved by the recent investigations of M. D'Orbigny.

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* A portion of the Moorish population of Africa is a very mixed race of Arabs, Berbers, Negroes, &c.

This distinguished naturalist passed many months on the table-land of the Andes which embraces the region of these extraordinary people, and examined the desiccated remains of hundreds of individuals in the tombs where they have lain for centuries. M. D'Orbigny remarked, that while many of the heads were deformed in the manner to which we have adverted, others differed in nothing from the usual conformation. It was also observed that the flattened skulls were uniformly those of men, while those of the women remained unaltered; and, again, that the most elongated heads were preserved in the largest and finest tombs, shewing that this cranial deformity was a mark of distinction. But to do away with any remaining doubt on this subject, M. D'Orbigny ascertained that the descendants of these ancient Peruvians yet inhabit the land of their ancestors, and bear the name of AYMARAS, which may have been their primitive designation; and lastly, the modern Aymaras resemble the common Quichua or Peruvian Indians in every thing that relates to physical conformation, not even excepting the head, which, however, they have ceased to mould artificially.

Submitted to the same anatomical test, the reputed giant and dwarf races of America prove to be the mere inventions of ignorance or imposition. A careful inspection of the remains of both, has fully satisfied me that the asserted gigantic form of some nations has been a hasty inference on the part of unpractised observers; while the so-called pygmies of the valley of the Mississippi were mere children, who, for reasons not wholly understood, were buried apart from the adult people of their tribe.

Thus it is that the American Indian, from the southern extremity of the continent to the northern limit of his range, is the same exterior man. With somewhat variable stature and complexion, his distinctive features, though variously modified, are never effaced; and he stands isolated from the rest of mankind, identified at a glance in every locality, and under every variety of circumstance; and even his desiccated remains which have withstood the destroying hand of time, preserve the primeval type of his race, excepting only when art has interposed to pervert it.

2. *Moral Traits.* These are, perhaps, as strongly marked as the physical characteristics of which we have just spoken; but they have been so often the subject of analysis as to claim only a passing notice on the present occasion. Among the most prominent of this series of mental operations is a sleepless caution, an untiring vigilance, which presides over every action and masks every motive. The Indian says nothing and does nothing without its influence: it enables him to deceive others without being himself suspected; it causes that proverbial taciturnity among strangers which changes to garrulity among the people of his own tribe; and it is the basis of that invincible firmness which teaches him to contend unrepiningly with every adverse circumstance, and even with death in its most hideous forms.

The love of war is so general, so characteristic, that it scarcely calls for a comment or an illustration. One nation is in almost perpetual hostility with another, tribe against tribe, man against man; and with this ruling passion are linked a merciless revenge, and an unsparing destructiveness. The Chickasaws have been known to make a stealthy march of six hundred miles from their own hunting grounds, for the sole purpose of destroying an encampment of their enemies. The small island of Nantucket, which contains but a few square miles of barren sand, was inhabited at the advent of the European colonies by two Indian tribes, who sometimes engaged in hot and deadly feud with each other. But what is yet more remarkable, the miserable natives of Terra del Fuego, whose common privations have linked them for a time in peace and fellowship, become suddenly excited by the same inherent ferocity, and exerted their puny efforts for mutual destruction. Of the destructive propensity of the Indian, which has long become a proverb, it is almost unnecessary to speak; but we may advert to a forcible example from the narrative of the traveller Hearne, who accompanied a trading party of northern Indians on a long journey; during which he declares that they killed every living creature that came within their reach; nor could they even pass a bird's nest without slaying the young or destroying the eggs.

That philosophic traveller, Dr Von Martius, gives a graphic view of the present state of natural and civil rights among the American aborigines. Their sub-division, he remarks, into an almost countless multitude of greater and smaller groups, and their entire exclusion and excommunication with regard to each other, strike the eye of the observer like the fragments of a vast ruin, to which the history of the other nations of the earth furnishes no analogy. "This disruption of all the bands by which society was anciently held together, accompanied by a Babylonish confusion of tongues, the rude right of force, the never ending tacit warfare of all against all, springing from that very disrupture,—appear to me the most essential, and, as far as history is concerned, the most significant points in the civil condition of the aboriginal population of America."

It may be said that these features of the Indian character are common to all mankind in the savage state. This is generally true; but in the American race they exist in a degree which will fairly challenge a comparison with similar traits in any existing people; and if we consider also their habitual indolence and improvidence, their indifference to private property, and the vague simplicity of their religious observances,—which, for the most part, are devoid of the specious aid of idolatry,—we must admit them to possess a peculiar and eccentric moral constitution.

If we turn now to the demi-civilized nations, we find the dawn of refinement coupled with those barbarous usages which characterize the Indian in his savage state. We see the Mexicans, like the later Romans, encouraging the most bloody and cruel rites, and these, too, in the name of religion, in order to inculcate hatred of their enemies, familiarity with danger, and contempt of death; and the moral effect of this system is manifest in their valorous, though unsuccessful, resistance to their Spanish conquerors.

Among the Peruvians, however, the case was different. The inhabitants had been subjugated to the Incas by a combined moral and physical influence. The Inca family were looked upon as beings of divine origin. They assumed to be the messengers of heaven, bearing rewards for the good, and punishment for the disobedient, conjoined with the arts of peace and various social institutions. History bears ample testimony that these specious pretences were employed first to captivate the fancy and then to enslave the man. The familiar adage that "knowledge is power," was as well understood by them as by us; learning was artfully restricted to a privileged class; and the genius of the few soon controlled the energies of the many. Thus the policy of the Incas inculcated in their subjects an abject obedience which knew no limit. They endeavoured to eradicate the feeling of individuality; or, in other words, to unite the minds of the plebeian multitude in a common will, which was that of their master. Thus when Pizarro made his first attack on the defenceless Peruvians in the presence of their Inca, the latter was borne in a throne on the shoulders of four men; and we are told by Herrera that while the Spaniards spared the sovereign, they aimed their deadly blows at his bearers, who, however, never shrunk from their sacred trust; for when one of their number fell, another immediately took his place; and the historian declares that if the whole day had been spent in killing them, others would still have come forward to the passive support of their master. In fact, what has been called the paternal government of the Incas was strictly such; for their subjects were children, who neither thought nor acted except at the dictation of another. Thus it was that a people whose moral impulses are known to have differed in little or nothing from those of the barbarous tribes, were reduced, partly by persuasion, partly by force, to a state of effeminate vassalage not unlike that of the modern Hindoos. Like the latter, too, they made good soldiers in their native wars, not from any principle of valour, but from the sentiment of passive obedience to their superiors; and hence, when they saw their monarch bound and imprisoned by the Spaniards, their conventional courage at once forsook them; and we behold the singular spectacle of an entire nation prostrated at a blow, like a strong man whose energies yield to a seemingly trivial but rankling wound.

After the Inca power was destroyed, however, the dormant spirit of the people was again aroused in all the moral vehemence of their race, and the gentle and unoffending Peruvian became transformed into the wily and merciless savage. Every one is familiar with the sequel. Resistance was too late to be availing, and the fetters to which they had confidingly submitted were soon rivetted for ever.

As we have already observed, the Incas depressed the moral energies of their subjects in order to secure their own power. This they effected by inculcating the arts of peace, prohibiting human sacrifices, and in a great measure avoiding capital punishments; and blood was seldom spilt excepting on the subjugation of warlike and refractory tribes. In these instances, however, the native ferocity of their race broke forth even in the bosom of the Incas; for we are told by Garcilaso, the descendant and apologist of the Peruvian kings, that some of their wars were absolutely exterminating; and among other examples he mentions that of the Inca Yupanqui against the province of Collao, in which whole districts were so completely depopulated, that they had subsequently to be colonized from other parts of the empire: and in another instance the same unsparing despot destroyed twenty thousand Caranques, whose bodies he ordered to be thrown into an adjacent lake, which yet bears the name of the Sea of Blood. In like manner, when Atahualpa contested the dominion with Guascar, he caused the latter, together with thirty of his brothers, to be put to death in cold blood, that nothing might impede his progress to the throne.

We have thus endeavoured to shew, that the same moral traits characterize all the aboriginal nations of this continent, from the humanized Peruvian to the rudest savage of the Brazilian forest.

3. *Intellectual Faculties.*—It has often been remarked, that the intellectual faculties are distributed with surprising equality among individuals of the same race who have been similarly educated, and subjected to the same moral and other influences: yet even among these, as in the physical man, we see the strong and the weak, with numberless intermediate gradations. This equality is infinitely more obvious in savage than in civilized communities, simply, because in the former the condition of life is more equal; whence it hap-

pens that in contrast to a single master mind, the plebeian multitude are content to live and die in their primitive ignorance and inferiority.

This truth is obvious at every step of the present investigation; for of the numberless hordes which have inhabited the American continent, a fractional portion only has left any trace of refinement. I venture here to repeat my matured conviction, that, as a race, they are decidedly inferior to the Mongolian stock. They are not only averse to the restraints of education, but seem for the most part incapable of a continued process of reasoning on abstract subjects. Their minds seize with avidity on simple truths, while they reject whatever requires investigation or analysis. Their proximity for more than two centuries to European communities, has scarcely effected an appreciable change in their manner of life; and as to their social condition, they are probably in most respects the same as at the primitive epoch of their existence. They have made no improvement in the construction of their dwellings, except when directed by Europeans who have become domiciliated among them; for the Indian cabin or the Indian tent, from Terra del Fuego to the river St Lawrence, is, perhaps, the humblest contrivance ever devised by man to screen himself from the elements. Nor is their mechanical ingenuity more conspicuous in the construction of their boats; for these, as we shall endeavour to shew in the sequel, have rarely been improved beyond the first rude conception. Their imitative faculty is of a very humble grade, nor have they any predilection for the arts or sciences. The long annals of missionary labour and private benefaction, present few exceptions to this cheerless picture, which is sustained by the testimony of nearly all practical observers. Even in those instances in which the Indians have received the benefits of education, and remained for years in civilized society, they lose little or none of the innate love of their national usages, which they almost invariably resume when left to choose for themselves.

Such is the intellectual poverty of the barbarous tribes; but contrasted with these, like an oasis in the desert, are the demi-civilized nations of the new world; a people whose attainments in the arts and sciences are a riddle in the history of the human mind. The Peruvians in the south, the Mexicans in the north, and the Muyscas of Bogota between the two, formed these contemporary centres of civilization, each independent of the other, and each equally skirted by wild and savage hordes. The mind dwells with surprise and admiration on their Cyclopean structures, which often rival those of Egypt in magnitude;—on their temples, which embrace almost every principle in architecture, except the arch alone; and on their statues and bas-reliefs, which, notwithstanding some conventional imperfections, are far above the rudimentary state of the arts.

I have elsewhere ventured to designate these demi-civilized nations by the collective name of the TOLTECAN FAMILY; for although the Mexican annals date their civilization from a period long antecedent to the appearance of the Toltecas, yet the latter seem to have cultivated the arts and sciences to a degree unknown to their predecessors. Besides, the various nations which at different times invaded and possessed themselves of Mexico, were characterized by the same fundamental language and the same physical traits, together with a strong analogy in their social institutions; and as the appearance of the Incas in Peru was nearly simultaneous with the dispersion of the Toltecas, in the year 1050 of our era, there is reasonable ground for the conjecture that the Mexicans and Peruvians were branches of the same Toltecan stock. We have alluded to a civilization antecedent to the appearance of the Incas, and which had already passed away when they assumed the government of the country. There are traditional and monumental evidences of this fact, which can leave no doubt on the mind, although of its date we can form no just conception. It may have even preceded the Christian era, nor do we know of any positive reasons to the contrary. Chronology may be called the crutch of history; but with all its imperfections it would be invaluable here, where no clue remains to unravel those mysterious records which excite our research, but constantly elude our scrutiny. We may be permitted, however, to repeat what is all-important to the present inquiry, that these ancient Peruvians were the progenitors of the existing Aymara tribes of Peru, while these last are identified in every particular with the people of the great Inca race. All the monuments which these various nations have left behind them, over a space of three thousand miles, go also to prove a common origin, because, notwithstanding some minor differences, certain leading features pervade and characterize them all.

Whether the hive of the civilized nations was, as some suppose, in the fabled region of Aztlan in the north, or whether, as the learned Cabrera has endeavoured to shew, their native seats were in Chiapas and Guatimala, we may not stop to inquire; but to them, and to them alone, we trace the monolithic gateways of Peru, the sculptures of Bogota, the ruined temples and pyramids of Mexico, and the mounds and fortifications of the valley of the Mississippi.

Such was the Toltecan Family; and it will now be inquired how it happens that so great a disparity should have existed in the intellectual character of the American nations, if they are all derived from a common stock, or, in other words, belong to the same race? How are we to reconcile the civilization of the one with the barbarism of the other? It is this question which has so much puzzled the philosophers of the past three centuries, and led them, in the face of facts, to insist on a plurality of races. We grant the seeming anomaly; but however much it is opposed to general rule, it is not without ample analogies among the people of the old world. No stronger example need be adduced than that which presents itself in the great Arabian family; for the Saracens who established their kingdom in Spain, whose history is replete with romance and refinement, whose colleges were the centres of genius and learning for several centuries, and whose arts and sciences have been blended with those of every subsequent age;—these very Saracens belong not only to the same race, but to the same family with the Bedouins of the desert; those intractable barbarians who scorn all restraints which are not imposed by their own chief, and whose immemorial laws forbid them to sow corn, to plant fruit-trees, or to build houses, in order that nothing may conflict with those roving and predatory habits which have continued unaltered through a period of three thousand years.

Other examples perhaps not less forcible, might be adduced in the families of the Mongolian race; but without extending the comparison, or attempting to investigate this singular intellectual disparity, we shall, for the present at least, content ourselves with the facts as we find them. It is important, however, to remark, that these civilized states do not stand isolated from their barbarous neighbours; on the contrary, they merge gradually into each other, so that some nations are with difficulty classed with either division, and rather form an intermediate link between the two. Such are the Araucanians, whose language and customs, and even whose arts, prove their direct affiliation with the Peruvians, although they far surpass the latter in sagacity and courage, at the same time that their social institutions present many features of intractable barbarism. So also the Aztec rulers of Mexico at the period of the Spanish invasion, exhibit, with their bloody sacrifices and multiform idolatry, a strong contrast to the gentler spirit of the Toltecas who preceded them, and whose arts and ingenuity they had usurped. Still later in this intermediate series were the Natchez tribes of the Mississippi, who retained some traces of the refinement of their Mexican progenitors, mingled with many of the rudest traits of savage life. It is thus that we can yet trace all the gradations, link by link, which connect these extremes together; shewing that although the civilization of these nations is fast becoming obsolete, although their arts and sciences have passed away with a former generation, still the people remain in all other respects unchanged, although a variety of causes has long been urging them onward to deep degradation and rapid extinction. Strange as these intellectual revolutions may seem, we venture to assert, that, all circumstances considered, they are not greater than those which have taken place between the ancient and modern Greeks. If we had not incontestible evidence to prove the fact, who would believe that the ancestors of the Greeks of the present day were the very people who gave glory to the age of Pericles!

It may still be insisted that the religion and the arts of the American nations point to Asia and Egypt; but it is obvious, as Humboldt and others have remarked, that these resemblances may have arisen from similar wants and impulses, acting on nations in many respects similarly circumstanced. "It would indeed be not only singular but wonderful and unaccountable," observes Dr Caldwell, "if tribes and nations of men, possessed of similar attributes of mind and body, residing in similar climates and situations, influenced by similar states of society, and obliged to support themselves by similar means, in similar pursuits,—it would form a problem altogether inexplicable, if nations thus situated did not contract habits and usages, and, instinctively, modes of life and action, possessing towards each other many striking resemblances." Here, also, we may draw an illustration from the old world; for, notwithstanding the comparative proximity of the Hindoos and Egyptians, and the evident analogies in their architecture, mythology, and social institutions, there is now no reason to believe them cognate nations; and the resemblances to which we have adverted have probably arisen from mutual intercourse, independent of lineal affiliation. And so with the nations of America. The casual appearance of ship-wrecked strangers would satisfactorily explain any sameness in the arts and usages of the one and the other, as well as those words which are often quoted in evidence of a common origin of language, but which are so few in number as to be readily accounted for on the foregoing principle.

The entire number of common words is said to be one hundred and four between the American languages and those of Asia and Australia; forty-three with those of Europe; and forty with those of Africa, making a total of one hundred and eighty-seven words. But taking into account the mere coincidence by which some of these analogies may be reasonably explained, I would inquire, in the language of an ingenious author, whether these facts are sufficient to prove a connexion between four hundred dialects of America and the various languages of the old world?

Even so late as the year 1833, a Japanese junk was wrecked on the north-west coast of America, and several of the crew escaped unhurt to the shore; and I have myself seen some porcelain vessels which were saved on that occasion. Such casualties may have occurred in the early periods of American history; and it requires no effort of the imagination to conceive the influence these persons might have exerted, in various respects, had they been introduced to the ancient courts of Peru and Mexico. They might have contributed something to extend, or at least to modify, the arts and sciences of the people among whom they were thrown, and have added a few words to the national language.

I am informed by my friend Mr Townsend, who passed several months among the tribes of the Columbia river, that the Indians there have already adopted from the Canadian traders several French words, which they use with as much freedom as if they belonged to their own vocabulary.

It follows, of course, from the preceding remarks, that we consider the American race to present the two extremes of intellectual character; the one capable of a certain degree of civilization and refinement, independent of extraneous aids; the other exhibiting an abasement which puts all mental culture at defiance. The one composed, as it were, of a handful of people, whose superiority and consequent acquisitions have made them the prey of covetous destroyers; the other a vast multitude of savage tribes, whose very barbarism is working their destruction from within and without. The links that connect them partake of the fate of the extremes themselves; and extinction appears to be the unhappy, but fast approaching, doom of them all.

4. *Maritime Enterprise.*—One of the most characteristic traits of all civilized and many barbarous communities, is the progress of maritime adventure. The Caucasian nations of every age present a striking illustration of this fact: their sails are spread on every ocean, and the fabled voyage of the Argonauts is but a type of their achievements from remote antiquity to the present time. Hence their undisputed dominion of the sea, and their successful colonization of every quarter of the globe. The Mongolians and Malays, though active and predatory, and proverbially aquatic in their habits,

are deficient in that mechanical invention which depends on a knowledge of mathematical principles; while they seem also incapable of those mental combinations which are requisite to a perfect acquaintance with naval tactics. The Negro, whose observant and imitative powers enable him to acquire with ease the details of seamanship, readily becomes a mariner, but rarely a commander; and history is silent on the nautical prowess of his race. Far behind all these is the man of America. Savage or civilized, the sea for him has had few charms, and his navigation has been almost exclusively restricted to lakes and rivers. A canoe excavated from a single log, was the principal vessel in use in the new world at the period of its discovery. Even the predatory Charibs, who were originally derived from the forests of Guayana, possessed no other boat than this simple contrivance, in which they seldom ventured out of sight of land; and never excepting in the tranquil periods of the tropical seas, when they sailed from shore to shore, the terror of the feebler natives of the surrounding islands. The canoes of the Arouacs of Cuba were not more ingeniously contrived than those of the ruder Charibs; which is the more surprising, since their island was the centre of a great archipelago, and their local position, therefore, in all respects calculated to develope any latent nautical propensities. When Cortez approached, in his ships, the Mexican harbour of Tobasco, he was astonished to find, even there, the sea-port, as it were, of a mighty empire, the same primitive model in the many vessels that skimmed the sea before him. Let us follow this conqueror to the imperial city itself, surrounded by lakes, and possessed of warlike defences superior to those of any other American people. The Spanish commander, foreseeing that to possess the lake would be to hold the keys of the city, had fifteen brigantines built at Tlascala; and these being subsequently taken to pieces, were borne on men's shoulders to the lake of Mexico, and there re-constructed and launched. The war thus commenced as a naval contest; and the Spanish historians, while they eulogize the valour of the Mexicans, are constrained to admit the utter futility of their aquatic defences: for although the subjects of Montezuma, knowing and anticipating the nature of the attack, came forth from the city in several thousand boats, these were so feebly constructed, and managed with so little dexterity, that in a few hours they were all destroyed, dispersed, or taken by the enemy.

Turning from the Mexicans, we naturally look to the Peruvians for some further advances in nautical skill; but although their country was comparatively a narrow strip of land, with an extended frontier on the ocean, we find even here the same primitive vessels and the same timid navigators. It is indeed questionable whether they ever designedly lost sight of land; nor does it appear that they made the sea subservient to their conquests. These were uniformly prosecuted by land, excepting perhaps those of the Incas, in their efforts to subdue the fierce islanders of Titicaca; but even the partial pen of Garcilaso limits all these inventions to log canoes and rafts of reeds; nor does it appear that the ingenuity of these people, so abundantly displayed on many other occasions, had ever added an improvement to the primeval germ of navigation.

Nor are those tribes which depend almost wholly on fish for their daily subsistence, much better provided than the others. The Chenouks and other nations on the western coast of America, have boats hewn with comparative ingenuity from a single plank, and compared to a butcher's tray; but in these frail vessels they keep cautiously within sight of land, and never venture on the water unless the weather is favourable to their enterprize. It is to be observed, however, that when the Indians are compelled to carry their boats across portages from river to river, they construct them of birch bark, and with a degree of ingenuity and adaptation much above their usual resources. Thus, boats that would carry nine men do not weigh over sixty pounds, and are therefore conveyed with ease to considerable distances. This is almost the only deviation from the log canoe, and is equally characteristic; for it is common among the interior Indians of both North and South America, and was noticed by De Solis in the Mexican provinces.

Inferior in these respects to the other tribes are the Fuegians; a people whom perpetual exposure and privation, and the influence of an inhospitable climate, have reduced to a feeble intelligence,—the moral childhood of their race. Not even the stimulus of necessity has been able to excite that ingenuity which would so amply provide for all their wants; and they starve amid the abundant stores of the ocean, because they possess no adequate means for obtaining them. The Falkland and Malouine islands, in but fifty degrees of South latitude, South Georgia, New South Shetland, and some smaller islands in nearly the same parallel, were, at their discovery, entirely uninhabited; nor is there any evidence of their ever having been visited by any American tribe. Yet they possess seals and other marine animals in vast numbers, and in these and all other respects appear to be not less productive than the region inhabited by the Esquimaux.

It is generally supposed that nautical enterprize results from the necessity of the case, in nations proximate to or surrounded by the sea. We have seen, however, that the natives of the islands of the Gulf of Mexico were exceptions to the rule; and we find another not less remarkable in the archipelago of Chiloe, on the coast of Chili. These islands are seen from the shore, and have a large Indian population, which depends for subsistence on fish taken from the surrounding ocean; yet even so late as the close of the past century, after more than two hundred years of communication with the Spaniards, their boats appear not to have been the least improved from their original model. The padre Gonzalez de Agueros, who resided many years among these islanders, describes their canoes as composed of five or six boards, narrowed at the ends, and lashed together with cords, the seams being filled with moss. They have sails, but neither keel nor deck; and in these frail and primitive vessels the inhabitants commit themselves to a tempestuous sea in search of their daily food. The same miserable vessels are found in exclusive use in the yet more southern archipelago of Guaitecas, in which a sparse population is distributed over eight hundred islands, and depends solely on the sea for subsistence. The mechanical ingenuity of these people, therefore, is not greater than that of the other Indians; but, from constant practice with their wretched bo s, they have acquired a dexterity in the use of them unknown to any other tribe, and in some instances, under the direction of the Spaniards, have become comparatively good mariners.

De Azara mentions a curious fact in illustration of the present inquiry. He declares that when his countrymen discovered the Rio de la Plata, they found its shores inhabited by two distinct Indian nations, the Charruas on the north, and the Patagonians on the south ; yet, strange to say, these restless people had never communicated with each other for war or for peace, for good or for evil, because they had neither boats nor canoes in which to cross the river.

The Indian is not defective in courage, even on the water ; but he lacks invention to construct better vessels, and tact to manage them. When he has been compelled to defend himself in his frail canoe, he has done so with the indomitable spirit of his race ; yet, with all his love of war and stratagem, I cannot find any account of a naval combat in which Europeans have borne no part.

The Payaguas Indians at one period took revenge on the Spaniards by infesting the rivers of Paraguay, in canoes which they managed with much adroitness ; and, darting from their lurking places, they intercepted the trading vessels going to and from Buenos Ayres, robbing them of their goods, and destroying their crews without mercy. Such was their success in these river piracies, that it required years of war and stratagem on the part of the Spaniards to subdue them.

The only example of a naval contest that I have met with, is described by Dobrizhoffer to have taken place between the so-called Mamalukes of St Paulo, in Brazil, and their enemies, the Guaranies. The former were a banditti derived from the intermarriage of the dregs of Europeans of all nations with the surrounding Indians ; and, assisted by two thousand of their native allies, they came forth to battle in three hundred boats. The Guaranies, on the other hand, had five ships armed with cannon. But it is obvious, from this statement, that European vessels and European tactics gave the battle all its importance. It took place on the river Mbororc, in Paraguay ; but, after all, both parties finding themselves out of their element on the water, at length abandoned their vessels by mutual agreement, aud fought to desperation on shore.

It is said of the inhabitants of New Holland, that their only substitute for a boat is a short and solid log, on which they place themselves astride, and thus venture upon the water. Even this, the humblest of all human contrivances, was in use among the Indians of the Bay of Honduras, who had learned to balance themselves so dexterously standing upon a log, as to be able in this position to pursue their customary occupation of fishing in the adjacent sea.

In fine, his long contact with European arts, has furnished the Indians with no additional means of contending with the watery element; and his log canoe and boat of birch-bark, are precisely the same as at the landing of Columbus.

5. *Manner of Interment.*—Veneration for the dead is a sentiment natural to man, whether civilized or savage: but the manner of expressing it, and of performing the rites of sepulture, differ widely in different nations. No offence excites greater exasperation in the breast of the Indian than the violation of the graves of his people; and he has even been known to disinter the bones of his ancestors, and bear them with him to a great distance, when circumstancees have compelled him to make a permanent change of residence.

But the *manner* of inhumation is so different from that practised by the rest of mankind, and at the same time so prevalent among the American nations, as to constitute another means of identifying them as parts of a single and peculiar race. This practice consists in burying the dead in the *sitting posture;* the legs being flexed against the abdomen, the arms also bent, and the chin supported on the palms of the hand. The natives of Patagonia, Brazil, and Guayana—the insular and other Charibs—the Florida tribes—the great chain of Lenapé nations—the inhabitants of both sides of the Rocky Mountains—and those also of Canada and the vast Northwestern region,—all conform, with occasional exceptions, to this conventional rite. So also with the demi-civilized communities from the most distant epochs; for the ancient Peruvians, to whom we have already so frequently referred, possessed this singular usage, as is verified by their numberless remains in the sepulchres of Titicaca. They did not, however, bury their dead, but placed them on the floors of their tombs, seated, and sewed up in sacks. The later Peruvians of the Inca race followed the same custom, sometimes inhuming the body, at others placing it in a tower above ground. Garcilaso de la Vega informs us, that, in the year 1560, he saw five embalmed bodies of the royal family, all of whom were seated in the Indian manner, with their hands crossed upon the breast, and their heads bent forward. So also the Mexicans from the most ancient time had adopted the same usage, which was equally the privilege of the king and his people. The most remarkable exception to the practice in question, is that in which the body is dissected before interment—the bones alone being deposited in the earth. This extraordinary rite has prevailed among various tribes from the southern to the northern extremity of their range, in Patagonia, Brazil, Florida, and Missouri, and indeed in many intervening localities; but even in these instances, the bones are often retained in their relative position by preserving the ligaments, and then interred in the attitude of a person seated. An example, among very many others, is recorded by the Baron Humboldt, in his visit to a cavern-cemetery of the Atures Indians, at the sources of the Orinoco; wherein he found hundreds of skeletons preserved each in a separate basket, the bones being held together by their natural connections, and the whole disposed in the conventional posture of which we are speaking.

I am well aware that this practice has been noticed by some navigators among the Polynesian Islands; the instances, however, appear so few as rather to form exceptions to the rule, like those of the Nassamones of northern Africa: but I have sought for it in vain among the continental Asiatics, who, if they ever possessed it, would have yet preserved it among some at least of their numberless tribes.

After this rapid view of the principal leading characteristics of the American race, let us now briefly inquire whether they denote an exotic origin; or whether there is not internal evidence that this race is as strictly aboriginal to America as the Mongolian is to Asia, or the Negro to Africa.

And, first, we turn to the Mongolian race, which, by a somewhat general consent, is admitted to include the Polar nations, and among them the Esquimaux of our continent. It is a very prevalent opinion that the latter people, who obviously belong to the Polar family of Asia, pass insensibly into the American race, and thus form the connecting link between the two. But without repeating what has already been said in reference to the Indian, we may briefly advert, for the purpose of comparison, to the widely different characteristics of the Esquimaux. These people are remarkable for a large and rather elongated head, which is low in front and projecting behind; the great width and flatness of the face is noted by all travellers; their eyes are small and black, the mouth small and round, and the nose is so diminutive and depressed, that, on looking at a skull in profile, the nasal bones are hardly visible. Their complexion, moreover, is comparatively fair, and there is a tendency throughout life to fulness and obesity. The traveller Hearne, while in company with a tribe of northern Indians, mentions a circumstance which is at least curious, because it shews the light in which the Esquimaux are regarded by their proximate neighbours on the south. He was the unwilling witness of a premeditated and unprovoked massacre of an entire encampment of Esquimaux, men, women, and children; and it is curious to remark that the aggressors apologised for their cruelty not only on the plea of an ancient feud, but by asserting that their unoffending victims were a people of different nature and origin from themselves, even in respect to sexual conformation.

The moral character of the Esquimaux differs from that of the Indian chiefly in the absence of the courage, cunning, cruelty, and improvidence so habitual in the Red man, who, in turn, is inferior in mechanical ingenuity, and, above all, in aquatic exercises. The Esquimaux, notwithstanding the intense cold of his climate, has been called an amphibious animal, so readily and equally does he adapt himself to the land or water. His boat is an evidence of mechanical skill; and the adroit manner in which he manages it is a proverb among mariners. The women are not less expert and enterprising than the men: each possesses a boat of peculiar and distinctive construction; and Crantz informs us, that children of the tender age of seven or eight years commence the unassisted management of their own little vessels.

How strongly do these and other traits which might be enumerated, contrast with those of the Indian, and enforce an ethnographic dissimilarity which is confirmed at every step of the investigation!

Some writers, however, think they detect in the Fuegian a being whose similar physical condition has produced in him all the characteristics of the Esquimaux; but we confidently assert that the latter is vastly superior both in his exterior organization and mental aptitude. In truth the two may be readily contrasted but not easily compared. The Fuegian bears a coarse but striking resemblance to the race to which he belongs, and every feature of his character assists in fixing his identity. The extremes of cold, with their many attending privations, by brutifying the features and distorting the expression of the face, reduce man to a mere caricature, a repulsive perversion of his original type. Compare the Mongols of Central Asia and China with the Polar nations of Siberia. Compare also the Hottentot with the contiguous black tribes on the north—the Tasmanian negro with the proper New Hollander,—and lastly, the wretched Fuegian with the Indian beyond the Magellanic strait; and we find in every instance how much more the man of a cold and inhospitable clime is degraded, physically and intellectually, than his more fortunate but affiliated neighbour. The operation of these perverting causes through successive ages of time, has obscured but not obliterated those lineaments which, however modified, point to an aboriginal stock.

Without attempting to enter the fathomless depths of philology, I am bound to advert to the opinion of Mr Gallatin, that all the nations from Cape Horn to the Arctic Ocean, have languages which possess "a distinct character common to all, and apparently differing from those of the other continent with which we are acquainted;" an analogy, moreover, which is not of an indefinite kind, but consists, for the most part, in peculiar conjugational modes of modifying the verbs by the insertion of syllables. It has been insisted by some writers that this analogy proves the cognate relation of the Esquimaux and Indians. This, however, is a mere postulate; for, from the evidence already adduced in respect to the ethnographic difference between these people, we have a right to infer that the resemblance in their respective languages has not been derived by the greater from the lesser source,—not by the Americans from the Esquimaux, but the reverse: for the Asiatics having arrived at various and distant periods, and in small parties, would naturally, if not unavoidably, adopt more or less of the language of the people among whom they settled, until their own dialects finally merged in those of the Chepewyan and other Indians who bound them on the south.

The Esquimaux, it may be remarked, at the present time extend much further south, and are much more numerous on the western than on the eastern coast of America, being found as low down as Mount St Elias; south of which, contrary to what is observed on the opposite side of the continent, they become more or less blended with the Indian tribes, and have imparted to the latter some portion of their mechanical ingenuity. This difference in the extent and influence of the western and eastern Esquimaux, is explained by the proximity of the former to Asia; and a redundant population has even forced some of them back to the parent hive, whither they have carried a dialect derived from the cognate tribes of America. Such are the Tsutchchi, who thus form a link between the Polar nations of the two continents.

It is a common opinion, also, that America has been peopled by the proper Mongols of Central and Eastern Asia; and volumes have been written on supposed affinities, physical, moral, and intellectual, to sustain this hypothesis. We have already glanced at the Mongolian features, as seen, though rudely and extravagantly developed, in the Polar nations; but there are some characters so prevalent as to pervade all the ramifications of the great Mongolian stock, from the repulsive Calmuck to the polished and more delicately featured Chinese. These are the small, depressed, and seemingly broken nose; the oblique position of the eye, which is drawn up at the external angle; the great width between the cheek bones, which are not only high, but expanded laterally; the arched and linear eyebrow; and, lastly, the complexion, which is invariably some shade of yellow or olive, and almost equally distant from the fair tint of the European and the red hue of the Indian. Without attempting a detailed comparison, we may briefly observe that the Mongolian, in his various localities, is distinguished for his imitative powers and mechanical ingenuity, and for a certain degree of nautical skill, in which, as we have suggested, he holds a place next to the nations of the Caucasian race. In fine, we are constrained to believe that there is no more resemblance between the Indian and Mongol, in respect to arts, architecture, mental features and social usages, than exists between any other two distinct races of mankind. Mr Ranking has written an elaborate treatise to prove that the Mongols, led by a descendant of Genghis Khan, conquered Peru and Mexico in the thirteenth century; but in the whole range of English literature there cannot be found a work more replete with distorted facts and illogical reasoning. The author begins by the singular assertion that "when Cuzco was founded by Manco Capac, none of the civilization introduced by the Peruvians and Mexicans was in existence;" thus overlooking the cultivated tribes who preceded the Inca family, and disregarding also the various demi-civilized nations which successively followed each other in Mexico, before that country fell under the rule of the Aztecs.* Mr Ranking intro-

* Crania Americana, p. 96.

duces the Mongols in large ships, with all the appliances of war, not even excepting elephants ; and in order that the Tartar general may correspond to Manco Capac, he is made to enter Peru by the Lake Titicaca, upwards of an hundred miles from the sea. Such statements may seem too absurd for sober discussion ; but they are not more so than various other subterfuges which have been resorted to in explanation of the precise manner in which the New World has been peopled from the Old.

But there is not a shadow of evidence that the Mongols ever reached America in ships excepting by mere accident ; and, therefore, their number must have always been too small, and too badly provided, to have dreamt of conquest in a country which has had a population of millions from immemorial time.

There is a third view of this question which remains to be noticed ; for, allowing that the Esquimaux and the cognate Polar nations are not the progenitors of the American race ; and admitting also that the Mongols of Central Asia could never have arrived in any requisite number by a direct voyage from one continent to the other, yet it is supposed by many learned men that these Mongols could have reached America by slow journeys from their own distant country, and that their hieroglyphic charts delineate many of the incidents of this protracted migration ; but there is no positive evidence in regard to direction and localities, although these, by a very general consent, are placed in the north and northwest. Cabrera, on the contrary, after the most patient research, aided by unusual facilities for investigation, traces the primal seat of the civilized nations of America to Southern Mexico, where the ruined cities of Copan, Uxmal, and Palenque, point to an epoch seemingly much more remote than any antiquities contained in or near the present metropolis of that country.

If we conventionally adopt the more prevalent opinion, and trace the Aztecs back to California or the Strait, we have, after all, but a vague tradition of a handful of persons who, for all we know to the contrary, may have been as indigenous to America as any people in it. The aborigines of this continent have always been of nomadic and migratory habits ; a fact which is amply illustrated in the traditional history of Mexico itself. So also with the barbarous tribes ; for the Lenapé, the Florida Indians, the Iroquois, the insular Charibs, and many others, were intruding nations, who, driven by want, or impelled by an innate and restless activity, had deserted their own possessions to seize upon others which did not belong to them. These nations, like their more polished neighbours, were in the constant practice of recording the events of their battles and hunting excursions by hieroglyphic symbols, made, according to circumstances, on trees, skins, or rocks ; and this rude but expressive language of signs has been justly regarded as the origin of the picture writing of the Mexicans. " The difference between them," observes Dr Coates, " does not appear greater than must necessarily exist between ignorant warriors and hunters in a simple form of society, and those of the members of a complicated state possessed of property, and even, as described by Clavigero, of a species of science and literature."

This gradation of the ruder into the more perfect art of hieroglyphic writing, not only affords an additional argument for the unity of origin of the American nations, but also constitutes another proof of the distinctness of their race ; for this picture-writing, even in its most elaborate forms, bears no other than the most general resemblance to any exotic hieroglyphics, nor, indeed, has a real equivalent been detected between them. We may, therefore, be permitted to repeat our conviction that the annals of the Mexicans bear no indisputable evidence of immigration from Asia ; but, on the other hand, that they are susceptible of as many different interpretations as there are theories to be supported.

It is remarked by Dr Coates, that the Mongolian theory, which we are now considering, is objectionable on account of its vastness. " To derive the population of the whole of the American continent from the north-western angle, requires the supposition of a continued chain of colonies during a long succession of ages, acquiring and using an immense diversity of languages, and pursuing each other along the huge ridge of the great American Andes, from Prince William's Sound in the far north, to the extremity of Terra del Fuego, a distance of one hundred and fifteen degrees of latitude, or of eight thousand miles. This long succession of occurrences is absolutely necessary to the theory, which is thus liable to the difficulty of requiring two extensive hypotheses at once. Several hundred colonies must be imagined to have issued from the same point all completely isolated, as their languages abundantly shew, unconnected by peaceful intercourse, but urging each other, by war and the destruction of the game, throughout a third part of the circumference of the globe.

"The traces of such a series of human waves would be naturally looked for in a tendency to advance population in the north, from which they emanated, and where the pressure must have been greatest, and the colonization of longest duration. Nothing like this is observed: the population of South America, and of Darien, Guatimala, and Mexico, being much greater in proportion than that of any country farther north. The marks of civilization, too—one of the most important proofs of long residence in a fixed spot—are all, as in the older world, in favour of the tropical climates." *

We may further inquire, how it happens that during the lapse of more than three hundred years since the discovery of America, there has not been an authenticated immigration from Asia? The long and desolating wars which have driven whole nations from the central to the northern parts of that continent, have not supplied a single colony to the New World. Nay, if such colonization had occurred within a thousand or two thousand years, would we not now possess more indubitable evidences of it in language, customs, and the arts?

We propose, in the next place, to make a very few observations in reference to the idea that America has been peopled

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* On the Origin of the Indian Population of America. By B. H. Coates, M.D. 1834.

by the MALAY race, which, in the ordinary classification, includes the Malays proper of the Indian Archipelago, and the Polynesians in all their numberless localities. These people, however, have so much of the Mongolian character, that nearly the same objections arise to both. The head of the Malay proper is more like that of the Indian, because it not unfrequently presents something of the vertical form of the occiput; and the transverse diameter, as measured between the parietal bones, is also remarkably large. But excepting in these respects, the osteological development concides with that of the Mongolian; while the category of objections which we have just urged against the latter people is equally valid in respect to the whole Malay race. For, independently of differences of organization, how great is the disparity in their arts and social institutions! So great indeed, that, to account for it, Dr Lang, one of the most ingenious supporters of the theory, insists on an intellectual degeneracy consequent to change of climate and circumstances. "It is an easy and natural process," says he, "for man to degenerate in the scale of civilization, as the Asiatics have evidently done in travelling to the northward and eastward. He has only to move forward a few hundred miles into the wilderness, and settle himself at a distance from all civilized men, and the process will advance with almost incredible celerity. For whether he comes in contact with savages or not, in the dark recesses of the forest his offspring will speedily arrive at a state of complete barbarism."

We confess our difficulty in imagining how the Polynesians, themselves a barbarous people, though possessing some of the attributes of civilized life, should become savages in the tropical regions of America, wherein the climate must be as congenial to their constitutions as their own, and the various other external circumstances are calculated to foster rather than to depress the energies of a naturally active and intelligent people. But the general prevalence of easterly winds is adverse to the colonization of America from the islands of the Pacific; for the nearest of these islands is one thousand eight hundred miles from the American coast; and when we reflect on the many difficulties which the mere distance opposes to navigation in small vessels, and the absolute necessity for food and water for a long period of time, we feel compelled to believe that America has received very feeble accessions to its population from the Polynesian islands. Such voyages, if admitted, could only have been accidental; for it is not to be supposed that these islanders would have attempted remote discoveries on the vast Pacific ocean in the very face of the trade winds; and a successful issue is among the least probable of human events.

Even admitting that the Polynesians have accomplished all that the theory requires, how does it happen that, on reaching the continent of America, they should all at once have relinquished their intuitive fondness for the water, forgotten the construction of their boats, and become the most timid and helpless navigators in the world?

A comparison of languages, moreover, gives no support to the Polynesian hypothesis; for all the zeal and ingenuity which have been devoted to this inquiry, have tended only to disclose a complete philological disparity.

The theories to which we have thus briefly adverted, would each derive the whole American population from a single source; but various others have been hazarded of a much more complex nature, by which the Indian nations are referred to a plurality of races, not even excepting the Caucasian. For example, the Peruvians, Muyscas, and Mexicans, are, by some advocates of this system, supposed to be Malays or Polynesians, while all the savage tribes are referred to the Mongolians; whence the civilization of the one and the barbarism of the other. But we insist that the origin of these great divisions must have been the same, because all their ethnographic characters, not excepting the construction of their numberless languages, go to enforce an identity of race.

Another doctrine which has had many disciples (among whom was the late Lord Kingsborough, author of *Mexican Antiquities*), teaches that the whole American population is descended from the Jews, through the Ten lost Tribes which were carried away by Salmanazer, King of Assyria. Here again the differences of physical organization should set this question at rest for ever; but independently of these, can we suppose that a people so tenacious as the Jews of their literature, language, and religion, would not have preserved a solitary, unequivocal memorial of either among the multitudinous tribes of this continent, if any direct affiliation had ever existed between them? In short, we coincide in opinion with a facetious author, who sums up all the evidence of the case with the conclusion, that "the Jewish theory cannot be true, for the simple reason that it is impossible."

We feel assured that the same objection bears not less strongly on every other hypothesis which deduces any portion of the American nations from a Caucasian source. In order to solve the problem of the origin of the monuments of America, independently of any agency of the aboriginal race, an opinion has been advanced that they are the work of a branch of the great Cyclopean family of the old world, known by the various designations of the Shepherd Kings of Egypt, the Anakim of Syria, the Oscans of Etruria, and the Pelasgians of Greece. These *wandering masons*, as they are also called, are supposed to have passed from Asia into America at a very early epoch of history, and to have built those more ancient monuments which are attributed to the Toltecan nation. This view, supported as it is by some striking resemblances, and especially in architectural decoration, leaves various important difficulties entirely unexplained; it necessarily pre-supposes a great influx of foreigners to account for such numerous and gigantic remains of human ingenuity and effort, at the same time that no trace of this exotic family can be detected in the existing Indian population. They and their arts are equally eradicated; and we can, at most, only conceive of the presence of these migratory strangers in small and isolated groups, which might have modified the arts of an antecedent civilization, while they themselves were too few in number to transmit their lineaments to any aboriginal community.

Closely allied to this theory, is that of our ingenious countryman, Mr Delafield, who derives the demi-civilized nations of America from "the Cuthites who built the monuments of Egypt and Indostan." He supposes them to have traversed all Asia to reach Behring's strait, and thus to have entered America at its northwest angle, whence they made their way, by slow journeys, to the central regions of the continent. Our objections to this theory will be found in what has been already stated; and we may merely add, that the *route* by which the author conducts his pilgrim adventurers appears to constitute the least plausible portion of his theory. Mr Delafield supposes the barbarous tribes to be of a different stock, and refers them to the Mongolians of Asia; thus adopting the idea of a plurality of races.

We shall lastly notice an imaginative classification which separates the aborigines of America into four *species* of men, exclusive of the Esquimaux. This curious but unphilosophical hypothesis has been advanced by M. Bory de St Vincent, a French naturalist of distinction, who considers the civilized nations to be cognate with the Malays, and designates them by the collective name of the *Neptunian species;* while to his three remaining species,—the Columbian, the American, and the Patagonian, he assigns certain vague geographical limits, without establishing any distinctive characteristics of the people themselves. The system is so devoid of foundation in nature, so fanciful in all its details, as hardly to merit a serious analysis; and we have introduced it on the present occasion to illustrate the extravagance and the poverty of some of the hypotheses which have been resorted to in explanation of the problem before us.

Once for all I repeat my conviction, that the study of physical conformation alone excludes every branch of the Caucasian race from any obvious participation in the peopling of this continent. If the Egyptians, Hindoos, Phœnicians, or Gauls, have ever, by accident or design, planted colonies in America, these must have been, sooner or later, dispersed and lost in the waves of a vast indigenous population. Such we know to have been the fact with the Northmen, whose repeated, though very partial, settlements in the present New England States, from the tenth to the thirteenth centuries, are now matter of history; yet, in the country itself they have not left a single indisputable trace of their sojourn.

In fine, our own conclusion, long ago deduced from a patient examination of the facts thus briefly and inadequately stated, is, that the American race is essentially separate and peculiar, whether we regard it in its physical, its moral, or its intellectual relations. To us there are no direct or obvious links between the people of the old world and the new; for even admitting the seeming analogies to which we have alluded, these are so few in number, and evidently so casual, as not to invalidate the main position; and even should it be hereafter shewn, that the arts, sciences, and religion of America can be traced to an exotic source, I maintain that the organic characters of the people themselves, through all their endless ramifications of tribes and nations, prove them to belong to one and the same race, and that this race is distinct from all others.

This idea may, at first view, seem incompatible with the history of man, as recorded in the Sacred Writings. Such, however, is not the fact. Where others can see nothing but chance, we can perceive a wise and obvious design, displayed in the original adaptation of the several races of men to those varied circumstances of climate and locality which, while congenial to the one, are destructive to the other. The evidences of history and the Egyptian monuments go to prove that these races were as distinctly stamped three thousand five hundred years ago as they are now; and, in fact, that they are coeval with the primitive dispersion of our species.*

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[We regret that want of space prevented us inserting in this Number the Appendix to Dr Morton's truly excellent Memoir.—EDITOR.]

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* I cannot omit the present occasion to express my admiration of the recent discoveries of Mr Stephens among the ruined cities of Central America and Yucatan. The spirit, ability, and success, which characterize these investigations, are an honour to that gentleman and to his country; and they will, probably, tend more than the labours of any other person to unravel the mysteries of American Archæology. Similar in design to these are the researches of my distinguished friend the Chevalier Friedrichthal, the result of whose labours, though not yet given to the world, are replete with facts of the utmost importance to the present inquiry.

*Observations on the Comet in the Whale, made at the Observatory of Hamburg.* By M. RUMKER. Communicated by Sir T. Makdougall Brisbane, Bart., President of the Royal Society of Edinburgh.

| 1844. | Mean Time at Hamburg. | | | Apparent Aphelion of the Comet. | | | Apparent Declination of the Comet. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | h. | m. | s. | ° | ′ | ″ | ° | ′ | ″ | |
| Sept. 12. | 13 | 8 | 49.3 | 9 | 18 | 23.5 | 14 | 23 | 46.9 | |
| | 13 | 13 | 38.9 | 9 | 18 | 31.1 | 14 | 23 | 26.0 | Merid. |
| 13. | 10 | 10 | 3.1 | 9 | 51 | 30.5 | 13 | 57 | 30.6 | |
| 20. | 9 | 49 | 56.3 | 13 | 36 | 46.4 | 10 | 32 | 58.0 | |
| 21. | 10 | 23 | 47.9 | 14 | 4 | 36.3 | 10 | 3 | 34.4 | |
| | 12 | 52 | 37.2 | 14 | 6 | 56.1 | | | | Merid. |
| 22. | 10 | 44 | 42.0 | 14 | 31 | 0.1 | 9 | 34 | 54.0 | |
| | 12 | 50 | 25.7 | 14 | 33 | 7.3 | 9 | 32 | 22.2 | Merid. |
| 24. | 11 | 44 | 0.8 | 15 | 20 | 39.4 | 8 | 38 | 10.0 | |
| | 12 | 45 | 47.2 | 15 | 21 | 35.5 | 8 | 36 | 37.9 | Merid. |
| 28. | 12 | 35 | 38.1 | 16 | 45 | 26.7 | 6 | 48 | 46.4 | Merid. |
| 30. | 9 | 3 | 16.7 | 17 | 19 | 55.2 | 6 | 1 | 20.6 | |
| Oct. 2. | 11 | 3 | 48.1 | 17 | 54 | 7.3 | 5 | 9 | 4.2 | |
| | 12 | 24 | 32.3 | 17 | 55 | 5.2 | 5 | 7 | 47.6 | Merid. |
| 3. | 10 | 35 | 24.5 | 18 | 9 | 13.8 | 4 | 45 | 9.3 | |
| 4. | 10 | 9 | 18.3 | 18 | 23 | 28.7 | 4 | 21 | 44.3 | |
| 5. | 9 | 25 | 7.8 | 18 | 37 | 25.9 | 3 | 58 | 58.9 | |
| 6. | 9 | 32 | 37.2 | 18 | 50 | 12.3 | 3 | 35 | 23.6 | |
| | 12 | 12 | 33.9 | | | | 3 | 32 | 52.4 | Merid. |
| 7. | 9 | 45 | 19.1 | 19 | 2 | 42.8 | 3 | 12 | 34.0 | |
| | 12 | 9 | 17.4 | | | | 3 | 10 | 10.1 | |
| 9. | 9 | 50 | 12.3 | 19 | 26 | 13.3 | 2 | 28 | 9.7 | |
| 10. | 9 | 58 | 11.9 | 19 | 36 | 58.9 | 2 | 6 | 29.6 | |
| 12. | 8 | 54 | 52.1 | 19 | 56 | 59.1 | 1 | 25 | 24.9 | |
| 13. | 11 | 50 | 5.8 | 20 | 7 | 34.1 | 1 | 2 | 40.3 | Merid. |
| 14. | 8 | 42 | 45.7 | 20 | 15 | 53.7 | 0 | 45 | 18.0 | |
| | 11 | 46 | 47.6 | | | | 0 | 42 | 22.6 | Merid. |
| 15. | 8 | 47 | 45.9 | 20 | 24 | 49.0 | 0 | 25 | 29.2 | |
| | 11 | 43 | 26.2 | 20 | 25 | 40.3 | 0 | 23 | 10.5 | Merid. |

# SCIENTIFIC INTELLIGENCE.

## GEOLOGY.

1. *Remarks on Fossil Birds. By Mr Paul Gervaes.—Ornitholites,* or the fossil indications of the ancient existence of birds, are of four principal kinds : *bones, eggs, feathers,* and *impressions* left by the feet when walking over deposits still soft.

The only known impressions have been remarked in the new red sandstone of Connecticut, by Mr Hitchcock, who has given them the name of *Ornithichnites ;* but the signification of these impressions has not yet been pointed out in a sufficiently scientific manner.

The feathers and eggs of birds have been hitherto met with only in the tertiary formations of Europe, and in small numbers ; the former in France and Italy, the latter in Auvergne.

The fossil bones of birds cannot lead us, in every case, to the precise determination of the species to which they belong. Pretty often we can only ascertain the Linnæan genus from them ; in other cases, they indicate only the family, order, or even the class merely. A very small number only can be determined specifically ; and these species are the only ones which ought to be named according to the principles of the Linnæan nomenclature.

The fossil bones of birds, the species of which cannot with certainty be recognised, may take the collective name of *Osteornis,* and a qualifying term added to the latter will indicate, by approximation, the nature of the birds which these remains lead us to conjecture ; but without which, geologists ought nevertheless to introduce them as so many established species into their systematic catalogues. M. Adolphe Brongniart has, for a long time, advantageously followed a similar mode of nomenclature in his skilful researches relating to fossil vegetables.

It is at present impossible to indicate with precision at what period the class of birds began to exist on the terrestrial globe, the ornitholite formations having, as yet, been very imperfectly examined, compared with those of the other vertebrate animals.

The present state of the science, however, shews that reptiles are not, as is still often asserted, the most highly organized vertebrates which existed in the secondary period, since birds were their contemporaries during that epoch.

Without taking into account the ornithichnites of the new red sandstones, we possess well established ornitholites of the secondary formations. They have been found in Tilgate Forest, in the neocomian formations of Glaris, and near Maidstone. We owe the determination of them to Messrs Mantell, Meyer, and Owen. According to the principles of nomenclature proposed above, by taking into account the affinities which have been asigned to them, we may name these, *Osteornis ardeaceus, scolopacinus* and *diomideus.*

The ornitholites of the tertiary formations are more numerous, and principally belong to fresh-water deposits. France possesses two very rich deposits of them in the gypsum of Paris, and in the marls and limestones of Auvergne.

Those of the gypsum of the neighbourhood of Paris have been principally studied by G. Cuvier. They consist of:—

Three birds of prey belonging to the genera *Haliætus, Buteo,* and *Strix.*

A gallinaceous bird of the subgenus *Coturnix.*

Three long-legged birds of the genera *Ibis, Scolopax* and *Pelidna.*

Likewise two palmipedes of the genus *Pelicanus.*

Judging from the figures Cuvier gives of them, others are certainly passerine birds; and his wading-bird allied to the Ibis, is an extinct species of Curlew, which may be named *Numenius gypsorum.*

M. Duval has found in the diluvium of the environs of Paris, near the barrier of Italy, a cubitus which I consider as belonging to a gallinaceous bird of the genus *Phasianus.* It is from the same place where bones of the badger, elephant, hippopotamus, and marmot, &c. are obtained.

MM. Constant Prevost, and Desnoyers, have procured in a deposit observed by them at Montmorency, and which has afforded them remains of Spermophilus, Cricetus, and Lagomys, some bones of birds which they regard as approaching to those of the common water-rail.

In Auvergne, the most curious ornitholites hitherto discovered are those of a wader of the genus *Phœnicopterus,* which it has been hitherto impossible to distinguish from the Flamingo still living in the south of Europe, and which ornithologists name *P. ruber.* And yet these bones are mingled with those of the rhinoceros, hyænodon, and other extinct species of the mammifera.

M. Jourdan, professor in the faculty of Lyons, has collected, among other ornitholites of Auvergne communicated to me, a portion of a pelvis, also from the tertiary formations, and which indicates a bird very nearly connected with *Mergus,* if it does not really belong to that genus. The fragment of a tarsus, from the collection of M. Bravard, comes from Arde, likewise in Auvergne; it belongs to a spurred gallinaceous bird, highly developed, is pretty likethat of the domestic cock, but appearing to come from a different species. An entire tarsus from the same collection has been found at Coude; it appears to me to belong to a kind of perdix or a small tetrao. As with the first mentioned tarsus, it belongs to a less ancient period than the Flamingo. In the work I am about to publish, I point out many other ornitholites of Auvergne, and in like manner, indicate those which have been collected in various other parts of France. Some of these are diluvial, and others the species of which can be determined as having their living representatives in the existing Fauna; such are *Corrus pica, Perdix cinerea, Perdix coturnix, Anas olor, Anas anser.* A portion of my work is devoted to the tertiary or diluvian ornitholites found in other countries of Europe; they are principally from England, Belgium, Germany, and Sardinia.

The remains of fossil birds which have been collected in countries foreign to Europe, are still more curious, and I may mention the principal facts in their history.

The *Gryphus antiquitatis,* Schubert, is from Behring Straits. It belongs to the family of vultures.

It is likewise to the vultures, and the gallino-gralli of the genus Kamichi, that we must refer the Dodo *(Didus ineptus),* the race of which has been destroyed in the Isle of France for about two centuries, and some bones of which, incrusted with stalactites, have been discovered in the island of Rodriguez, and described by G. Cuvier and M. de Blainville.

The megatherian deposits of South America, have furnished M. Lund with thirty-three species of birds, some still belonging to that part of the world, others extinct, but all pertaining to American genera. The new collections made by M. Claussen, enable us to add to the list given by M. Lund, a *Cathartes* larger than the existing species, a *Strix*, a *Caprimulgus*, a genus allied to *Dicholophus*, and a *Psittacus*.

A concluding paragraph of this work is devoted to the species of *Cursores* allied to the Cassowaries, which M. Owen has made known to the public under the name of *Dinornis*, the bones of which, described with so much care by this naturalist, have been found in New Zealand.*

2. *On Gigantic extinct Mammalia in Australia. By Prof. Owen.*—The author observes that the first information respecting the extinct Fauna of Australia, was derived from Major Mitchell's researches in the ossiferous caves of Wellington Valley. All the remains there discovered, with one exception, indicated the existence of only marsupial animals, of extinct species, differing chiefly in being larger than any now living. The specimen, which thus differed from the rest, was the fragment of a lower jaw, with molar teeth, and the socket of a single incisor; it most nearly resembled the wombat, and had been named *Diprotodon* by Mr Owen. Since that period (1835), Sir Thomas Mitchell, Count Strelitzky, and other gentlemen, have obtained collections of bones from caves on the Darling Downs, west of Morton Bay, and other localities at a distance from Wellington Valley. From an examination of these, Mr Owen has determined the former existence in Australia of a mastodon, nearly allied to the *M. angustidens*, remains of which are so abundant in Europe, and also allied to the *M. Andium* of North and South America; and he observes that the fact of the wide distribution of remains of the mastodon in Europe, Asia, and America, prepared him to receive, with less surprise, the unequivocal evidence of its existence in Australia also. Mr Owen then proceeded to the consideration of the fossil remains of the marsupialia, a class of animals to which, with the exception of small rodentia, such as rats and mice, all the indigenous quadrupeds of Australia belonged. With regard to the Diprotodon before mentioned, much additional evidence had been required to establish the marsupial character of a quadruped as large as a rhinoceros; and amongst the remains lately obtained in the bed of the Condamine river, at Morton Bay, was a specimen consisting of the anterior part of the lower jaw, with the base of a tusk, and a portion of the molar teeth, the tusk being identical with one from Wellington Valley. This specimen shews that the animal possessed large incisive tusks, combined with molar teeth, like those of the kangaroo, characterized by two transverse ridges; the marsupial character of these remains was also indicated by the bending in of the angle of the jaw. Mr Owen referred to a second gigantic type of extinct marsupials; but observed that further evidence relative to the marsupial character of these great quadrupeds was most desirable. From examination, he concluded that the great extinct herbivorous

* From l'Institut. No. 557, p. 293.

marsupials did not exhibit the peculiar disproportion of the extremities characteristic of the kangaroos, but were possessed of legs of nearly equal length like the wombat. The species of marsupial quadrupeds already known to inhabit Australia, form, as Cuvier observed, a small chain of animals, representing the quadrupeds of America and Europe, which was now rendered more complete by the discovery of extinct genera representing the pachydermata, and equal to the medium bulk those animals now attain.—*Association Report in Athenæum*, No. 886, p. 956.

3. *On the influence of Fucoidal Plants upon the formations of the Earth ; on Metamorphism in general, and particularly the Metamorphosis of the Scandinavian Alum Slate. By Prof. G. Forchhammer.* —It was remarked by the Professor, at a meeting of the British Association, that geologists had occupied themselves by extensive observations on the beds of sand and clay which have been carried into the ocean, but few have paid any attention to the soluble salts which are removed from the dry lands by the action of rain. Thus large quantities of potash and lime are constantly being carried into the ocean. The conditions of marine vegetation were next examined, and the analysis given of a great many fucoidal plants, all of which contained an exceedingly large amount of potash, often as much as five, and in some cases eight, per cent. Sea-water is found to contain but little of this alkali ; it must, therefore, be concluded that the plants of the ocean have the power of separating the potash readily. Of magnesia, about one per cent. of the weight of the dried plant was generally found in the ashes. This chemical constitution of the ashes of the fucus tribe, explains several great phenomena in the general nature of life ; and it was suggested that, by returning the sea-weed to the land, in the state of manure, we should be restoring to it the potash of which it had been deprived. The memoir then entered extensively into the question of metamorphism, and gave an examination of the clay of the Scandinavian district. It was then shewn that the formation of beds, where fucoidal plants have grown, had a considerable influence on their structure and composition, as they would derive many of their constituents from them. It was conjectured that the conditions of the alum slate of Scandinavia were thus modified. As this paper will be printed entire in the Reports of the Association, we give but a short abstract.

Prof. Liebig made some remarks on the necessity of alkaline bases for plants, and on the remarkable facts brought forward by Prof. Forchhammer, that whilst sea-water contained, in 1000 grains, only 1 grain of potash, so large a portion should be found in the fucoidal plants. Mr Lyell observed, that the attention of chemists being turned to these great geological questions, he anticipated important results to science. He had visited the district, and confirmed the statement given.—*Athenæum*, No. 886, p. 955.

4. *On the Fossil Fishes of the London Clay. By M. Agassiz.*—The group of fish peculiar to the London clay, whose remains are particularly abundant in the Isle of Sheppy, do not exhibit those strange forms which distinguish most of the fish of the more ancient formations ; but every thing reminds us of the fish living in the present seas. The examination of these remains is attended, however, with difficulty, on account of the state in which the specimens are found, imbedded in hard

clay, which has replaced the soft parts of the fish, and as they belong chiefly to the cycloid and ctenoid orders, with soft scales, which are generally of small size, and easily detached and broken, the crania are the only portions usually preserved entire. In the classes of reptiles or mammalia, the peculiarities presented by the cranium point out, with certainty, the relations of the animal to which it belonged; but nothing is so variable as the shape of the bones which make up the skeleton of a fish's head, and the multitude of processes and depressions serving for the attachment of muscles, gives to this part such a diversity, that the ichthyologist must often despair of being able to refer these fossil crania to their proper types; especially as they are often incomplete, wanting the jaws, the bones of the face, and the opercular and branchial apparatus, leaving only the bony inclosure of the brain. The author gives a detailed anatomical description of the various families. He then institutes a comparison between the species found at Sheppy, and those now existing on the English coast, and concludes, that although their general character is somewhat different, yet their distribution has taken place according to the same laws. The forty-four species of fish, whose osseous remains are found at Sheppy, are referred to thirty-seven genera, nearly all of them unknown in the present seas; and, excepting the gadoids, or cod tribe, their recent representatives are mostly confined to southern seas. The important evidence to be derived from a comparison of the scales of these species with those of existing lists, remains to be obtained, and is attended with difficulty, as it requires the aid of the microscope.—*Athenæum*, No. 886, p. 956.

5. *On the Toadstone or Amygdaloid of Derbyshire. By J. Alsop.*—Mr Alsop, at the York meeting of the British Association, observed, that many mining operations had been recently made in Derbyshire, with the view of finding a continuation of the veins beneath the beds of toadstone,—experiments which are very difficult, owing to the thickness of the toadstone, and uncertain in their results, on account of the varying character and productiveness of the strata and veins. In the section of Crich Cliff, a bed of clay, about a foot thick, becomes, within a short distance, fourteen fathoms thick, and contains large and hard nodules of toadstone; and the thick bed of toadstone sunk through at one shaft, diminishes to a foot or two in thickness at the other. In the Worksworth district, the "Great clay," containing blocks of toadstone, is clearly proved to be the same as that at Crich, by the three beds of clay below each; of these, the first, or "twenty fathom" clay, is unproductive; the second, or "bearing clay," is seventeen fathoms lower; and the third clay, which is five fathoms lower still, is remarkably undulating. These "three clays" are also recognisable at the Snitterton mines; but here, what was a thin bed of clay at Crich and Worksworth, becomes a bed of toadstone about twelve fathoms thick. The second toadstone at Snitterton is similar to the one at Crich and the great clay at Worksworth, and the limestone resting upon it is similar in its character; there is also, apparently, another toadstone bearing the same relation to the second as the twenty fathom clay at the other places; it is seen at the section of Bonsall, where the three clays, and two beds of toadstone beneath them, are well known.—*Athenæum*, No. 887, p. 976.

6. *Our supposed inexhaustible Stores of Coal.*—The opinion, that our stores of coal are all but inexhaustible, rests wholly on assumed data,

and not upon any accurate and detailed statistical accounts, such as alone could warrant a confident opinion. This question will, ere long, become a subject of serious concern, unless some measures are taken to found our calculations on a solid basis. It is an easy matter to assume that a considerable thickness of available coal extends over hundreds of square miles; but the different opinions formed by men of the highest respectability and talent, strongly prove how meagre and unsatisfactory are the only data on which their estimates are founded. It is not, however, the mere quantity of coal that is to be considered; especial regard must be had to its quality, depth, thickness, extent, and position. Many of the inferior seams can only be worked in conjunction with those which, by their superior quality, repay the expense of workingt hem at depths varying from 300 to 600 yards; and it may readily be conceived that inferior coal only could not be profitably raised from pits equal in depth to three or four times the height of St Paul's cathedral, unless the price of such inferior coal was raised to more than the present price of the best coal. It is the additional expense, and consequent additional difficulty, of competing with other countries, that is the vital question to be considered. It is not the exhaustion of mines, but the period at which they can be profitably worked, that merits earnest and immediate attention; and it is with especial reference to this that the value and increasing necessity for mining plans is so strongly apparent. If these inferior seams are not worked now, in conjunction with the better seams, they will, in all probability, be wholly lost; and, to a certainty, they must be so, if no permanent registration is adopted to show what were the former circumstances of each mine.—*T. Sopwith, on the National Importance of preserving Mining Records.*

7. *Eruption of Boiling-Water from the extinct Volcano of Solfatara.*—From Naples, we learn, that the famous extinct volcano of Solfatara, near Puzzuoli, the last eruption of which took place in 1198, and which, in 1507, according to the writers of the time, threw up immense quantities of boiling water, has, for a few days preceding the date of the communication, repeated that phenomena, the same having been preceded by an emission of hot sulphureous vapour. The thermal water ejected is thrown from the eastern portion of the crater at intervals, and in the form of jets, from 15 to 20 feet in height.—*Athenæum*, No. 892, p. 1100.

8. *Temperature of the Mediterranean.*—M. Aimé has addressed to the Academy of Sciences of Paris some observations on the temperature of the Mediterranean Sea, of which the following, according to him, are the results:—

1. Near the shores of the Mediterranean, the temperature at the surface of the sea is notably higher than at a distance from land during the day, and sometimes lower during the night. Near the shores of the ocean, the temperature at the surface of the sea is lower than at a distance from land.

2. The mean temperature of the year at the surface is nearly the same as that of the air.

3. The diurnal variation of the temperature ceases to be sensible at 16 or 18 yards, and the annual variation at 300 or 400 yards.

4. In the morning, after a clear and calm night, the temperature of the surface is colder than that of the layers situated some yards below it.

5. The minimum temperature of the deep waters of the Mediterranean is equal to the mean of the winter temperatures at the surface. This low temperature of the bottom is not, therefore, induced by the entrance of the waters of the ocean, but rather by the precipitation of the upper strata during the winter.*

9. *On Polarization of Light in reference to the Light of the Sun. Paris Academy of Sciences, Oct.* 14. M. Arago made some remarks on the polarization of light, in reference to whether the light, produced by a solid incandescent body, proceeds from the surface or the interior. The state of polarization presented by the light, says M. Arago, proves that it proceeds from the interior of a solid body; an inflamed gas, on the contrary, gives no kind of refraction. Hence, it may be assumed, that the luminous portion of the sun is a gas. The light given out by a solid body comes partly from its interior, and is not the same which illuminates it.

## MINERALOGY.

10. *Discovery of Niobium, a New Metal.*—In a valuable paper on the composition of Tantalite, just published in Poggendorff's Annals, Professor Henry Rose of Berlin announces his discovery of a new metal, which he terms *Niobium*, from Niobe the daughter of Tantalus,—a name given to indicate its resemblance to Tantalum. He detected its oxide, which he designates *Niobic acid,* and which differs in many respects from Tantalic acid, in the Tantalite of Bodenmais in Bavaria. Assuming a similar atomic composition for Tantalic acid and Niobic acid, the atomic weight of Niobium is greater than that of Tantalum. The Niobic acid does not exist in the Tantalite of Finland.

11. *Da brée on the Occurrence of Axinite in a fossiliferous Rock in the Vosges.*—Hitherto axinite does not appear to have been observed in any *fossiliferous* rock; and it may therefore not be uninteresting to mention, in some detail, the mode of occurrence of this substance, as lately observed by me at Rothau, in the Vosges; and I am the more induced to do this, because we have here a new example of the manner in which igneous rocks can alter stratified formations; not only by their heat, but also by the introduction of new elements. Near the village of Rothau, in the valley of the Bruche, the transition formation is traversed by a blackish, very fine grained rock, in which hornblende is disseminated in small crystals. This rock, for which we may provisionally retain the name of trap, forms a hill, termed the *le petit Donon de Rothau.* The transition formation of the locality consists principally of a very hard petrosiliceous rock, and, at a little distance from the trap, it contains numerous organic remains, and more particularly the *Calomopora spongites* of Goldfuss, and *Flustræ.* Nodules of lamellar limestone are met with, where these remains of madrepores are accumulated, and it is precisely at the same points that epidote, hornblende, and quartz in a crystalline state, make their appearance. This association may lead us to believe, that the carbonate of lime of this rock is of madreporic origin, and further, that the epidote and hornblende were formed at the

* From l'Institut, No. 558, p. 298.

expense of this limestone, and only where it existed. It is remarkable that the siliceous rock contains various organic forms, which are perfectly preserved; thus there are impressions of *Calomopora spongites*, which are remarkably distinct, and which are surrounded by a mixture of epidote, hornblende, quartz, and lamellar limestone; it thus appears that the crystallization of the quartz, of these silicates, and of the limestone, was effected without there being fusion in the mass. Besides these animal remains, there are other cavities of indistinct form, which are lined with brilliant crystals of acicular hornblende, of epidote, and of quartz, and which, from the similarity of their size to the first, may be supposed to be also madreporic impressions, but to have had their outlines altered more or less by crystallization. It was in one of these cavities that I found small crystals of axinite, presenting the planes denominated *l* and *s* by Haüy. The characteristic reactions of this substance leave no doubt as to its nature. Before the blowpipe, it swells and melts into a blackish enamel, and, with a mixture of fluor-spar and bisulphate of potass, it communicates an intense green colour to the flame. The same mineral is also found in crystalline masses, and mixed with the four other substances indicated above. If tourmaline was not very rare in the neighbouring granitic mountain group of the *Champ du Feu*, it would be possible that the debris of that mineral had been mechanically disseminated in the slates at the time of their deposition, and that, by the influence of heat, the axinite was produced from elements pre-existing in the rock, as frequently takes place with respect to epidote, hornblende, or garnet. This, however, is not the case here; and it is much more probable that the boracic acid was conveyed into the transition beds, in consequence of the eruption of the trap-rock. The metalliferous masses of the S.E. of Norway, situated at the very contact of the transition formation with hornblendic rock, or with granite, also sometimes contain axinite, which was there formed at the same time as the metalliferous combinations, probably by a process analogous to that to which the axinite of Rothau owes its origin. The same may probably also be true regarding the stanniferous slate of Botallack in Cornwall, which contains, besides the oxide of tin, shorl, axinite, garnet, and hornblende. The introduction of boracic acid, which contributed to the formation of the axinite at Rothau, and in the metalliferous repositories of the environs in Christiania, has doubtless some analogy with the emanations of boracic acid, which, in Tuscany, abound in the vicinity of serpentine, or with the boracic acid evolved from the crater of Vulcano in the Lipari islands.*

## CHEMISTRY.

12. *Experiments of Brown and Knox.*—In reference to the experiments of Brown as to the conversion of paracyanogen into silicon, which have been refuted on all sides, Knox has performed experiments on the simple nature of nitrogen. For this purpose, he employed ammonia-

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* Communicated to the Academy of Sciences, by Mons. A. Daubrée; *Comptes Rendus*, tom. xviii., p. 870.

nitruret of potassium, heated with iron filings, in an iron crucible. From twenty grains of ammonia-nitruret of potassium, and the same quantity of iron, he states, that he obtained silicon, which, when fused with carbonate of potash, afforded 1.55 grains of silica. According to this experiment, therefore, nitrogen consists of silicon and hydrogen, or of these substances combined with oxygen. Statements of this description cannot be read without astonishment; but all surprise vanishes when we direct our attention to the continuation of the investigation. The experimenter prepared siliciuret of potassium by heating silica with potassium; he then passed a current of dry muriatic acid gas over it, and obtained a mixture of one volume of nitrogen and four volumes of hydrogen. Whoever prepares siliciuret of potassium in this manner, can also produce any gas he pleases.—*Berzelius' Jahres-Bericht*, 1844.

13. *On the occurrence of Xanthic Oxide in Guano.*—Magnus has announced that Unger has discovered in his laboratory, in guano, the substance which Marcet has named Xanthic Oxide. This body, so interesting to physiologists and chemists, has been hitherto met with only twice in pathological secretions of the kidneys. The most extensive researches regarding it we owe to Liebig and Wöhler, occasioned by their labours on the nature of uric acid. They have given it the name of xanthine; but these chemists possessed only a very minute quantity of it, obtained from a stone which previously served, in part, for the investigation of Stromeyer.

Xanthic oxide is obtained from guano, by dissolving the latter in muriatic acid, and precipitating the solution by an alkali. Caustic potass eliminates, from the precipitate, a small quantity of it, which is not always the same in amount. By the aid of a stream of carbonic acid gas, or by the addition of sal-ammoniac, we extract the xanthic oxide from its solution in potass, from which it separates in proportion as the ammonia disengages. The pulverulent and yellowish substance obtained, possesses all the properties which Liebig and Wöhler have attributed to xanthic oxide, and differs from it only in being soluble in muriatic acid, as is apparent from its mode of preparation. But Unger has found that xanthic oxide forms not only with muriatic acid, but also with various other acids, crystallized compounds, which are soluble in water, and which he will afterwards fully describe.

It thus appears that guano, a substance in itself already so remarkable, and which promises the same happy results for the agriculture of Europe, as it seems to have yielded in very ancient times for that of South America, promises likewise a rich harvest of interesting facts to science.

The small proportion in which the xanthic oxide is found in guano, does not allow us to suppose that this substance is produced by slow decomposition. The inequality with which this body is found diffused among the guano, renders it very probable that it is a pathological product which was voided along with the excrements of birds, unless we consent to admit that it is there as the normal ejectment of certain birds. At all events, it would be of the greatest interest to become acquainted with these species of birds, which probably are still living.*

* From Poggendorff's Annalen., 1844, No. 5, p. 158.

14. *Heat from Solid Carbonic Acid.*—There is a remarkable reaction between solid carbonic acid and the caustic alkalies. If a small piece of solid carbonic acid be wrapped in cotton, with a little pulverized caustic potash, and the whole be pressed between the fingers, so much heat is evolved as to make it uncomfortable to hold. This is the most remarkable illustration of heat from chemical union. One of the agents employed is the coldest substance in nature with which we are acquainted, that which we select to shew the effects of extreme refrigeration. The other is at the natural temperature. Both, moreover, are in the dry or solid state. Yet their union or simple contact produces heat sufficient, at least, to inflame phosphorus. This reaction is noticed, as it suggests some striking experiments. It has very possibly been observed by others, though it is not referred to in various works on the subject.—WM. F. CHANNING, Boston, May 2, 1843, *American Journal of Science and Arts*, Vol. xlvi. No. 1. p. 215.

## ZOOLOGY.

15. *Professor E. Forbes's Bathymetrical Rese rches.*—The secretary then read part of a letter from Professor Loven of Stockholm on the subject of Professor E. Forbes's bathymetrical researches. After remarking on the close correspondence between his own researches and those of Professor Forbes, he says—" As to the regions, the Littoral and Laminarian are very well defined every where, and their characteristic species do not spread very far out of them. The same is the case with the region of Florideous Algæ, which is most developed nearer to the open sea. But it is not so with the regions from 15 to 100 fathoms. Here is, at the same time, the greatest number of species, and the greatest variety of their local assemblages; and it appears to me that their distribution is regulated, not only by depths, currents, &c., but by the nature of the bottom itself, the mixture of clay, mud, pebbles, &c. Thus, for instance, the same species of Amphidesma, Nucula, Natica, Eulima, Dentalium, &c., which are characteristic of a certain muddy ground of 15 to 20 fathoms, are found together at 80 to 100 fathoms. Hence it appears, that the species in this region have generally a wider vertical range than the Littoral, Laminarian, and, perhaps, as great as the Deep Sea coral. The last named region is with us characterised in the south by *Oculina ramea* and *Terebratula*, and in the north by Astrophyton, Cidaris. *Spatangus purpureus* of an immense size,—all living between Gorgoniæ and the gigantic *Alcyonium arboreum*, which continues as far down as any fisherman's line can be sunk. As to the point where animal life ceases, it must be somewhere; but with us it is unknown. As vegetation ceases at a line far above the deepest regions of animal life, of course the zoophagous mollusca are altogether predominant in those parts, while the phytophagous are more peculiar to the upper regions. The observation of Professor Forbes, that British species are found in the Mediterranean, but only at greater depths, corresponds exactly with what has occurred to me. In Bohnslau (between Gottenburg and Norway), we find at 80 fathoms, species which, in Finmark, may be readily collected at 20; and on the last-named coast, some species even

ascend into the littoral region, which, with us here in the south, keep within 10 to 11 fathoms.—*Brit. Assoc. Report; Athenæum*, No. 886, p. 957.

16. *Guyon on the Cagots of the Pyrenees.*—M. Guyon has sent to the Academy of Sciences six new drawings of heads of the cagots of the Pyrenees, in order to justify the opinion he formerly expressed, that an anatomical character of the cagots appears to consist in the form of the ear, which is rounded, and without a lobe. He again called attention to another opinion expressed by him, that the cagots belong to a race of lofty stature, and perfectly similar in form; and that the goitre and cretinism, with which many of the cagots are affected, are entirely owing to the nature of the localities they inhabit. Accordingly, of the six subjects whose ears were represented by him, two were affected with goitre, and one with cretinism.*

17. *Coral Fishery.*—The *Moniteur Algerien* gives the following account of the coral fishery at La Calle, from the 1st of April to the 30th September 1844. The total number of boats employed was 170, of which only one was French. The others were—124 Neapolitan, 40 Tuscan, 4 Sardinian, and 1 Tunisian. The crew of the whole amounted to 1700 men. The total value of the coral taken is estimated at 1,355,750 frs.; the duties on which, from all the boats employed, except the French, which paid no duty, were 179,073 frs. The average gross earnings of the boats employed in the fishery amounted to 7975 frs.; but deducting the duty, and the expenses of the fishery for wages, wear and tear, &c., the average nett profit for each is estimated at 1367 frs. 60 cents. The nett profits of the French boats, no duty having been paid, are given at 2535 frs.—*Athenæum*, No. 892, p. 1100.

18. *Goadby's Method of Preparing Animal Substances.*—Mr Goadby exhibited before the British Association a series of preparations of animal bodies, preserved in glass cases, according to a method of his own suggestion. Many gentlemen having complained that they had not succeeded in preparing animal substances in the way which he recommended, he was desirous of stating fully the plans which he pursued. The following were the formulæ for all the solutions he used:—

A 1.

| | |
|---|---|
| Bay-salt, | 4 oz. |
| Alum, | 2 oz. |
| Corrosive sublimate, | 2 grains. |
| Water, | 1 quart. |

A 2.

| | |
|---|---|
| Bay-salt, | 4 oz. |
| Alum, | 2 oz. |
| Corrosive sublimate, | 4 grains. |
| Water, | 2 quarts. |

* From l'Institut, No. 559, p. 307.

B.

| | |
|---|---|
| Bay-salt, . . . . . . . . . | ½ lb. |
| Corrosive sublimate, . . . . . . | 2 grains. |
| Water, . . . . . . . . . | 1 quart. |

B B.

| | |
|---|---|
| Bay-salt, . . . . . . . . . | ½ lb. |
| Arsenious acid (or white oxide of arsenic), . | 20 grains. |
| Boiling water, . . . . . . . | 1 quart. |

C

| | |
|---|---|
| Bay-salt, . . . . . . . . . | ½ lb. |
| Arsenious acid, . . . . . . . | 20 grains. |
| Corrosive sublimate, . . . . . . | 2 grains. |
| Boiling Water, . . . . . . . | 1 quart. |

The first, A 1, was the ordinary solution he used. A 2, where there was a tendency to mouldiness, and the animal texture was tender, as, although salt preserved animal matters, it sometimes destroyed the tissue. B was used in cases where animals contained carbonate of lime, as, in these cases, alum produced decomposition. For old preparations, arsenic was substituted for corrosive sublimate, as in BB, but where there was a tendency to too much softening, the corrosive sublimate should be added as in C.

Prof. Owen stated that these solutions were better than alcohol for the preservation of nervous matter. In the course of his remarks he called attention to the dissections of the invertebrate animals, made by Mr Goadby, many of which are at present in the Museum of the College of Surgeons.

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## NEW PUBLICATIONS RECEIVED.

1. Review of a System of Mineralogy by James D. Dana. *These pages contains a full, and, on the whole, a judicious critique of the author's valuable System of Mineralogy, a work noticed in a former number of this Journal.*

2. Vestiges of the Natural History of Creation. 1 vol., pp. 390. John Churchill, London. *Although we do not agree with the ingenious author of this interesting volume in several of his speculations, yet we can safely recommend it to the attention of our readers, who will perceive, from the subjoined table of Contents, that the subjects discussed are of an attractive nature.*

Contents.—The Bodies of Space—Their arrangement and formation —Constituent materials of the Earth, and of the other Bodies of Space —The Earth formed—Era of the Primary Rocks—Commencement of Organic Life—Sea Plants, Corals, &c.—Era of the old Red Sandstone —Fishes abundant—Secondary Rocks—Era of the Carboniferous Formation—Land formed—Commencement of Land Plants—Era of the new Red Sandstone—Terrestrial Zoology commences with Reptiles—First traces of Birds—Era of the Oolite—Commencement of Mammalia—Era of the Cretaceous Formation—Era of the Tertiary Formation—Mammalia abundant—Era of the Superficial formations—Commencement of present species—General considerations respecting the origin of the Animated Tribes—Particular considerations respecting the origin of the Animated Tribes—Hypothesis of the Development of the Vegetable and Animal Kingdoms—Macleay's system of Animated Nature—This system considered in connection with the Progress of Organic Creation, and as indicating the natural states of Man—Early history of Mankind—Mental Constitution of Animals—Purpose, and general condition of, the Animated Creation—Note conclusory.

3. On Landed Property, and the Economy of Estates; comprehending the relation of Landlord and Tenant, and the principles and forms of Leases; Farm-Buildings, Enclosures, Drains, Embankments, Roads, and other rural works; Minerals and Woods. By David Low, Esq., F.R.S.E., &c. 1 vol., pp. 680. Longman, Brown, Green, and Longmans. London, 1844. *We consider this as an invaluable work for landowners, tenants, and all who are entrusted with the management of estates; and we feel satisfied that it will add not a little to the high reputation of its author. Besides the portions of the treatise devoted more immediately to Rural Economy, there is a lucid and important section on Mineral Property, and more especially on the working of metals, coal, limestone, building-stones, &c. There is also an interesting and comprehensive chapter on woods, including both the culture of forest-trees, and the general management of wood-land.*

4. Reports on the First, Second, and Third Meetings of the Association of American Geologists and Naturalists, at Philadelphia, in 1840 and 1841, and at Boston in 1842; embracing its Proceedings and Transactions. Gould, Kendal, and Lincoln. Boston, 1843.

5. Sandhurst College Text-Books,—Astronomy and Geodesy. By Professor Narrien, F.R.S., &c. 1 vol., pp. 427. Longman, Brown, Green, and Longmans, Paternoster Row, London. 1845.

6. A History of Crustacea. By Thomas Bell, F.R.S., &c. Part I. John Van Voorst, 1 Paternoster Row, London. 1844.

7. The Encyclopædia of Chemistry, Theoretical and Practical; presenting a Complete and Extended View of the Present State of Chemical Science. By James C. Booth, Mem. of the Am. Phil Soc., &c.; and Martin H. Boye, Mem. of the Am. Phil. Soc. Carey and Hart, Philadelphia. *Six numbers of this work have reached us. Judging from the industry, research, and accuracy of the authors, we anticipate, that, when finished, it will contribute to the advancement of chemical science, and find a place in every chemical laboratory and library. The style, too, in which it is got up is very creditable to the American publishers.*

8. Tableau Général des Poissons Fossiles rangés par Terrains. Par Louis Agassiz. Neuchatel, 1844.

9. Notice sur la Succession des Poissons Fossiles, dans la Série des Formations Geologiques. Par Louis Agassiz. Neuchatel, 1843.

10. Essai sur la Classification des Poissons. Par Louis Agassiz. Neuchatel, 1844.

11. Poggendorff's Annalen der Physik und Chemie, up to No. 10 of the year 1844.

12. Comptes Rendus, up to No. 26 (24 Juin 1844) of the Premier Semestre, of the year 1844.

13. Silliman's American Journal of Science and the Arts, up to No. 2 of vol. xlvii. for July, August, and September, 1844.

14. Bibliothèque Universelle de Genève, up to October 1844; but September not received.

15. Guide to the Geology of Scotland. By Mr James Nicol. Oliver and Boyd. Edinburgh, 1844. Pp. 272, 12mo. With map and numerous coloured sections. *This cheap and generally accurate compilation will be useful to the travelling geologist in his progress through Scotland.*

16. Geology, Introductory, Descriptive, and Practical. By Professor Ansted of King's College, London. 2 vols. 8vo. John Van Voorst. London, 1844. *Professor Ansted's beautifully illustrated and interesting work affords the best view of English Geology hitherto produced. On this ground we recommend it to the particular attention of Geologists.*

17. Studien des Göttingischen Vereins Bergmännischer Freunde. Von Joh. Friedr. Ludw. Hausmann. Fünften Bandes Zweites Heft. 8vo, 1844.

18. Ueber eine Lagerähnliche Basaltische Ausfüllung am Ochsenberge unweit Dransfeldt. Von J. Fr. L. Hausmann.

19. On some Fossil Remains of Anoplotherium and Giraffe from the Sewalik Hills in North India. By H. Falconer, M.D., F.G.S., and Captain P. T. Cautley of the Bengal Artillery, F.G.S.

20. *On the Glacier Question.*—Quelques Remarques sur les Discussions qu'ont Suscitées les Rescherches de cette Année (1841); and Bulletin de la Société des Sciences Naturelles de Neuchatel.

21. Sur la Dispersion du Terrain Erratique entre le Jura et les Alps, dans la Suisse Occidentale et en Savoie. Par Arnold Guyot, Docteur et Professeur.

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## *List of Patents granted for Scotland from 24th September to 20th December* 1844.

1. To Peter Rothwell Jackson, of Strawberry Hill, near Manchester, in the county of Lancaster, engineer, "certain improvements in the

construction and manufacture of wheels, cylinders, hoops, and rollers, and in the machinery or apparatus connected therewith, and also improvements in steam-valves."—24th September 1844.

2. To Wilton George Turner, of Gateshead, in the county of Durham, doctor in philosophy, "an improved mode of directing the passage of, and otherwise dealing with, the noxious vapours and other matters arising from chemical works in certain cases."—25th September 1844.

3. To Thomas Fuller, of the firm of William Collier and Co., of Manchester, in the county of Lancaster, engineer, "certain improvements in machinery, tools or apparatus for turning, boring, and cutting metals and other substances."—30th September 1844.

4. To Henry Oliver Robinson, of No. 12, Old Jewry, in the city of London, engineer, "certain improvements in steam machinery and apparatus for the manufacture and refining of sugar."—1st October 1844.

5. To Pryce Buckley Williames, of Llegodig, in the county of Montgomery, North Wales, "certain improvements in the manufacture of artificial stone."—9th October 1844.

6. To Jean Baptiste Paul Chappe, of Manchester, in the county of Lancaster, spinner and doubler, "certain improvements in machinery or apparatus for spinning and doubling cotton and other fibrous substances." —9th October 1844.

7. To Jacob Samuda, of the Southwark Iron Works, engineer, and Joseph D'Aguilar Samuda, of the same place, engineer, "certain improvements in the manufacture and arrangement of parts and apparatus for the construction and working of atmospheric railways."—10th October 1844.

8. To William Clarke, of Nottingham, lace manufacturer, "improvements in machinery for manufacturing ornamented bobbin net or twist lace."—15th October 1844.

9. To William Cormack, of York Street, Commercial Road, in the county of Middlesex, manufacturing chemist, "a new or improved method or plan for purifying coal-gas."—15th October 1844.

10. To Vice-Admiral Sir Graham Eden Hamond, Baronet, K.C.B., of Norton Lodge, Yarmouth, Isle of Wight, being a communication from his son Commander Andrew Snape Hamond, R.N., now commanding Her Majesty's steam sloop of war Salamander, stationed in the Pacific, "improvements in the mode of fastening on and reefing paddle-wheel float-boards, or paddles."—15th October 1844.

11. To George Augustus Kollmann, of the German Chapel, St James's Palace, in the county of Middlesex, gentleman, "certain improvements in railways and locomotive and other carriages."—16th October 1844.

12. To William Henry Ritchie, of Lincoln's Inn, in the county of Middlesex, gentleman, being a communication from abroad, "improvements in obtaining copper from ores."—17th October 1844.

13. To Richard Roberts, of the Globe Works, Manchester, in the county of Lancaster, engineer, "certain improvements in machinery or apparatus for the preparation of cotton wool and flax, and also for spinning and doubling cotton, silk, wool and other fibrous substances." —19th October 1844.

14. To John Grieve, of Portobello, in the county of Edinburgh, Scotland, engineer, "certain improvements in the production and use of steam, applicable to steam-engines."—21st October 1844.

15. To Robert Hazard, of Clifton, near the city of Bristol, confectioner, "improvements in baths."—21st October 1844.

16. To Pierre Armand le Comte de Fontainemoreau, of the English and Foreign Patent Office, 1 Skinner's Place, Sise Lane, in the city of London, being a communication from abroad, "for a new mode of constructing barometers and other pneumatic instruments."—22d October 1844.

17. To John Henry Rehe, of Moscow Road, in the county of Middlesex, surgeon, "improvements in the manufacture of starch and farinaceous food."—22d October 1844.

18. To Isaiah Davies, of Birmingham, in the county of Warwick, engineer, "certain improvements in steam-engines, part of which improvements are applicable to impelling wheel-carriages."—26th October 1844.

19. To Frederick Steiner, of Hyndburn Cottage, near Accrington, in the county of Lancaster, turkey-red dyer, "a new colouring matter to be used in dyeing certain colours on cotton, woollen, silk, and linen fabrics." —30th October 1844.

20. To Moses Poole, of the Patent Office, London, gentleman, being a communication from abroad, "improvements in machinery for emptying privies and cess-pools."—30th October 1844.

21. To Thomas Brown Jordan, of Cottage Road, Pimlico, in the county of Middlesex, mathematical divider, "improvements in the manufacture of blocks, or surfaces for surface printing, embossing, and moulding."—11th November 1844.

22. To George Fergusson Wilson, of Belmont, Vauxhall, in the county of Surry, gentleman; George Gwynne, of Princes Street, Cavendish Square, in the county of Middlesex, gentleman; and James Pillans Wilson, of Belmont aforesaid, gentleman, "improvements in treating fatty and oily matters, and in the manufacture of candles and night lights."—11th November 1844.

23. To James Pilbrow of Tottenham, in the county of Middlesex, civil

engineer, "certain improvements in propelling carriages on railways and common roads, and vessels on rivers and canals."—13th November 1844.

24. To Sir George Steuart Mackenzie of Coul, in the county of Ross, Baronet, "an improvement or improvements in the manufacture of paper, more particularly for the purposes of writing and copying writings, and machinery for effecting the same; also the manufacture of a fluid or fluids, to be used with the improved paper in the manner of ink."—15th November 1844.

25. To William Bedington Junior, of Birmingham, in the county of Warwick, manufacturer, "improvements in the construction of furnaces."—18th November 1844.

26. To John Dearman Dunnicliff, of the town and county of the town of Nottingham, lace manufacturer, William Crofts, of New Lenton, in the county of Nottingham, lace manufacturer, and John Woodhouse Bagley, of New Radford, in the county of Nottingham, mechanic, "certain improvements in the manufacture of lace and other weavings."—18th November 1844.

27. To Felix Moreau, of Ghent, in the kingdom of Belgium, engineer, "improvements in the manufacture of corks, and other similar articles made of cork-wood or other materials, and the application of certain of the refuse matters to various useful purposes for which they have never heretofore been employed.—19th November 1844.

28. To John Groom, of Oldham, in the county of Lancaster, mechanic, "certain improvements in machinery or apparatus for preparing, slubbing and roving, cotton, wool, and other fibrous materials."—22d November 1844.

29. To Josias Christopher Gamble, of St Helens, in the county of Lancaster, manufacturing chemist, "improvements in the manufacture of sulphuric acid."—25th November 1844.

30. To William Johnson, of Bury, in the county of Lancaster, agent, "improvements in machinery or apparatus for preparing cotton, wool, flax, and other fibrous substances."—25th November 1844.

31. To Ebenezer May Dorr, of Ludgate Hill, in the city of London, gentleman, being a communication from abroad, and partly his own invention, "improvements in the manufacture of horse-shoe nails."—25th November 1844.

32. To Robert William Sievier, of Henrietta Street, Cavendish Square, in the county of Middlesex, gentleman, "certain improvements in looms for weaving, and in the mode or method of producing plain or figured goods or fabrics."—26th November 1844.

33. To James Nasmyth, of Patricroft, in the county of Lancaster,

civil-engineer, "certain improvements in machinery or apparatus for hewing, dressing, splitting, breaking, stamping, crushing, and pressing stone or other materials."—27th November 1844.

34. To David Auld, engineer, of Dalmarnock Road, and Andrew Auld, engineer, of No. 78 West Street, Tradestown, both in Glasgow, in the county of Lanark. "an improved method or methods of regulating the pressure and generation of steam in steam-boilers and generators."—29th November 1844.

35. To Charles Watterson, of the firm of MacGuire, Watterson, and Co., of Manchester, in the county of Lancaster, soap manufacturers, "certain improvements in the manufacture of soap."—9th December 1844.

36. To Louis Joseph Wallerand, of Basing Lane, in the city of London, merchant, being a communication from abroad, "improvements in dyeing or staining various kinds of fabrics."—16th December 1844.

37. To Alexander Turnbull, of No. 48 Russell Square, in the county of Middlesex, doctor of medicine, "a new mode or method of more expeditiously and effectually tanning hides and skins, and of extracting and separating the catechnic acid from the tannin acid, in the catechu or terra japonica used in tanning."—18th December 1844.

38. To Henry Cartwright, of the Dean, near Broseley, in the county of Salop, farmer, "certain improvements in the construction of paddle-wheels."—20th December 1844.

THE

# EDINBURGH NEW

# PHILOSOPHICAL JOURNAL.

## *On the Life and Writings of Commandant Emile Le Puillon de Boblaye.* By M. Rozet.*

Those who become devoted to the study of the sciences, soon cease to think of themselves, under the influence of that strong attraction which this pursuit presents to the mind. Filled with the desire of advancing farther than their predecessors, they steadily follow the road on which they have entered, without being deterred by its length or the difficulties they encounter at every step: in their eyes, the removal of one obstacle is only an additional motive for attempting to overcome another even more formidable. Thus advancing from one degree of success to another, the man devoted to science seldom looks to what he has done, but rather to what yet remains for him to do, in order to accomplish the object which his genius has assigned to him. But at last his strength gives way, disease assails his person, and he expires in the midst of his vast undertakings, when he imagined that he had still a long time to live, and when many years were still necessary to complete what his comprehensive mind had conceived. Such has been the fate of all men of superior mind whom nature has placed on this earth in order to enlighten others; such has been that of the colleague whose premature loss we now deplore.

* Read to the Geological Society of France, at its meeting on 1st April 1844.

Emile le Puillon de Boblaye, *Chef d'escadron au corps royal d'etat-major*, Chevalier of the Legion of Honour, and of the Greek order of the Saviour, Member of the Geological Society of France, and of many other learned Societies, was born at Pontivy, in the department of Morbihan, on the 16th November 1792. His father, member of the *Chambre des Comptes* of Brittany, died in 1838, being president of the Civil Tribunal of Pontivy. His mother, a highly educated woman and of great merit, having undertaken the early education of her six children, did not fail to inspire them with that filial and fraternal affection which has its source in the heart of mothers, and to excite in them a strong taste for study. On leaving his mother, Emile de Boblaye entered the College of Pontivy, where his brilliant success soon shewed the strength and superiority of his intellect, both to his teachers and fellow-pupils. From the College of Pontivy he went to that of Rouen, where he completed the studies required for the Polytechnic School, into which he was admitted in the month of November 1811, his name being the ninth on the list of merit.

On the 25th September 1813, he left this celebrated school, with the brevet of sub-lieutenant in the Imperial corps of military geographical engineers. He had been six months in the *école d'application* of this corps, when severity of climate, joined to the defection of our allies, after having opened the gates of France to united Europe, brought under the walls of Paris the remains of those innumerable legions, before which our valiant soldiery had shed almost the last drop of their blood. At this period of mournful recollection, the defence of the *Barrière du Trône* was entrusted to the battalion of the Polytechnic School, in which there happened to be one of Boblaye's brothers. Influenced by his patriotism as well as by his attachment to this brother, he ran and placed himself by his side, and shared, by his spirited conduct, in the glory which the Polytechnic School acquired in that memorable defence.

When peace was re-established among the nations of Europe, and the mutilated remains of our valiant army were permitted to sheath their swords, the government conceived the happy idea of employing the geographical engineers in constructing a great topographical map of France; a map which might supersede that of Cassini, which was concluded in the midst of civil discord, and the accuracy of which the lapse of time and the progress of the sciences had alike tended to impair. Boblaye was connected with the geodetical department of this great work; and, along with Colonel Bonne, he took part in measuring the perpendicular from Brest to Strasburg, on which both geodetical and astronomical observations were at the same time made, with a view to determine the general form of our planet.

While engaged in this occupation, which lasted for several years, our colleague had to spend a long time among the ancient formations of Brittany, the geognostical relations of which were, as yet, very imperfectly known. Geographical engineers are often obliged to remain many successive days at a signal-post, on the top of a mountain, till the bad weather cease, or a cloud, which covers another signal, be dispersed. In such circumstances Boblaye did not remain inactive; his scrutinizing glance, embracing all around him, when prevented examining the heavens, was busily employed upon the earth. It is to these circumstances that we are indebted, in part, for the numerous geological observations with which he has enriched science, and which, on his return to the capital, he communicated to Cuvier, Cordier, Brongniart, &c. It was while exploring Brittany that our intimacy commenced, and I have often had the advantage of becoming acquainted with his beautiful discoveries before those under whose direction we both studied. Our colleague was long in coming to a determination to publish his work on this curious portion of France, although he had amassed a great quantity of materials. Influenced by his filial love, as well as by his taste for geology, he often returned to this province; and he had examined it in every direction. The first result of his researches was the discovery of a new ore of iron, the mining of which soon became a new source of riches for the country. It was not till the year 1827, that his *Essay on the Configuration and Geological Constitution of Brittany*,* made

* Annales du Museum, t. xv.

its appearance ; a work full of new facts, described with that clearness, and classified with that judgment, for which our colleague was distinguished. Geologists were then enabled to understand the relations which exist between the different stratified formations of Brittany and the large quantity of plutonic rocks which have traversed and modified them at so many points.

Being connected with the topographical operations in the north of France in the year 1827, Boblaye engaged with great ardour in the study of the jurassic formation of that country, when he was seized with brain fever, which brought him nearly to the grave. Happily, however, the strength of his constitution enabled him to overcome this attack, and as soon as he was able to walk, he resumed his favourite studies. His *Memoir on the jurassic formation of the north of France*,* appeared in 1829. He points out, in this treatise, the relations of the different members of the series with those of England, to which the attention of all the Continental geologists was then directed.

In the course of this same year, he was subjected to a severe affliction. He received an order to set out for Greece, where a French army had just put a final stop to Ottoman encroachments, at a moment when the hopeless condition of his younger brother, the individual who shared in his attachment to geology, required him not to leave his bedside. He complied with the order as soon as another Boblaye arrived to take his place beside the dying youth ; and scarcely had he set foot in the vessel which was to convey him to Greece, when his brother's death took place.

The campaign in the Peloponnesus, to a mind so intelligent and active as that of our fellow member, was the occasion of a multitude of researches and important discoveries. No intellect could remain inactive in such a country ; *his* embraced every thing, geodesy, topography, geology, archæology, &c. &c. Conjointly with his companion Pétier, he began to make a great trigonometrical survey, in order to lay the foundations of a general map of the country. While so doing, he soon exposed himself to the influences which produce

* Annales des Sciences Naturelles, Mai 1829.

that cruel disease which eventually deprived us of him altogether. From a desire of seeing as much of the country as possible, he would not submit to follow the convoy which transported the instruments and baggage. Hastening forwards, he arrived alone, very much heated, on the mountains, and immediately began to examine the country with his telescope. Soon the cold seized him ; and this imprudent act, very often repeated, at last brought upon him a severe fever. Numerous successive attacks of this kind often obliged him to interrupt his labours. At last the disease made such progress, that, in the month of August 1830, Boblaye was compelled to leave the Morea and return to France. It was now upwards of sixteen years that an individual so distinguished had been connected with scientific works of high importance, during which enlightened views and remarkable memoirs had often indicated his genius, and yet this individual had only attained the rank of Captain, so peculiar was the organization of the body of geographical engineers.

Although he did not remain above sixteen months in Greece, our colleague brought back with him an enormous mass of materials. He assisted in the great work published under the direction of Colonel Bory de Saint Vincent, and drew up, in connection with M. Virlet, the geological and mineralogical portion.* M. Boué has said :†—" Our fellow members, MM. Boblaye and Virlet, cannot be sufficiently rewarded for the valuable present they have made to science at the expense of their own health. M. Boblaye introduces the geological description of Greece by a survey of the recent progress and present state of geology. In this sketch, we perceive the touch of a skilful geographer and geologist, who searches for truth above every thing else with the coolness of a mathematician." We have learned, from the publication of our colleagues, that Olympus and Pindus are composed of granite, gneiss, and mica-slate, of talc-slate and granular limestone ; that Attica, Mount Athos, the Chalcidic Chersonesus, the mountains of Macedonia, and the isle of Thaso with

* Description of Greece, &c.

† Resumé of the progress of Geology for 1833, p. 346, and following.

its marbles, present also the same rocks ; that a long band of the jurassic and chalk formations extends along Carniola and Albania as far as the Gulf of Lepanto ; that the tertiary formation is developed in the Thracian Chersonesus, as also in the islands of Lemnos, Imbros, Samothrace, and Tenedos : finally, that numerous traces of recent eruptions are to be seen in the islands of the gulf of Athens, nearly all of which are volcanic.

For his geological description, Boblaye drew up a map on a scale of $\frac{1}{600000}$, reduced from the great map of the Morea, in six sheets, published by the War Department. This map, coloured geologically, in concert with M. Virlet, is entitled, " Map of the Morea and the Cyclades, representing the principal facts of ancient geography, and also of natural geography." It is accompanied by a learned memoir, entitled " Geographical researches on the ruins of the Morea." This memoir comprehends all the information that resulted from the labours of the members of the scientific expedition and the officers employed in constructing the map, respecting the topography of the ruins of the ancient Peloponnesus. This remarkable work, which would have opened the doors of the Academy of Inscriptions to our colleague, if he had lived longer, cost him three years' researches in the works of antiquity and those of the middle ages, and in the writings of modern travellers. It makes us acquainted with the boundaries of every state, and of every province; and furnishes curious details respecting the towns, and all the ruins which time and the hands of barbarians have not entirely swept away.

On his return from Greece, Boblaye read to the Society a memoir entitled, " Notice respecting the alterations produced on the calcareous rocks along the shores of Greece by the action of the sea."* The new and original observations embodied in this essay, tend to fix the principles by which we may recognise the traces of ancient sea-beaches in the interior of countries.

Having been elected secretary to the Geological Society in 1834, he made a very remarkable report on the works of the

* Bulletin of the Geological Society of France, t. i., p. 150; and Jameson's Journal.

members during the year 1832 and 1833. At the extraordinary meeting at Alençon, in 1837, he presented a geological map of the environs of that town, on a scale of $\frac{1}{40000}$, on which he had marked the heights at which the various formations come in contact. The map was accompanied by a sheet of sections, indicating the relative position of these formations, and the configuration of the surface: it is to be regretted that this work was never published. It was at the close of the meeting at Alençon, that the celebrated Buckland, while returning thanks to the officers of the Society, expressed the esteem which he and his fellow-countrymen entertained for the geological works of Boblaye.

Our fellow-member was employed in arranging the numerous observations which he had made in the department of Orne, when he received orders to repair to Africa, in order to triangulate the newly-acquired conquests in the province of Constantine. There, as in Greece, he engaged with ardour in the study of natural history, geography, and archæology. On his return to France, in the beginning of 1839, he announced to the Society, at its first sitting in February, that a great portion of the province consisted of the chalk formation, containing *Catilli* and *Inocerami*, of the same species as those of the chalk of Valogne; and that this formation is covered by a thick deposit of calcareous marl, rich in fossils, which must belong to the lower portion of the tertiary formation. From this important fact, he concludes that the tertiary formations must *s'echelonner*, with relation to the basin of the Mediterranean, in the same manner in the south as in the north. A short time after this interesting communication, having returned to Pontivy, he presented to the Society numerous specimens of mâcliferous slates, from the Salles of Rohan, containing, at the same time, *mâcles* (chiastolites) of considerable size, spirifers, and trilobites, evident proofs of the metamorphism of these rocks.

Having been appointed member of the Scientific Commission of Algeria, he again went to Africa in August 1839. In the month of November, in the same year, he accompanied the Duke of Orleans in the famous expedition of the Portes-de-Fer. This young prince, whose loss France still deplores, required to see our colleague only for a short time, in order to appreciate his high talent, his courage, and the noble frankness of which he gave him many proofs during this campaign. Captain Boblaye had reported at head-quarters that the *corps d'armée* was keenly engaged with the Kabyles, when the Duke of Orleans, who heard the firing, asked of those around him, "What has taken place with the advanced guard?"—"Nothing of importance," his attendants replied, as they wished to prevent him exposing himself; "Nothing of importance!" replied Boblaye, "the enemy is in force, and there is hot work, your Highness!" The Duke started instantly at the gallop, and fought like the rest. Our colleague was appreciated by this prince, not only as a soldier, but still more as a *savant*. He often spoke to him of geology and archæology. The beautiful escarpments of the Atlas mountains, the masses of marine shells accumulated at a great many different places, the remains of Roman roads, the ruins of cities, the forts and triumphal arches erected by the ancient masters of Africa, elevated his youthful and brilliant imagination. He often asked Boblaye for information, and requested him to give his opinion respecting so many wonders; and the profound knowledge which our fellow-member evinced in his replies, obtained for him the esteem and friendship of his Highness, who, on his return from this glorious campaign, presented him with a snuff-box ornamented with his cipher. On the 28th February 1840, he was appointed *chef d'escadron d'etat-major*, after being twenty-four years in the rank of officer.

Commandant Boblaye returned to France at the close of 1839, and, fatigued with the wandering life he had hitherto led, thought of enjoying repose. He married on the 10th February 1840, but was soon obliged to tear himself from his new affections, as the topographical section of the African army had need of a skilful and courageous chief. On the 6th March he again left Paris, and recrossed the Mediterranean.

In the two preceding campaigns, the health of the commandant, already impaired by the fevers of Greece, had suffered severe shocks. The fatigues of that upon which he now entered soon developed in him a scorbutic complaint, which obliged him to return to Europe for proper treatment. Believing himself cured, he resumed his labours on the map of France, at which he continued, as head of the Topographical Section, till 1842. At this period, the veneration which his fellow-countrymen entertained for his family, the esteem which his extensive knowledge had procured for him, and the confidence which his frank and loyal character had inspired, caused him to be elected, by a large majority, deputy for the arrondissement of Pontivy, his native town.

From that moment a new series of ideas took possession of his mind, and he abandoned geology. Having accepted a political trust, he thought that all his time was due to his country: what time was left from examining projected laws, the labours of the committees appointed by the Chamber, and attending to the necessities and wants of his constituents, he devoted to the study of the national finances. In 1843, he published a curious and important synoptical table of the revenues, expenses, debt, and public credit in France. This table was to be followed by others, all the materials for which were already collected.

But the terrible attacks his health had sustained since 1827, had produced a great change on his vigorous constitution. The activity of his mind, and his love for study, prevented him from perceiving the progress of his disease and yielding to the advice of his friends, who recommended rest. Last year, wishing to finish a great geological map of Brittany, long since commenced, he set out for that province, and took part in the military evolutions of the camp of Plélan, near Rennes. He there fatigued himself too much, and returned to Paris extremely unwell. The germs of the disease he had contracted in the Ardennes, in Greece, and in Africa, soon developed themselves with such virulence, that it was impossible for his physicians to arrest its progress.

Boblaye bore the pain of this dreadful disease with a fortitude which never for a moment gave way. He saw the approach of death with tranquillity and resignation, and breathed his last on the 4th December 1843, solely occupied with those he left behind him, his wife and young child. On the 6th, his brother, *chef d'escadron d'artillerie*, who was present at the time of his death, his numerous friends, his colleagues of the Chamber of Deputies, of the Geological Society, of the Philomathic Society, and his brother officers, assembled to convey his mortal remains to their final resting place, which was by the side of his younger brother, who died in 1829.

Sit illis terra levis !

Twice had our fellow-member enjoyed the honour of being on the list of candidates for admission into the Geological Section of the Academy of Sciences, and he had the prospect of being elected at the next vacancy.

There were found in his portfolio many unpublished notes on his travels in Greece, Africa, and the interior of France, on the public finances, and, finally, the first part of a great work on the Roman roads in Gaul. Death overtook him in the midst of his labours, at a period when, as with so many other men of genius, knowing that there remained for him much to do, he believed that he had still a long time to live.

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## *Comparative Remarks on the Recent and Fossil Mollusca of the South of Italy, and more particularly of Sicily.* By Dr A. Philippi.

In comparing the Molluscous Fauna of the Sicilian Seas* with the Mollusca which, during the tertiary period, were contained in the seas out of which a large portion of Sicily and Calabria was elevated, the following are the principal questions that present themselves :—1*st*, Were the seas at the time of the tertiary period generally richer or poorer in mollusca than they are at present ? 2*d*, How many of the species living at the present day existed at that time, and survived the catastrophes which separate the tertiary period

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* As connected with this subject we would refer our readers to an interesting Memoir by Dr Philippi, on the Molluscous Animals of South Italy, compared with those of other regions ; translated in the first number of the Quarterly Journal of the Geological Society—a periodical to which we wish all success.—Ed.

from our own epoch? and how many species were destroyed by these catastrophes? *3d*, Do the species which are common to both periods present differences with reference to their relative abundance, or to their size and other characters, which, although in themselves considerable, are still not of sufficient importance to justify a specific separation? *4th*, What are the relations of the individual localities which afford fossils? Are they all of the same age? and can subdivisions be established in the tertiary formation of Southern Italy? *5th*, What are the relations of the tertiary formation of Southern Italy to other tertiary formations?

I am not in possession of sufficient data to answer the last question satisfactorily, but my investigations have led me to the following results respecting the four preceding queries.

### I. *Comparative number of the Mollusca of the present epoch, and of the Tertiary Period.*

In the tertiary beds of Southern Italy, it is almost exclusively marine shells which are met with, and, of course, no remains of naked mollusca are found. If we subtract the latter as well as the land and fresh water mollusca from the total number of living mollusca which have been observed, there remain—

188 Marine Bivalves,
10 Brachiopoda,
11 Pteropoda,
313 Conchiferous Marine Gasteropoda,
15 Cirrhipeda,

In all 537 Mollusca which could occur in a fossil state.

The number of fossil mollusca hitherto found amounts to—

231 Marine Bivalves,
13 Brachiopoda,
5 Pteropoda,
322 Conchiferous Marine Gasteropoda,
5 Cirrhipeda.

576

It thus appears that, at the time of the Tertiary period, the sea was but a little richer in mollusca than it is at present.

It must be granted that future investigations will probably add a larger number to the list of fossils than to that of living species; but, on the other hand, it is to be remembered that the tertiary period lasted a much longer time, and that, during its continuance, species became extinct and new ones were added. It is therefore extremely probable that, during the tertiary period, the sea was neither poorer nor richer in mollusca than it is at present.*

The relative numbers belonging to the principal orders were somewhat different from what they are at present; thus we have—

| | During the tertiary period. | At the present epoch. |
|---|---|---|
| Marine Bivalves, | 0.40 | 0.35 |
| Brachiopoda, | 0.02½ | 0.02 |
| Pteropoda, | 0.01 | 0.02 |
| Conchiferous Marine Gasteropoda, | 0.56 | 0.58 |
| Cirrhipeda, | 0.01 | 0.03 |

The Bivalves and Brachiopoda, therefore, predominated more at a former period than they do at present, and the Gasteropoda and Cirrhipeda are now more numerous than they were formerly. Hence, I think, we may conclude that, at the time of the Tertiary period, there were fewer coasts in existence, and that the submarine land, which is now converted into dry land, then consisted chiefly of shallows.

## II. *Relative numbers of the extinct and living species.*

Of the 537 marine mollusca which could occur in the fossil state, I have not met with the following 169 (not quite a third part) among the Tertiary petrifactions of Southern Italy:—

### Bivalves.

Clavagella balanorum, *Scac.*
angulata, *Ph.*
Teredo navalis, *L.*
Teredo Bruguieri, *D. Ch.*
palmulata, *D. Ch.*
Pholas candida, *L.*

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* If we were to adopt this principle as the basis of our calculations, and to divide the whole geological series only into the tertiary, chalk, Jura, old secondary, and transition formations, the number of fossil species would amount to at least five times as many as that of the living; and if, on a moderate calculation, we were to reckon the latter at 8000, the former would amount to about 40,000 species!

Solen legumen, *L.*
Panopæa Aldrovandi, *Men.*
Scrobicularia piperata, *Gm.*
Cottardi, *Pay.*
Erycina ovata, *Ph.*
Bornia seminulum, *Ph.*
Solenomya mediterranea, *Lam.*
Corbula revoluta, *Broc.*
Pandora flexuosa, *Sow.*
Thracia ovalis, *Ph.*
fabula, *Ph.*
Galeomma Turtoni, *Sow.*
Venerupis decussata, *Ph.*
Tellina fabula, *Gm.*
Costæ, *Ph.*
baltica, *L.*
Lucina? bipartita, *Ph.*
Scacchia elliptica, *Scac.*
ovata, *Ph.*
Venus geographica, *G.*
læta, *Poli.*
aurea, *Mat.*
Beudanti, *Pay.*
nitens, *Ph. and Sc.*
Cardium scabrum, *Ph.*
parvum, *Ph.*
Arca scabra, *Poli.*
imbricata, *Poli.*
Pectunculus lineatus, *Ph.*
Modiola costulata, *Riss.*
Pinna truncata, *Ph.*
rudis, *L.*
pectinata, *L.*
muricata, *Pol.*
marginata, *Lam.*
vitrea, *Gm.*
Lima inflata, *Lam.*
Pecten sulcatus, *Lam.*
Testæ, *Bivon.*
gibbus, *Lam.*
Spondylus aculeatus, *Chemn.*
Anomia aspera, *Ph.*
scabrella, *Ph.*
pectiniformis, *Poli.*
elegans, *Ph.*
margaritacea, *Ph.*
aculeata, *Mont.*

BRACHIOPODA.

Orthis lunifera, *Ph.*
neapolitana, *Sc.*
Orthis anomioides, *Ph. and Sc.*
Thecidea mediterranea, *Riss.*

PTEROPODA.

Hyalæa gibbosa, *Rang.*
vaginella, *Cantr.*
Cleodora cuspidata, *Q. and G.*
Cleodora striata, *Rang.*
acicula, *Rang.*
zonata, *D. Ch.*

GASTEROPODA.

Chiton pulchellus, *Ph.*
Polii, *Ph.*
Rissoi, *Pay.*
lævis, *Penn.*
variegatus, *Ph.*
cajetanus, *Poli.*
Patella Rouxii, *Pay.*
cœrulea, *L.*
fragilis, *Ph.*
Emarginula Huzardi, *Pay.*
Fissurella rosea, *Lam.*
Pileopsis militaris, *Pult.*
Thyreus paradoxus, *Ph.*
Crepidula gibbosa, *Dfr.*
Bullæa planciana, *Ph.*
Bulla vestita, *Ph.*
ovulata, *Broc.*
Bulla Ampulla, *L.*
diaphana, *Ar. and Mag.*
Rissoa, elata, *Ph.*
violacea, *Desm.*
similis, *Scac.*
Auriscalpium, *L.*
clathrata, *Ph.*
coronata, *Sc.*
radiata, *Ph.*
rudis, *Ph.*
gracilis, *Ph.*
cingulata, *Ph.*
tenera, *Ph.*
subsulcata, *Ph.*
fulva, *Mich.*
labiata, *Mühlf.*
soluta, *Ph.*

Truncatella littorina *Desh.*
? fusca, *Ph.*
atomus, *Ph.*
Chemnitzia scalaris, *Ph.*
obliquata, *Ph.*
† Nerita versicolor, *Lam.*
Natica marochiensis, *Lam.*
helicina, *Broc.?*
Ianthina bicolor, *Mke.*
nitens, *Mke.*
patula, *Ph.*
Sigaretus haliotideus, *L.*
Vermetus semisurrectus, *Biv.*
Scalaria pulchella, *Biv.*
crenata, *L.*
Delphinula exilissima, *Ph.*
Solarium discus, *Ph.*
Trochus granulatus, *Born.*
dubius, *Ph.*
pumilio, *Ph.*
unidentatus, *Ph.*
villicus, *Ph.*
leucophæus, *Ph.*
Racketti, *Pay.*
pygmæus, *Ph.*
† carneolus, *Lam.*
Turbo neritoides, *L.*
littoreus, *L.*
obtusatus, *L.*
muricatus, *L.*
Scissurella plicata, *Ph.*
striatula, *Ph.*
Cerithium lævigatum, *Ph.*
Pleurotoma purpureum, *Mont.*
costulatum, *Riss.*
multilineolatum, *Desh.*
pusillum, *Scac.*
plicatum, *Lam.*
tæniatum, *Desh.*
Bertrandi, *Pay.*
lævigatum, *Ph.*
secalinum, *Ph.*
Laviæ, *Ph.*
Pyrula squamulata, *Ph.*
† Santangeli, *Mar.*
Murex tetrapterus, *Bronn.*
Tritonium variegatum, *Lam.*
scrobiculator, *L.*
cutaceum, *L.*
Chenopus sirresianus, *Mich.*
Cassidaria depressa, *Ph.*
Dolium galea, *L.*
Buccinum Scacchianum, *Ph.*
candidissimum, *Ph.*
Tirei, *Mas.*
Lefebvrii, *Mas.*
Terebra aciculata, *Lam.*
Ovula carnea, *L.*
† Cypræa annulus, *L.*
† moneta, *L.*
erosa, *L.*
helvola, *L.*
Dentalium rubescens, *Desh.*

CIRRHIPEDA.

Balanus intermedius, *Ph.*
hemisphæricus, *Brg.*
galeatus, *L.*
Acasta Spongites, *Poli.*
Chthamalus glaber, *Poli.*
Coronula bissexlobata, *Blain.*
Anatifa lævis, *Brg.*
striata, *Brg.*
Pollicipes Scalpellum, *L.*

Thus, the following mollusca made their appearance in the sea subsequently to the Tertiary period :—

| | | |
|---|---|---|
| Of the 188 Marine Bivalves, . . . . | 53* | or 0.19 |
| ... 10 Brachiopoda, . . . . | 4 | ... 0.40 |
| ... 11 Pteropoda, . . . . | 6 | ... 0.58 |
| ... 313 Conchiferous Marine Gasteropoda, | 97 | ... 0.31 |
| ... 15 Cirrhipeda, . . . . . . | 9 | ... 0.60 |

On the other hand, of 576 fossil species of marine shells, the following 193, or almost exactly ⅓, no longer occur in the sea at the present day.

* In the original 35, evidently a typographical error.—ED.

BIVALVES.

Aspergillum, maniculatum, *Ph.*
Clavagella bacillaris, *Desh.*
Clavagella sp.
Pholas vibonensis, *Ph.*
Solen tenuis, *Ph.*
Solecurtus multistriatus, *Scac.*
Panopæa Faujasii, *Men.*
Bivonæ, *Ph.*
Anatina oblonga, *Ph.*
pusilla, *Ph.*
Scrobicularia tenuis, *Ph.*
Erycina pusilla, *Ph.*
angulosa, *Bronn.*
longicallis, *Scac.*
similis, *Ph.*
Corbula crispata, *Scac.*
costellata, *Desh.*
Thracia ventricosa, *Ph.*
elongata, *Ph.*
Tellina pusilla, *Ph.*
pleurosticta, *Ph.*
ovata, *Sow.*
elliptica, *Broc.*
strigilata, *Ph.*
Diplodonta Lupinus, *Broc.*
Lucina transversa, *Bronn.*
albella, *Lam.*
Scacchia inversa, *Ph.*
Astarte lævigata, *Münst.*
Cytherea fragilis, *Ph.*
Venus senilis, *Broc.*
vetula, *Bast.*
? miliaris, *Ph.*
Cardium multicostatum, *Broc.*
Hippagus acutecostatus, *Ph.*
Arca mytiloides, *Broc.*
Breislaki, *Bast.*
aspera, *Ph.*
obliqua, *Ph.*
Arca pectunculoides, *Scac.*
Pectunculus variabilis, *Sow.*
auritus, *Broc.*
minutus, *Ph.*
pygmæus, *Ph.*
Nucula placentina, *Lam.*
excisa, *Ph.*
striata, *Lam.*
pusio, *Ph.*
glabra, *Ph.*
cuspidata, *Ph.*
dilatata. *Ph.*
pellucida, *Ph.*
decipiens, *Ph.*
Chama dissimilis, *Bronn.*
Modiola grandis, *Ph.*
phaseolina, *Ph.*
sericea, *Bronn.*
Mytilus antiquorum, *Sow.* (?)
Arcinella lævis, *Ph.*
Perna Soldanii, *Desh.*
Pecten cristatus, *Bronn.*
Alessii, *Ph.*
latissimus, *Broc.*
palmatus, *Lam.*
scabrellus, *Lam.*
rimulosus, *Ph.*
antiquatus, *Ph.*
fimbriatus, *Ph.*
pygmæus, *Münst.*
semicostatus, *Münst.*
Hinnites læviusculus, *Ph.*
Plicatula mytilina, *Ph.*
Ostrea bellovacina, *Lam.*
prægrandis, *Ph.*
longirostris, *Lam.*
foliosa, *Broc.*
Anomia striata, *Broc.*

BRACHIOPODA.

Terebratula grandis, *Blum.*
bipartita, *Broc.*
biplicata, *Sow.*
sphenoidea, *Ph.*
Terebratula septata, *Ph.*
euthyra, *Ph.*
Orthis eusticta, *Ph.*

GASTEROPODA.

Emarginula decussata, *Ph.*
Brocchia sinuosa, *Broc.*
Bulla convoluta, *Broc.*
lævis, *Ar. et Mag.*
Aplysia ? deperdita, *Ph.*
? grandis,
Melania ? soluta, *Ph.*
Valvata ? striata, *Ph.*
Rissoa sculpta, *Ph.*
reticulata, *Ph.*
textilis, *Ph.*
areolata, *Ph.*
substriata, *Ph.*
canaliculata, *Ph.*

Eulima Scillæ, *Scac.*
affinis, *Ph.*
Bulimus, *Scac.*
Chemnitzia pusilla, *Ph.*
Terebellum, *Ph.*
Natica undata, *Ph.*
tigrina, *Dfr.*
Scalaria trinacria, *Ph.*
plicosa, *Ph.*
crispa, *Lam.*
Delphinula nitens, *Ph.*
elegantula, *Ph.*
Bifrontia ? zanclæa, *Ph.*
Solarium reticulatum, *Ph.*
pseudoperspectivum, *Broc.*
Trochus crispus, *Kön.*
millegranus, *Ph.*
parvulus, *Ph.*
bullatus, *Ph.*
patulus, *Broc.*
gemmulatus, *Ph.*
filosus, *Ph.*
glabratus, *Ph.*
crispulus, *Ph.*
euomphalus, *Ph.*
strigosus, *Gm.*
suturalis, *Ph.*
marginulatus, *Ph.*
Ottoi, *Ph.*
cinctus, *Ph.*
Scissurella aspera, *Ph.*
Turritella tornata, *Broc.*
vermicularis, *Broc.*
subangulata, *Broc.*
Cerithium calabrum, *Ph.*
tricinctum, *Broc.*
Scæa stenogyra, *Ph.*
Pleurotoma cataphractum, *Broc.*
torquatum, *Ph.*
dimidiatum, *Broc.*
galeritum, *Ph.*
pygmæum, *Ph.*
noduliferum, *Ph.*
sigmoideum, *Bronn.*
harpula, *Broc.*
columnæ, *Scac.*
comma, *Sow.*
Pleurotoma Imperati, *Scac.*
decussatum, *Ph.*
semiplicatum, *Bronn.*
Tarentini, *Ph.*
Payraudeaui, *Desh.*
Maggiori, *Ph.*
Turricula, *Broc.*
Renieri, *Scac.*
carinatum, *Biv. fil.*
Cancellaria hirta, *Broc.*
coronata, *Scac.*
Fusus longiroster, *Broc.*
clavatus, *Broc.*
scalaris, *Broc.*
rudis, *Ph.*
politus, *Ren.*
Murex vaginatus, *De Cr. et J.*
multilamellosus, *Ph.*
Chenopus pes graculi, *Bronn.*
desciscens, *Ph.*
Strombus coronatus, *Dfr.*
Cassidaria striata, *Sow.*
Purpura cyclopum, *Ph.*
Buccinum serratum, *Broc.*
musivum, *Broc.*
granulatum, *Ph.*
spinulosum, *Ph.*
acutecostatum, *Ph.*
pusillum, *Ph.*
exile, *Ph.*
Columbella Greci, *Ph.*
Mitra cupressina, *Broc.*
Voluta rarispina, *Lam.*
Ancillaria obsoleta, *Broc.*
Conus Brocchii, *Bronn.*
demissus, *Ph.*
Dentalium sexangulum, *Gm.*
multistriatum, *Desh.*
sulcatum, *Lam.*
substriatum, *Desh.*
tetragonum, *Broc.*
incertum, *Desh.*
coarctatum, *Lam.*
striatum, *Lam.*
triquetrum, *Broc.*
ovulum, *Ph.*

### Cirrhipeda.

Chthamalus gigas.
Pollicipes carinatus.

The following, therefore, are the relative numbers of species of the Tertiary period which are now extinct :—

| | | |
|---|---|---|
| Of the 231 | Bivalves, | 77 or 0.29 |
| 13 | Brachiopoda, | 7 ,, 0.54 |
| 5 | Pteropoda, | 0 ,, 0.00 |
| 322 | Conchiferous Gasteropoda, | 108 ,, 0.31 |
| 5 | Cirrhipeda, | 2 ,, 0.00 |
| 576 | | 194 or 0.33 |

Among the fossil species there are some which do not now live in the Mediterranean of Southern Italy, but are known to exist in other seas, viz. :—

Mya truncata, *L.* Greenland ; in the whole Northern Atlantic Ocean ; and, according to Brocchi, in Tuscany.
Lutraria solenoides, *Lam.* On the coasts of France, &c.
Tellina crassa, *L.* In the North Sea.
Lucina columbella, *Lam.* Senegal.
pennsylvanica, *L.* On the coasts of America.
Cyprina islandica, *L.* North Sea ; Iceland ; Canada.
Cardium hians, *Broc.* In warm seas ; near Algiers.
Lima bullata, *Turton.* North Sea.
Pecten medius, *Lam.?* Red Sea.
Ostrea edulis, *L.* North Sea.
Patella vulgata, *L.* North Sea.
Niso Terebellum, *Chemn.* Nicobar Islands.
Vermetus intortus, *Lam.* Antilles.
Trochus strigosus, *Gm.* On the Coast of Morocco.
Fusus contrarius, *L.* North Atlantic Ocean.
Buccinum undatum, *L.* Do. do.
Terebra fuscata, *Broc.* Senegal.
Dentalium elephantinum, *L.* Indian Sea.
multistriatum, *Desh.* Indian Sea?
coarctatum, *Lam.* English Channel.

Thus, of 382 species which are common to the Tertiary formation and the present period, there are only 20 species which do not belong to that portion of the Mediterranean Sea which washes Southern Italy ! Hence it may be concluded with great certainty, that at the time of the Tertiary period, the climate could not have been very different from what it is at present. But perhaps it may be said that this conclusion is overturned by the 194 extinct species ; and that these species belonged either to the newly-discovered ice-period, or to a warm climate ? A hasty glance at the list already given, is sufficient to shew that neither of these suppositions is correct. It is no doubt true that the occurrence of *Aspergillum maniculatum*, *Perna Soldanii*, *Plicatula mytilina*, *Strombus coronatus*, *Terebra fusca* and *duplicata*, *Voluta rarispina*, and *Ancillaria obsoleta*, is at first sight in favour of a warmer climate, because these genera do not occur in the seas of the northern temperate zone; and it cannot be denied that the species most closely allied to *Cytherea multilamellosa* is *Cytherea cygnus*, which now lives near Canton (not in the Mediterranean, as conjectured by Deshayes). The number, however, of living and extinct species which favour the idea of a warmer climate, is extremely inconsiderable, in comparison to the number of the remaining species; and we have, on the other hand, species which are now confined to colder seas, such as *Mya truncata*, *Cyprina islandica*, and *Fusus contrarius;* so that we are entitled to regard it as an incontrovertible fact, that, *in Southern Italy, at the time of the Tertiary period, the climate was neither much warmer nor much colder, than it is at present.* It can hardly be urged as a valid argument against this view, that simultaneously, or at a later period (we shall afterwards see that the palæontological phenomena admit of no separation of the Tertiary period, from the Diluvial period, and from the Alluvial period). Elephants, Rhinoceroses, and Hippopotami, also lived in Sicily, because these animals, belonging to different species from those which now live in hot climates, could exist perfectly well in the present climate of Sicily.

### III. *Physiognomy of the Mollusca of the Tertiary Period and of the present day.*

If we consider the relative abundance of the species from which results what may be termed the *Physiognomy* of the molluscous fauna, we find not a few species equally common at the present day and in the Tertiary period; but also that a number of species formerly very abundant, have become rare or even extinct, and *vice versa*, a number of species are now very abundant which were formerly rare or altogether awanting.* It may be remarked, that the very species which

* We regret that want of space prevents us from giving Dr Philippi's lists illustrative of this part of the subject, and that the same reason will oblige us to omit the detailed lists under Sect. IV. of the present memoir.—Edit.

are *most abundant* at the present day, such as, *Venus geographica*, *Venus laeta, Poli, Turbo neritoides, L.*, did not exist during the Tertiary period.

It may be asserted, generally, that the differences observed between living and fossil specimens of the same species, are not greater than those which occur between individuals of the same species; nay, it is not at all a rare occurrence, to find difficulty in determining whether a specimen be fossil or not. This is the case, for instance, with the specimens occurring in the clay of Abbate, near Palermo, which are washed out by the sea, and are very often inhabited by hermit-crabs. These species are frequently in an astonishing state of preservation; and hence there is a sufficient apology for their being regarded as recent shells. This seems to have taken place with those conchologists, who, like Linnæus, assigned Sicily as a locality to *Dentalium elephantinum*; and also with Kiener, when he included *Murex vaginatus* among the living species; but, in the latter instance, the author is very much to be blamed for altering the names.

It is, however, remarkable that *certain species seem to have been very much larger in former times than they are at present.* We have striking examples of this fact in *Lucina radula*, *Lucina fragilis*, *Cytherea rudis*, *Poli*, *Venus radiata*, *Cardium Deshayesii*, *Cardium papillosum*, *Mytilus edulis*, *Pileopsis ungarica*, *Turritella communis*, and *Turritella triplicata*. I could enlarge this list considerably; but still the majority of the species agree completely in size; and, what is very singular, *certain species were constantly much smaller during the Tertiary period than they are at present*; the number of the latter, however, is comparatively small. As examples of this circumstance, I would particularly instance *Bulla lignaria*, and *Terebratula vitrea*, which formerly scarcely attained half the size they now present; and, next to them, I would mention *Corbula nucleus*.*

From these facts nothing further can be deduced than that

* In my *Enumeratio molluscorum Siciliæ*, I have invariably given the relative sizes of the fossil and living shells, when they differed from each other.

formerly the various circumstances, the localities, the nature of the sub-marine land, &c., were more favourable for the development and growth of certain species, but were also less favourable for the development of a very few species; and that, *speaking generally*, these various circumstances were at that time similar to those of the present day.

IV. *What is the proportion of the living and extinct species at the individual localities? Have all the latter a like age? Can subdivisions be established in the Tertiary formation of Southern Italy; and if so, what are they?*

In general, the fossils are chiefly abundant in clay, in marl, and in shell sand; but it is of no importance for the object of the present memoir, to describe petrographically the individual localities, more especially as the same petrifactions occur in the clay and in the shell sand, and even in the compact limestone, as can be well seen near Palermo. In a similar manner, it may be remarked, the same recent species occur, at the present day, on sandy shores, as well as on muddy coasts, &c. The geognostical phenomena, so far as Sicily is concerned, have been most fully described by my late friend Frederick Hoffmann, in his "*Geognostische Beobachtungen, gesammelt auf einer Reise durch Italien und Sicilien.*"

I propose soon to give a detailed description of the tertiary formation of Calabria; the distribution of that formation is very distinctly delineated in the map which Von Tschikalschoff has copied with perfect exactness from original materials furnished by me. I would refer my readers to that gentleman's '*Coup d'oeil sur la constitution géologique des provinces meridionales du royaume de Naples.*"

If we place together all the individual localities of Sicily, &c., and arrange them according to the proportion which the extinct species bear to the living, beginning with the localities which present the largest number of extinct species, and ending with those which afford the smallest, we shall evidently exhibit them in the order of their relative ages; for the first must, of course, be regarded as the oldest, and the last as the newest.

| | Not found in the Mediterranean. | Extinct. |
|---|---|---|
| Monasterace, . . . . | 0.77 | 0.77 |
| Sortino, . . . . | 0.53 | 0.53 |
| Cotrone, Cutro, &c., . . | 0.46 | 0.43 |
| Naseti, . . . . | 0.50 | 0.40 |
| Valley of Lamato, . . | 0.37 | 0 35 |
| Caltagirone, . . . | 0.38 | 0.30 |
| Interior of Sicily, . . | 0.34 | 0.30 |
| Buccheri, . . . . | 0.34 | 0.30 |
| Caltanissetta, . . . | 0.34 | 0.29 |
| Syracuse, . . . | 0.25 | 0.25 |
| Palermo, . . . | 0.25 | 0.23 |
| Gravina, . . . . | 0.25 | 0.22 |
| Pezzo, . . . . | 0.18 | 0.18 |
| Messina, . . . . | 0.17 | 0.17 |
| Girgenti, . . . . | 0.20 | 0.15 |
| Militello, . . . . | 0.15 | 0.14 |
| Carrubbare, near Reggio, . | 0.11 | 0.11 |
| Monteleone, . . . | 0.10 | 0.08 |
| Cefali, near Catania, . . | 0.09 | 0.08 |
| Sciacca, . . . . | 0.11 | 0.06 |
| Tarento, . . . . | 0.05½ | 0.05½ |
| Nizzeti, near Catania, . . | 0.06 | 0.05 |
| Melazzo . . . . | 0.04 | 0.03 |
| Island of Ischia, . . . | 0.01⅓ | 0.01⅓ |
| The coast near Monte Nuovo, . | 0.01 | 0.00 |
| Pozzuoli, . . . . | 0.00 | 0.00 |

We thus see plainly, that the transition from the Tertiary period to the present time has taken place quite gradually; and that no great revolutions have given rise to lines of demarcation; but that, on the contrary, individual species have gradually become extinct, and others have been added, until the present fauna has been formed.

We can establish no subdivisions in the Tertiary deposits of Southern Italy; for we cannot even fix a limit between the Tertiary period and the Diluvial period, or the period of the present day. The division of the Tertiary series into Eocene, Pliocene, and Miocene, is not applicable to the formations of Southern Italy, in so far as it is founded on the relative proportions of extinct and living species; and, as regards other localities, it may also turn out to be uncertain and arbitrary.

Lastly, we may conclude with great certainty, that the Tertiary formations of Southern Italy did not rise from the bottom of the sea at one and the same time, but that they are the result of numerous and repeated elevations which have even continued to the historical period.*

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*On admitting the Back-Light, in Portable Dioramas, upon different parts of a Picture at different times ; on using Light from Oil, &c.* By GEORGE TAIT, Esq., F.R.S.S.A. Communicated by the Royal Scottish Society of Arts.†

In portable dioramas, which I described in former communications to the Royal Scottish Society of Arts,‡ the back-light was admitted behind *the whole* of a picture *at once.* I have now fitted up some pictures, so as to admit the back-light upon *different parts at different times ;* an arrangement which obviously increases materially the variety of effects which may be introduced into a picture, when the subject makes that desirable. It is done simply by means of shutters, behind different parts of the picture, attached to the stretching-frame, which are moved by wires or cords affixed to them, passing outwards through the opening by which the picture is inserted, and adjusted so as to be moved without noise. That opening may be either at the top or at the side of the box, as may be preferred. Tissue-paper is used along with the shutters, when it is necessary, in such a manner as to produce the effect intended.

In dioramas constructed for internal light (as described in my last two communications), particularly when shutters are used as before suggested, it is convenient to have two counterpoises, just sufficient to prevent the springs from closing the gas stop-cocks ; which counterpoises can be attached, when necessary, to the cords for opening the stop-cocks, and by means of which the flames can be retained, during pleasure,

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* From Erichson s Archiv für Naturgeschichte : Zehnter Jahrgang, viertes Heft, p. 348. 1844.

† Read, and diorama exhibited, before the Royal Scottish Society of Arts, on 13th January 1845.

‡ See vol. xxxii., p. 142 ; vol. xxxiii.. p. 64 ; vol. xxxiv., p. 275 ; vol. xxxv., p. 53 ; and Transactions of the Society, vol. ii., pp. 127, 162, 215, and 230.

at any height desired; and the hands may thus be left at liberty to move any other part of the apparatus.

I may take this opportunity of mentioning, that, instead of using the front slider of tissue-paper, immediately behind the pictures, formerly suggested (at N O of the diagram*), it is more simple and convenient to attach tissue-paper to the back of the stretching-frame of any picture for which that is necessary, in order to produce uniformity of effect by the back-light, on account of any object, for example the moon, being made to transmit the light without diffusing it. It seems better not to use tissue-paper behind a picture, unless it be necessary, as it intercepts more than a third part of the light.

If oil, instead of gas, be used for lighting a diorama internally, there are practical objections, unnecessary to be here detailed, to lighting the pictures by the direct rays from the flames. But they may be lighted by means of any substance which transmits light abundantly, and diffuses it sufficiently (for example, one or two plies of glass, coarsely ground on both sides), applied to an opening in a screen in front of each of the flames, in a line between the flame and the pictures, placed very near the flame, and having the light concentrated upon it by a reflector behind, in a continuation of the same line. The quantity of light admitted upon that substance is modified to any extent by a slider or sliders, properly formed and adjusted, on the side of the opening next to the flame. Those two surfaces, thus enlightened and thus darkened, are the sources of the front and the back light to the pictures, and occupy the places of the gas flames. But gas is, in all respects, so very much preferable to oil for lighting a diorama internally, and is now in so general use, that it seems unnecessary to enter more into detail with regard to the application of oil to that purpose.

EDINBURGH, *December* 26, 1844.

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* See vol. xxxiv., p. 276.

*Description of the Great Chimney at St Rollox, Glasgow, and of the Climbing-Machine used in examining and repairing a Rent in that Chimney at the height of* 280 *feet.* By LEWIS D. B. GORDON, Esq., Professor of Civil-Engineering in the University of Glasgow, and LAURENCE HILL, Junior, Esq., F.R.S.S.A., Civil-Engineer. With a Plate. Communicated by the Royal Scottish Society of Arts.*

The great chimney at St Rollox, Glasgow, was erected in order to carry off the muriatic acid, and other gases, escaping in the works, at such a height that, before the gases could fall, they should be so diluted as to be innocuous. The peculiar construction of the chimney, viz., a double cone, was adopted, in order to maintain the heat of the gases as long as possible; and at the same time the internal form of the chimney and its dimensions are such, that there should be a maximum discharge for the same temperature of the ascending column. The chimney perfectly accomplished this end; but soon after its erection, the process in which the muriatic acid is disengaged, was so conducted, that the whole gas is now collected, condensed, and applied to useful purposes, or run off; and thus the great function of the chimney's enormous height is no longer brought into use.

It may be mentioned, that 120 tons of coals are consumed per day in St Rollox works, the whole product of the combustion of which goes up the great chimney, drawn, in some cases, from a distance through flues 400 yards long. The chimney was designed with a curved batter, the curve being the logarithmic curve; but it was not so built, from some error in setting out the work at its commencement, Mr Gordon being at the time absent.

The following are its exact dimensions:—

* Read before the Society, and drawings and model exhibited, by David Stevenson, Esq., F.R.S.E., V.P., R.S.S.A., civil-engineer, 9th December 1844.

| | |
|---|---|
| Total height from foundations, . | 447 feet 6 in. |
| Depth of foundations, . . . . | 15 ... 0 ... |
| Total height above the surface, | 432 feet 6 in. |
| Diameter at base, . | 45 feet. |
| ... ... surface, | 40 ... |
| ... ... top, . | 13 feet 6 in. |

There are used in its construction 1,250,000 bricks of first quality, weighing 121 lb. per cubic foot, resisting 63 tons' pressure per superficial foot before *cracking*, and requiring 110 tons to crush them. The brick-work is $3\frac{1}{2}$ bricks at bottom, and $1\frac{1}{2}$ at top. The internal flue is 260 feet high, *and is perfectly vertical.*

It took six months, in two different seasons, autumn 1841, and spring 1842, to build it, which was accomplished without the slightest accident. It was finished in June 1842.

In May 1844, a rent was discovered in one side, about 36 feet long, extending, from a point about 100 feet from the top, downwards. This rent was affirmed by some to have been caused by lightning. The rent gradually increased during June and July, and then a similar rent was discovered on the opposite side, beginning somewhat lower down than that first observed, but extending only 45 feet. This created some apprehension; and, in August, it was determined to examine the chimney where the rents appeared, and, according to the result of this examination, to proceed to measures of security or of protection. Scaffolding appeared at first the only means of effecting the desired examination, without stopping the works. Balloons were afterwards proposed, but were considered not so likely a means of accomplishing the end in view, although the celebrated Mr Green, on being applied to, offered the use of a balloon, and his own personal superintendence of the ascent. During the erection of the chimney, in 1841,—while Mr Colthurst, civil-engineer, was superintending the laying of the foundations, and erection of the first 80 feet of the great chimney,—an accident occurred to a chimney of a cotton-factory in the neighbourhood of St Rollox, which rendered it highly desirable that some one should go to the top of the chimney. Scaffolding would have cost L.20. Mr Colthurst suggested that, by driving *staples* into the joints of the brick-work, a man might be able to climb to the top safely and very cheaply. A man was got who undertook to carry out the suggestion, and actually went up the outside of a chimney 112 feet high, threw down a loose coping-stone from the top, and descended; the whole job occupying two days. Working upon this suggestion of Mr Colthurst, we contrived the Climbing-Machine, for examining the rent in the great chimney, at a height of 280 feet from the ground. The drawings are a correct representation, and shew the details of the machine, in which two men worked themselves up 280 feet on the chimney in the course of nine days, including the time occupied in filling up the rent.

Instead of the  staples on which the climber set his foot, and held on by means of a band with a hook to it, which, passing round his waist, or rather under his arms, supported him while driving in a new staple at the level of his head, or nearly so;—instead of this, in the original, the new machine is so arranged, that two men working in it, bore or "jump" two holes in the brick-work, to receive two lewises. The ropes being hooked on to the lewis on each side, the machine is moved up by means of the ratchets and pall worked by the men. A movement of about 5 feet is thus made. The safety-chains are then put on to the pins, or lewises, besides the hooks of the ropes. The men, thus secure, go to the top stage of the machine, and, working there, drive each a new hole to receive a new pair of lewises; which being well fixed, the ropes are taken off the first lewises, and put on to the new pair. While the machine *is in motion*, the men were at first dependent on the ropes alone, but by attaching the vertical *racks*, which constantly press outwards against the pins, it was very improbable, or scarcely possible, that, even should the ropes break, the machine could fall more than 2 inches before being brought up by the *ratchets* catching on the pins.

On gaining the position of the rent, a strong pulley was fixed in the chimney, through which a rope was passed, extending to the ground; and to this point an ascent can very easily be made at any future time. The persons employed were *slaters* by trade, an old and a young man. It was made a principle not to bribe any one to undertake the job. The men worked at wages of 5s. per day, or little more than their ordinary wages. They were steady, sober, active men; and credit is due to them for the excellent manner in which they did the work. Mr Gordon or Mr Hill went up with the machine each day; and, after careful examination and deliberation, concluded that the rent is an effect of expansion from heat. Though the fissure was found in one place to be 2 inches wide, and its average width to be nearly 1 inch, yet the nature of it was such, that a rod could not be put through the fissure to the inside of the chimney. It would have been very desirable to have got a thermometer into the interior; but not having succeeded in getting it through the fissure, the expedient of driving a hole for the purpose was not adopted at the time, from its being inconvenient; and so the opportunity was lost. It may be mentioned, however, that *red-hot* matter has been more than once observed projected in a column from the top of this 432 feet high chimney. The temperature in the chimney, near the top, is probably seldom under 600° F.

*Description of Climbing Machine.* (Plate VI).

Fig. 1. is a side view.
... 2. is a back view.
... 3. a plan across the windlass.

The frame, which was as light as possible, consistent with proper strength, was about 10 feet high, 3 feet deep, and 4 feet wide; the beams next the stalk projected about 15 inches further at each end. W is the windlass, worked by the ratchet-handles H H. P P, two pullies fixed to windlass, round which the ropes were wound when the machine was ascending. L L, the lewises, securely fixed into the chimney, and to which the ropes were hooked. The heads of these lewises were bent at a right angle, so as to overlap the long plates I I, by which means the machine was held close to the chimney. F F F F, four friction-rollers, to prevent the machine from rubbing against the stalk. S S, two short chains, which were used for holding up the machine while the ropes R R were being shifted to a new set of lewises, for another lift. K K, two long racks, which were hung on pins at O O.—They worked into, or against, the two under lewises, and were used in order to prevent the machine from falling, in case any accident should happen to the ropes.

By working the handles backwards and forwards, the machine was sent up a lift of 5 feet in a few minutes. Two catches (not shewn in the drawing) worked into the teeth of the windlass wheels, and prevented their recoil. When the men were boring the holes for the lewises in the stalk, they stood on the upper floor or board U; and the jumpers used to bore the holes were worked through guides fixed to the frame of the machine. At the end of a day's work, the lewises were taken out and used over again in the next day's ascent. The ascent of 280 feet occupied nearly nine days, including the time spent in repairing the rent. The men were hoisted to the cage by a windlass on the ground, the rope from which worked over a large pulley within the machine.

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*Report of the Committee of the Royal Scottish Society of Arts, on the Climbing-Machine, used at St Rollox by Professor Gordon and Mr Hill.*

The Committee having examined the apparatus employed by Professor Gordon and Mr Hill for ascending the chimney of St Rollox, and the accompanying description of it, beg leave to report as follows:—

*First,* The application of machinery to the ascent of high elevations, under similar circumstances, so far as the reporters know, is new.

*Second,* The mechanical arrangements for raising the cradle, and also for preventing its fall, are simple and well devised.

*Third,* Its use at St Rollox is the best proof that the reporters can adduce of the success of its practical application. They have, therefore, to recommend it to the favourable notice of the Society, and to suggest that it be printed in the Transactions.

(Signed) David Stevenson, *Convener.*
Geo. Buchanan.
Geo. Glover.

Edinburgh, 21*st January* 1845.

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*On a Method of rendering Baily's Compensation Pendulum insensible to Hygrometric Influence.* By Mr Robert Bryson, F.R.S.E., Watchmaker, Edinburgh. Communicated by the Royal Scottish Society of Arts.*

The well-known law by which all bodies expand by the increment of heat, and contract by its decrement, is every day brought under the notice of the watchmaker. To-day the temperature is high, all his time-keepers are slow; to-morrow it may be frost, and they inevitably gain upon their rate; to obviate these inconveniences, many contrivances have been resorted to under the name of compensation balances and pendulums.

* Read before the Society, 13th January 1845.

Professor Gordon & Mr. Hill's

**CLIMBING MACHINE**

*Fig. 2.*

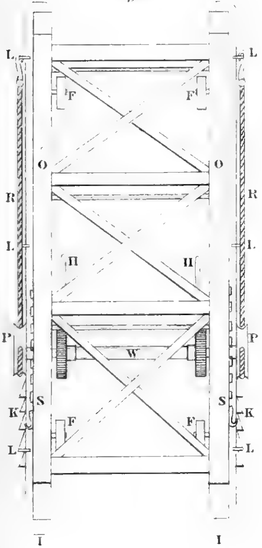
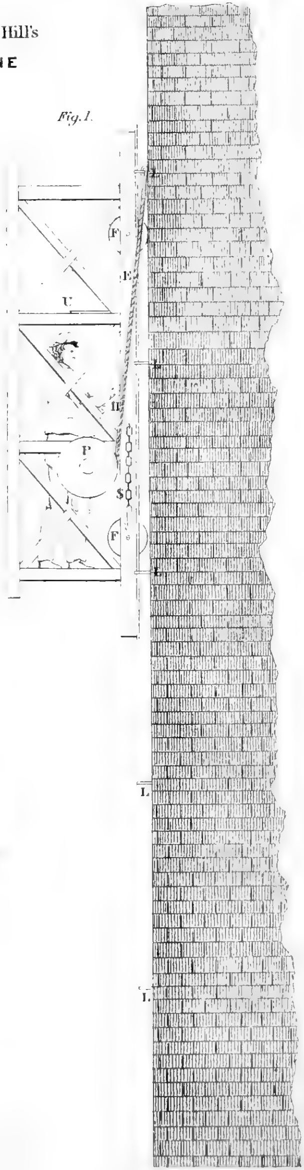



*Fig. 1.*



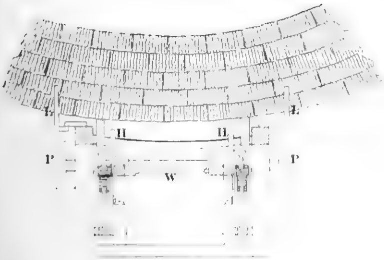




*Fig. 3.*

George Graham, the inventor of the clock escapement which bears his name, was the first who succeeded in compensating a pendulum for thermal changes. In December 1721, he attached to a clock a compound pendulum composed of a single steel-rod, fixed to a stirrup or frame, carrying a glass jar filled with mercury. The effect from expansion of the rod downwards was thus counteracted by the increased length of the column of mercury raising the centre of oscillation; thus maintaining the equality of rate in all temperatures.

This elegant invention was no less remarkable in its simplicity than in the fact, that not the slightest improvement has as yet been made on this, the first, regulator of Graham.

The expense of this most accurate pendulum is, however, considerable, and many attempts have been made to obtain a cheaper substitute; this desideratum has been ably supplied by the late lamented Francis Baily, Secretary of the Astronomical Society of London.

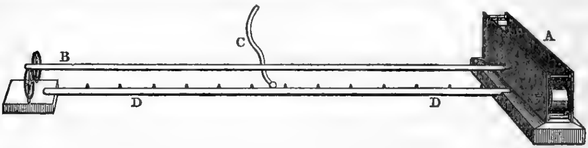
This pendulum consists of a leaden cylinder attached to a rod of the common pine (*Pinus strobus*), and is thus described by the inventor :—"Take a cylindrical deal-rod of a convenient size, but not less than 46 inches in length, about ⅜ of an inch diameter; procure a leaden cylinder, with a hole through the centre which will freely admit the end of the rod, and of such a length, that when put in the lathe it may be reduced to the required standard of 14.3 inches, and to the required weight. It will be more convenient to have this cylinder too long rather than too short, since we may readily diminish its length, if, on trial, it should be found to *over-compensate* the pendulum."*

The following are the respective weights, as given by Baily, of a leaden cylinder 14.3 inches long, and having a hole through the centre equal to ⅜ of an inch diameter.

| Diameter of Cylinder. | Weight of Cylinder. |
|---|---|
| 1¼ inches. | 6.56 lbs. |
| 1½ ... | 9.73 ... |
| 1¾ ... | 13.47 ... |
| 2.0 ... | 17.80 ... |
| 2¼ ... | 22.70 ... |

* These dimensions are on the assumption, that deal expands .0000022685 of its bulk for 1° Fahrenheit, and lead .0000159200.

This eminent astronomer has not taken into account any influence on his pendulum-rod by hygrometric change, an effect much more appreciable in a deal-rod pendulum, and, therefore, detrimental to its usefulness, than the mere thermal effect. The method adopted for the purpose of rendering the rod insensible to a humid atmosphere, is first to deprive it of its natural and acquired moisture by baking; and, secondly, to prevent its absorption either of air or moisture, by long immersion in copal varnish. This covering is found to preserve more effectually the wood from such influences than any hitherto tried. The apparatus employed is very simple and convenient, as it can perform the operation of baking in less than an hour. It consists of a piece of clock-work A, giving a rotatory motion, by means of a spring, to the hollow cylindrical tube B, supported by two friction-wheels, on which it revolves, as seen at the left side of the figure. C is a flexible pipe supplying gas to a tube below, marked D D; this tube is pierced by ten or twelve small apertures, from which the gas burns and heats the upper tube B, containing the pendulum-rod. This upper tube is also pierced with a series of holes




for the purpose of permitting the escape of the moisture of the rod, these apertures being placed between the jets of gas so as to prevent the heat acting on the contained wood. Wire-gauze was tried above the gas-tube DD with good effect, as it caused the complete combustion of the gas, and there was, consequently, no deposition of carbon on the revolving tube, which, when deposited to any great extent, robbed it of much heat. The pendulum-rod, before baking, is to be finished in all its parts, with screw below and suspending-tube above. This is a necessary precaution, as if baked before mounting, moisture would be absorbed at the ends, thus rendering the instrument less perfect. When the rod is finished, it is to be placed in the revolving tube B, and exposed to the flame until no moisture can be perceived issuing from the apertures; by moving the rod backwards and forwards in the tube at intervals of a few minutes, it will be regularly heated throughout its whole length. While hot, it is then plunged into a tube filled with copal varnish and allowed to remain during twenty-four hours. When removed, the varnish must be slowly evaporated in a warm situation, and, when dry, is ready for use.

For the purpose of ascertaining how far the process was successful in rendering the rod insensible to humidity, an unbaked and unvarnished pendulum was tried, the rod was $\frac{3}{8}$ of an inch diameter, and had a leaden cylinder 14.3 inches long. The clock, to which it was attached, was set a-going early in April 1842, and on the 9th its rate was observed gaining 9 seconds per day. It was placed in the front of the shop in Princes Street, where it was exposed to a dry atmosphere during ten days; the mean indication of the hygrometer (Leslie's) being 29.3 degrees, the mean daily rate of the clock being 9″.5 gaining. The pendulum being fixed, the clock was removed, on the 19th, to a cellar 10 feet below its former situation, when its rate was observed, in a few days, to have changed to 6″.5 gaining per day, the hygrometer shewing 8 degrees only of dryness; in this situation it remained during ten days, its error always observed, as in the first experiment, at noon. The mean result of these ten days exhibited a gaining rate of 6″.1 per day, while the mean indication of the hygrometer was 9.9 degrees of dryness. These observations will be more clearly understood by reference to the annexed tables, which contain the details of the experiments. In the experiment now under consideration, the pendulum was supposed to be nearly compensated; no correction is, therefore, required for the thermal differences shewn in the tables. The mean range of the barometer, during the period of the two first experiments, was 0.256 inches, giving a correction, for difference of density, = − 0″.076 to be applied to the clock's rate in the cellar, we have then the rate = 6″.024. This rate will be still further reduced if we correct it for the difference of height, which, being 10 feet, gives a correction = − 0″.055 for diminution of gravity, making the corrected rate of the clock in moist atmosphere = 5″.969 gaining per day.

It is, therefore, evident that a dry well-seasoned rod unbaked and unvarnished, will lose on its rate per day 3″.53 by a change in the humidity of the atmosphere, equivalent to 19°.4 of Leslie's hygrometer.

The third experiment possesses little interest further than verifying the first, and shewing the tendency of the wood to regain its former condition, when the humid was exchanged for a drier atmosphere.

We may now contrast with the above the effect produced by baking and varnishing.

Accordingly, the fourth and fifth experiments exhibit the rate and the conditions under which it was obtained, after the rod had been baked, varnished, and properly dried as described. In these two experiments we have a mean difference of 19.6 degrees of the hygrometer, while the barometer exhibits a mean difference of 0·328 inches, giving a correction = + 0″.098 to be applied to the clock's rate in the cellar, which makes it = 2″.758, this quantity being corrected, as before, for diminution of gravity, makes the corrected rate in the cellar = 2″.703.

From these observations the change of rate produced by hygrometric influence, is reduced by this method of treating the pendulum rod from a variation of 3″.53 to 0″.37 of a second per day; a quantity which in most time-keepers would be entirely disregarded. We have, therefore, a pendulum nearly perfect at a cost very little exceeding those attached to ordinary clocks, and fitted for most general purposes to which astronomical regulators are usually applied.*

The quantity of moisture thrown out by the baking process is very considerable, a rod weighing, before heating, 900 grains, lost 130 grains, a second 152 grains, a third 107 grains of moisture. These rods were cut from the library shelves of the Earl of Stair, fitted up in his house in the High Street. They must have been in that situation for nearly two centuries, and would certainly be called well-seasoned; yet we see in the great amount thrown out, an affinity for moisture possessed by very few solid substances.

* Among many supplied to gentlemen eminent in science, we may state six were observed by Sir Thomas Brisbane and the late lamented Professor Henderson, who have both, from an experience of two years, spoken highly of the performance of this pendulum.

1st *Experiment. Pendulum-rod unbaked (clock in dry atmosphere).*

| | Fast. | Rate. | Hygrom. | Ther. | Barom. |
|---|---|---|---|---|---|
| 1842. | ′ ″ | ′ ″ | ° | ° | In. |
| April 9. Noon. | 0 9.0 | 0 9.0 | 27.0 | 54.5 | 30.249 |
| ... 10. ... | 0 18.5 | 0 9.5 | 23.0 | 53.5 | 30.220 |
| ... 11. ... | 0 28.0 | 0 9.5 | 40.0 | 56.5 | 30.252 |
| ... 12. ... | 0 37.5 | 0 9.5 | 31.5 | 54.0 | 30.200 |
| ... 13. ... | 0 47.0 | 0 9.5 | 33.5 | 55.0 | 30.140 |
| ... 14. ... | 0 57.0 | 0 10.0 | 25.0 | 53.0 | 30.148 |
| ... 15. ... | 1 7.0 | 0 10.0 | 26.0 | 54.0 | 30.231 |
| ... 16. ... | 1 16.5 | 0 9.5 | 35.0 | 54.0 | 30.241 |
| ... 17. ... | 1 26.0 | 0 9.5 | 27.0 | 55.0 | 30.198 |
| ... 18. ... | 1 35.5 | 0 9.5 | 25.0 | 53.0 | 30.118 |
| Mean . . | | 0 9.5 | 29.3 | 54.2 | 30.199 |

2d *Experiment. Pendulum-rod unbaked (clock in moist atmosphere).*

| | Fast. | Rate. | Hygrom. | Ther. | Barom. |
|---|---|---|---|---|---|
| 1842. | ′ ″ | ′ ″ | ° | ° | In. |
| April 26. Noon. | 0 6.5 | 0 6.5 | 8.0 | 48.0 | 30.120 |
| ... 27. ... | 0 12.5 | 0 6.0 | 10.0 | 49.0 | 30.102 |
| ... 28. ... | 0 18.5 | 0 6.0 | 9.5 | 48.0 | 30.038 |
| ... 29. ... | 0 31.5 | 0 6.5 | 9.0 | 48.5 | 29.956 |
| ... 30. ... | 0 37.5 | 0 6.0 | 9.0 | 48.5 | 30.092 |
| May 1. ... | 0 43.0 | 0 5.5 | 9.0 | 48.5 | 30.010 |
| ... 2. ... | 0 49.0 | 0 6.0 | 13.0 | 49.0 | 29.860 |
| ... 3. ... | 0 55.0 | 0 6.0 | 13.5 | 49.5 | 29.732 |
| ... 4. ... | 1 1.0 | 0 6.0 | 8.5 | 49.5 | 29.510 |
| Mean . . | | 0 6.1 | 9.9 | 48.6 | 29.943 |

3d *Experiment. Pendulum-rod unbaked (clock in dry atmosphere).*

| | Fast. | Rate. | Hygrom. | Ther. | Barom. |
|---|---|---|---|---|---|
| 1842. | ′ ″ | ′ ″ | ° | ° | In. |
| May 6. Noon. | 0 8.0 | 0 8.0 | 33.0 | 57.5 | 28.907 |
| ... 7. ... | 0 16.0 | 0 8.0 | 22.0 | 55.0 | 28.620 |
| ... 8. ... | 0 24.5 | 0 8.5 | 28.0 | 54.0 | 29.132 |
| ... 9. ... | 0 32.5 | 0 8.0 | 29.0 | 54.0 | 29.846 |
| ... 10. ... | 0 40.5 | 0 8.0 | 35.0 | 56.0 | 29.930 |
| ... 11. ... | 0 49.0 | 0 8.5 | 30.0 | 56.5 | 29.726 |
| ... 12. ... | 0 57.0 | 0 8.0 | 22.0 | 55.0 | 29.858 |
| ... 13. ... | 1 5.0 | 0 8.0 | 22.0 | 55.0 | 29.910 |
| ... 14. ... | 1 12.5 | 0 7.5 | 20.0 | 58.0 | 30.082 |
| ... 15. ... | 1 20.5 | 0 8.0 | 22.0 | 56.0 | 30.222 |
| Mean . . | | 0 8.5 | 26.3 | 55.7 | 29.623 |

*4th Experiment. Pendulum-rod baked aud varnished (clock in dry atmosphere).*

| | Fast. | Rate. | Hygrom. | Ther. | Barom. |
|---|---|---|---|---|---|
| 1842. | | | | | In. |
| May 27. Noon. | 0′ 2.0″ | 0′ 2.0″ | 20.0 | 57°.5 | 29.682 |
| ... 28. ... | 0 4.0 | 0 2.0 | 20.0 | 58.5 | 29.718 |
| ... 29. ... | 0 6.0 | 0 2.0 | 17.0 | 60.0 | 29.772 |
| ... 30. ... | 0 8.0 | 0 2.0 | 30.0 | 59.0 | 29.626 |
| ... 31. ... | 0 11.0 | 0 3.0 | 31.0 | 61.0 | 29.622 |
| June 1. ... | 0 14.0 | 0 3.0 | 33.0 | 58.5 | 29.944 |
| Mean . | | 0 2.33 | 25.1 | 59.8 | 29.727 |

*5th Experiment. Pendulum-rod baked and varnished (clock in moist atmosphere).*

| | Fast. | Rate. | Hygrom. | Ther. | Barom. |
|---|---|---|---|---|---|
| 1842. | | | | | In. |
| June 3. Noon. | 0′ 3.0″ | 0′ 3.0″ | 5′.0 | 49°.0 | 30.134 |
| ... 4. ... | 0 6.0 | 0 3.0 | 3.0 | 48.5 | 29.936 |
| ... 5. ... | 0 8.5 | 0 2.5 | 2.0 | 49.5 | 29.944 |
| ... 6. ... | 0 11.5 | 0 3.0 | 3.0 | 50.5 | 30.160 |
| ... 7. ... | 0 14.0 | 0 2.5 | 5.0 | 50.5 | 29.840 |
| ... 8. ... | 0 16.0 | 0 2.0 | 3.0 | 51.0 | 30.318 |
| Mean . . | | 0 2.66 | 3.5 | 49.8 | 30.055 |

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## *An Account of some Experiments tending to illustrate the Formation of Guano.* By John Davy, M.D., F.R.SS. Lond. & Ed., Inspector-General of Army Hospitals, L. R. Communicated by the Author.

From the analysis of guano, both of the South American and African kind, it appears that this excellent manure consists mainly of insoluble phosphates, and of nitrogenous compounds,—the one, it may be inferred, derived from the feces, the other from the urine, of sea-fowl; with this marked difference, however, in regard to the latter, that the oxalate of ammonia is more abundant in them than the lithate, of which, as it is well known, the solid urine of birds is chiefly composed.

As we know that the sun's rays have, in many instances, a remarkable effect as a chemical agent, it occurred to me as probable, that the oxalic acid found in guano might be produced from the lithic acid of the urine of birds, in consequence of the agency of the light of the sun, aided by an accompanying high temperature, such as must prevail in a tropical climate.

To submit this conjecture to the test of experiment, a portion of the solid urine of the white-headed sea-eagle, slightly moistened with water, was put into a glass tube, with a cork, having a small notch in it to allow of the entrance of air,—and suspended against a southern wall, where it was exposed to sunshine or strong light the greater part of the day. The experiment was commenced on the 20th of last March, and continued till the 31st of May. During this period of 70 days, the weather, a great part of the time, was unusually fine and dry; only 5 inches of rain fell from the 20th of March to the 30th of April, and only .13 of an inch from the 1st to the 31st of May; and more than half the time, viz., about 47 days, there was bright sunshine. The range of temperature at the same time was great, even in the shade, extending from below the freezing point, which it often was during the clear nights, to 60° and 65° by day.

The urine of the sea-eagle, the subject of the experiment, previously examined, was found to consist chiefly of lithate of ammonia, with a little animal matter, and to be entirely destitute of oxalic acid. After exposure, it was found, on examination, to contain a small proportion only of lithic acid, and a large proportion of oxalic acid in combination with ammonia. Its resemblance now to guano was remarkable. It had a strong ammoniacal odour, mixed with the peculiar odour of guano. Under the microscope, it was found to abound in prismatic crystals, such as occur in guano, and which, as they were soluble in water, and yielded, with muriate of lime, a copious precipitate of oxalate of lime, were evidently crystals of oxalate of ammonia; and, in accordance with this composition, a portion of them put by have remained unaltered in their form, after exposure to the air now more than six months. With the odour of the guano, the lower portion of the mass had acquired a brown colour, not unlike that of guano, and, like its colouring matter, soluble in water; whilst its upper surface was almost colourless, being formed chiefly of oxalate of ammonia, nearly pure, in needle crystals, visible to the naked eye, collected in little stella-form groups, presenting, even in this circumstance, another resemblance to guano, in which often light-coloured masses are met with, composed principally of the same salt.

The next experiments made were of a comparative kind, with a view to endeavour to determine whether the action of light is really essential to the conversion; whether the presence of atmospheric air is essential; and whether lithic acid, uncombined with ammonia in its pure state, is capable, under the influence of light, of being changed into the oxalate of ammonia.

Accordingly, a portion of the same urine of the sea-eagle, moistened, was exposed to light as before; another portion was put by in a dark place; a third was confined over mercury in a glass tube, in which was a measured quantity of atmospheric air, and so placed as to be well exposed to light and sunshine; and, lastly, a portion of lithic acid, moistened, was similarly exposed, but not confined over mercury.

These experiments were begun on the 7th of last June, and they were continued until the 15th of October. During this time, comprising 100 days, there was a much larger proportion of gloomy weather than during the period of the first experiment;—this is pretty correctly indicated by the number of days in which rain fell, viz. 80, and the total quantity of rain, viz. 26.05 inches, as measured by the rain-gauge; and at the same time the atmospheric temperature was more uniform, with few exceptions, cool by day, and not cold at night.

The result of the experiment No. 1, namely, that in which the moistened urine of the sea-eagle was exposed to light, atmospheric air not being excluded, was similar to that of the preceding, but less strongly marked.

The result of the 2d experiment, namely, of that in which the urine, moistened, had been kept excluded from light, was, too, generally similar: the urine was found to have an ammoniacal odour, mixed with one slightly putrid, and to contain some oxalate of ammonia, as was shewn both by the microscope and by chemical examination, but in proportionally less quantity than in that under the influence of light.

In the 3d experiment, that in which the urine was confined over mercury, in a limited portion of atmospheric air ($\frac{1}{2}$ cubic inch), the volume of the air was little changed, but its composition greatly. At the commencement of the experiment, it consisted, as atmospheric air, of 21 oxygen and 79 azote; at the termination, it was found composed of 64 carbonic acid (so much was absorbed by lime-water), and of 36 azote. The solid urine had no sensible smell of ammonia; it afforded, however, indications of the presence of oxalate of ammonia, but in a very minute quantity, merely a trace, and without any smell, at least that I could perceive, of the volatile alkali.

The result of the last experiment, namely, that in which pure lithic acid in its granular state was exposed to light, atmospheric air not being excluded, was altogether negative: its colour was not altered, nor its granular form; it had acquired no smell of ammonia; and, carefully tested for oxalate of ammonia, not a vestige of this salt could be detected. It may be mentioned, that it was obtained by precipitation by dilute muriatic acid from a solution of lithate of ammonia in water.

From the results of these experiments, and considering the composition of the lithic and oxalic acids, the former containing the elements of the latter, and of ammonia, but with excess of carbon, may it not be inferred, that though the light of the sun is not essential to the conversion of the lithate of ammonia into the oxalate, it promotes and accelerates the change; and, further, that the presence of atmospheric air is required for the change, the excess of carbon uniting with the oxygen, and separating in the form of carbonic acid gas? And, in confirmation of this, it may be mentioned, that though the urine of the sea-eagle alone, moistened with water, subjected many hours to the temperature of 212°, yielded no oxalate of ammonia, it afforded a notable portion of this salt, when exposed to the same temperature, mixed with some black oxide of manganese; and, it may be worthy of remark, that, in this instance too, a brown soluble matter appeared to be developed.

From the negative results of the experiments in which lithic acid, moistened, was exposed to light, may it not be inferred that the presence of some foreign matter, acting as a leaven, is necessary to excite, and, with oxygen, to effect, the conversion of the lithate of ammonia into the oxalate? In corroboration, I may remark, that on the addition of ammonia to the lithic acid, converting it into lithate of ammonia, the same negative results were obtained, after exposure to light, not excluding the access of atmospheric air during a period of 74 days, namely, from the 15th of October to the 29th of December.

To return to guano.—Comparing the Peruvian with the African, I have always found, in accordance with the preceding remark relative to the influence of the sun's rays, a larger proportion of lithate of ammonia in the former than in the latter:—in the latter, indeed, I have never found more than a trace of this substance, and in many specimens I have not been able to detect even a trace of it; instead, there has been a large proportion of the oxalate. May not this be owing to the different states of atmosphere on the two coasts; the one always shrouded by clouds intercepting the direct rays of the sun, and enfeebling their action; the other commonly clear, permitting the sun's rays to act with full effect? And may not the short time in which the conversion of the lithate of ammonia into the oxalate takes place, as shewn in the first experiment detailed, help to explain the absence of the lithate even in specimens of guano taken from the surface, and of recent production? Such a specimen I lately received, brought from the island of Ichaboe, off the African coast, described "as having been scraped off a rock, where it was in a thin layer, much exposed to the sun," in which I could not detect the smallest quantity of lithate of ammonia, but abundance of oxalate. The effect of the sun's rays in accelerating the conversion of the lithate into the oxalate of ammonia in guano, or in the urine of the sea-eagle, seems to be like that which it exercises on lithic acid, moistened with nitric acid, in converting it into the purple compound—the test of lithic acid. The change, as is well known, does not take place at common temperatures—a pretty high temperature is required to effect it; but I find that, when exposed to the direct rays of the sun, it is rapidly effected, and that even when the temperature is kept low, by having had the platina capsule in which the mixture was made, in contact with water.

In the experiments in which the urine of the sea-eagle was exposed to light, moistened, in a limited portion of atmospheric air, I have stated that the volume of azote remaining at its termination, was 36 only, instead of 79, the proportion in which it existed at the commencement,—seeming, consequently, to indicate clearly an absorption of azote.

Should such an absorption of azote be proved, by farther inquiry, to accompany the conversion of the lithate into the oxalate of ammonia, in the instance of the formation of guano from the excrements of birds, it will be an interesting fact in the economy of nature, and may help, with the generation of nitre, to account for there being no change, as far as has hitherto been determined by experiments, in the composition of the atmosphere;—the great principles of equilibrium being, on the part of vegetables, the separation of carbon, and the evolution of oxygen from carbonic acid gas, the product of combustion and respiration;—on the part of disintegrating rocks, such as contain alkali and lime, and of the excrements of birds, and probably of animals generally, undergoing decomposition, the absorption of azote—its separation from the atmosphere, to form either nitre or ammonia; designed, in their turn, to fertilize the soil, and promote vegetation.

THE OAKS, AMBLESIDE,
*December* 30. 1844.

*On the Heights of Mountains, &c., in Norway.*

Our geographical works and books of travels are, for the most part, singularly vague and inaccurate on the subject of the heights of mountains, mountain-passes, &c., in Norway, and very incorrect as to the orthography of the names. We are therefore glad that the means of remedying these defects, so far as the present state of knowledge admits of, are amply supplied in the Second Part of Keilhau's Gaea Norvegica, which we have just received. A long chapter of that important work is devoted to elaborate tables of heights, which have been carefully prepared from the very best published and manuscript sources of information,* by Captain A. Vibe,

* As many of the published works and memoirs which have afforded materials for Captain Vibe's Tables are entirely unknown in this country, we subjoin a list of the principal authorities quoted by him :—

*Professor B. M. Keilhau* :—Nogle Efterretninger om et hidtil ubekjendt Stykke af det söndenfjeldske Norge, in Budstikken for 1820, p. 385.

———————— Reise i Oest og Vest-Finmarken; Christiania, 1831.

———————— Reise i Nordre-Trondhjems-Amt, in Magazin for Naturvidenskaberne, 2d series, vol. i.

———————— Geognostiske Bem. over Oesterdalen, in Nyt. Magazin f. Naturv., vol. ii., p. 1.

———————— Reise i Lister-og Mandals-Amt i 1839, *l. c.*, p. 333.

———————— Reise til den östlige Deel af Christiansands-Stift i 1840, in Nyt. Mag. f. Naturv., vol. iii.

———————— Measurements made in the years 1841–2–3, and communicated to Captain Vibe.

*Th. Broch, Captain of the Engineers* :—Iagttagelser til Höidebestemmelser, &c., in Magazin for Naturv., 2d series, vol. ii., und in Nyt. Mag. f. Naturv., vol. i.

*Professor C. Smith* :—Iagttagelser paa en Fjeldreise, 1812, in Top. Stat. Saml., part 2, vol. ii.

*Lieutenant N. S. Wergeland* :—Höidemaalinger i Aarene, 1841, 2 og 3. MS.

*R. Suhrland* :—Maalinger paa Reiser til Trondhjem og Nordland i 1841 og 1843. MS.

*Leopold Von Buch* :—Reise fra Christiania til Bergen, in Top. Stat. Samlinger, vol. i., p. 141.

———————— Reise durch Norwegen und Lappland, Berlin, 1810. (The heights given by Von Buch seem to be calculated according to Trembley's formula.)

of the Norwegian Engineers. Numerous determinations of heights have been made in Norway during the last thirty or forty years; but still, in a country abounding as it does in extensive and very inaccessible mountainous districts, much yet remains to be done in this department; and thus we find from Captain Vibe's Tables, that the precise heights of the highest summits of Norway, and, therefore, of Scandinavia, have not been determined with certainty: this, however, ought not to surprise us, when we remember how recently Ben-na-muic-dui was ascertained to be the highest point in Great Britain.

In Captain Vibe's tables, the heights, which amount to about 1200 in number, are given in round numbers in Rhenish feet; and where two or more good authorities have furnished

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*Professor C. F. Naumann*:—Beiträge zur Kenntniss Norwegens, Leipzig, 1824.

*Joh. Aschehoug, clergyman*:—Reise til Fredrikshald, 1816. MS.

*Everest's* Journey through Norway, &c., 1820.

*Professor C. Boeck. og Prof. Keilhau*:—Reise i Smaalehnene, 1834. MS.

*G. Bohr*:—Om Iisbræerne i Justedalen, in the periodical called "Blandinger," vol. ii.

*Lieut.-Col. W. M. Carpelan*:—Et Besög i Fjeldstuen 1823, in Mag. for Naturv., Jahrg. 2, vol. i.

———————— Om en nærmere Vei mellem Bergen og Christiania, in "Budstikken" for 1824, p. 24.

*Professor Esmark*:—Reise til Trondhjem; Christiania, 1829 (contains many errors of the press, &c.).

———————— Bemærkninger paa en Reise til Gousta-Fjeld, in Top. Stat. Samlinger, 1st series, vol. ii.

*C. Fearnley*:—Indberetning om en Geognostisk Reise i Guldbrandsdalen, 1841. MS.

*Professor C. Hansteen*:—Geographiske Bestemmelser af nogle Punkter i Christianias Omegn, in Magazin for Naturv., 1824, H. iii.

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*W. Hisinger*:—Anteckningar i Physik och Geognosie, &c., Upsala, 1819.

———————— Tabeller öfver Hojdmätningar i Swerige och Norrige, Stockholm, 1829.

*C. H. Langberg, Director of the Mint*:—Reise i Bergens Stift, 1834. MS.

*P. I. Maschmann*:—Höidemaalinger med Barometer, foretagne i Tellemarken, 1832. MS.

*P. A. Schult, Director of Mines*:—Nogle maalte Fjeldhöider i det Nordenfjeldske, in Magaz. f. Naturv., vol. viii., p. 272.

*Capt. Vibe's* own Measurements in 1842.

measurements, the mean numbers have been taken. Most of the measurements were made with the barometer, but some of the heights were determined geometrically.

The following selection contains the greatest elevations above the level of the sea in the different *Amts* or districts; and also the heights above the level of the sea of some of the mountain-passes and other interesting localities, as well as of the snow-line and of the limits of various forest trees. The Rhenish feet have been converted into English feet, the Rhenish foot being reckoned = 1.0297 English.

### Agershuus-Amt.

| | |
|---|---|
| *Egeberg*, near Christiania, . . . . | 400 |
| *To-Aasen*, Næsodden, near Christiania, . . | 690 |
| *Skrebjergene*, in Feiringen, . . . | 2430 |
| Highest part of the road between *Hakedalen* and *Maridalen*, | 1310 |
| *Mjösen*, the largest lake in Norway :— | |
| *a*. When the water is low, at the end of December, | 410 |
| *b*. When the water is at its mean height, May and June, | 430 |

### Smaalehnenes-Amt.

| | |
|---|---|
| *Linnekleppen*, hill between Rakkestad and Oedemark, the highest point in Smaalehnene, . . | 1050 |

### Hedemarkens-Amt.

| | |
|---|---|
| *Sölen* (Stor-Sölen) in Lille-Elvedalen, Oesterdalen, . | 6180 |
| *Sölen* (Sölentind) in Reendalen, Oesterdalen, towards the Fæmund Lake (conjectural), . . . | 6180 |
| *Tronfjeld* in Tönsaet, Oesterdalen, . . . | 5630 |
| Pass between *Kakhælledalen* and *Enunden* (chain of the Dovre), . . . . . . | 3700 |
| *Plateau of Dovre*, mean height on the same pass, . | 3600 |
| *Lake of Fæmund*, Oesterdalen, . . . | 2250 |
| *Lake of Stub or Stue*, on the boundary between Tönsæt and Quikne, and at the water-shed between Agershuus and Trondhjems-Stift, . . . | 2260 |

### Christians-Amt.

| | |
|---|---|
| *Nautgardstinden* between Sjodalen and Veodalen in the mountainous district to the south of the Ota-Vand, Guldbrandsdalen, . . . . | 7620 |

*The highest mountain summits of Scandinavia* belong to the group of the *Jötunfjelde*, and, according to Broch, lie to the south-west of Nautgardstinden, between the Gjendin Lake and the valley which bounds Mugnafjeld (Kalvaahögda) on the north. Broch estimates their height at upwards of 8200 feet above the level of the sea, and mentions the following names: Steinflybraepiggen, Glittertinden, Svartdalspiggene, and Storhöe. In 1841 and 1842 Wergeland determined the height of *Glittertinden,* in Lom, Guldbrandsdalen, to be about . 8100

And with the assistance of a theodolite he estimated approximately the following heights :—

*a. Ymesfjeld* (Store-Galdhöpiggen), between the Leera-Elv and the Visa-Elv, probably the highest mountain of the Jötun group, and *the highest summit in Scandinavia,* nearly 500 feet higher than Glittertinden, about . . 8550

*b.* Highest *Skagstölstind* from 100 to 200 feet lower than Ymesfjeld, that is to say, . . 8400

*c. Tykningssuen* and *Heilstuguhöe,* 150 feet higher than Nautgardstinden, therefore . . 7770

*d. Leerhöe* and *Beshöe,* the same height as Nautgardstinden, therefore . . . 7620

*e. Kjernhultinden,* 200 feet higher than the last, therefore . . . . 7820

*Kalvaahögda* or *Mugnafjeld* in Valders, . . 7180

*Sneehætten* (Dovre chain), . . . 7600

According to Naumann, Skreahög is not much lower.

Pass over the *Filefjeld,* . . . . 4060

Summits of the *Dovre* Chain :—

*a. Blaahat,* . . . . 5350

*b. Liltværotind,* . . . . 5350

*c. Fogstuhöe* (Graahöe), between Jerkind and Fogstuen, . . . . 5690

*d. Storekuven,* on the east side of the valley of Dovre, . . . . 4890

*Jerkind,* on the Dovre chain, . . . 3140

Highest point of the road between *Jerkind* and *Kongsvold* (Dovre), . . . . . 4110

*Ronden,* between Ætnedalen and Sæl, Guldbrandsdalen—

*a.* Western Cone, . . . . 6400

*b.* Northern Cone, termed *Högronden,* . 6930

(Three peaks to the S. are about 300 feet higher.)

*Gjendin Lake,* in Vaage, Guldbrandsdalen, . 3250

BUSKERUDS-AMT.

*Skogshorn* in Hallingdal, . . . . 5660

*Krogkleven* in Hole, Ringerige, . . . 1230

Town of *Kongsberg,* . . . . 500

JARLSBERGS AND LAURVIGS-AMT.

*Vettakollen* in Laurdal, the last mountain of any considerable height met with in travelling from Kongsberg to Laurvig, . . . . . . 1540

BRATSBERG-AMT.

*Gousta-Fjeld* in Tellemarken, . . . . 6180
Highest point of the road between the *Tind Lake* and *Skjærvedalen*, . . . . . . 3610
*Rukanfossen*, waterfall in Tellemarken:—
*a.* Highest point of the fall, . . 2260
*b.* Perpendicular descent of water, . . 890

NEDENÆS AND RAABYGDELAGETS-AMT.

*Urddalsknuden*, highest point of the Ruen mountains in Hyllestad, . . . . . . 4640
Mountain to the east of *Vattendalen* in Bykle, . 3760

LISTER AND MANDALS-AMT.

*Grubbaafjeld* in Lister, . . . . . 3600
*Smölebakken* in Oustad, . . . . . 2840
*Figgelandsheien*, on the Orte-Vand, . . 2840

STAVANGER-AMT.

*Findalsrinden*, NW. from Siredals-Vand, . . 2340
Highest point of the road between *Vattendal* and *Suledals-Vand*, . . . . . . 4190

SÖNDRE-BERGENHUUS-AMT.

*Folgefonden*:—
*Aga-Nuten*, . . . . . . 4660
*Melderskin* above Rosendal, . . . 4690
*Hundsöira*, . . . . . . 5380
*Regnenuten*, . . . . . . 5370
Highest spot above *Tokheim* at the upper part of the Odde-Fjord, . . . . . 5460
*Saxaklep*, one of the highest points to the north of Folgefonden, . . . . . 4630
*Solen-Nuten*, portion of Folgefonden opposite Ullensvang, 4630
Highest point of the road between *Reisæter* and *Jondalen* (near Saxaklep), . . . . 4520
*Hallingjökelen*, highest mountain in Hardanger . 5720
*Hartoug* (Haarteigen, Hartangen) on Hardangerfjeld:—
Base, or *Plateau* of *Hardangerfjeld* . 4860
*Summit*, . . . . . . 5560
*Sælheefonden*, E. or SE. from Söfjorden in Hardanger, 4730
*Vöringsfoss*, waterfall in Hardanger:—
Höl, farm-house, near upper part of the fall, 2190

| | |
|---|---|
| Height of the fall, . . . | 480 |
| Height of the spot whence a view is obtained, above the commencement of the fall, . . | 180 |
| The *Jettegryderne* or *Riesentöpfe* (Giants' cauldrons) on the mountains above *Ousedalen*, . . . | 2630 |

NORDRE-BERGENHUUS-AMT.

| | |
|---|---|
| *Justedals-Bræen*, glaciers in Indre-Sogn :— | |
| *Bersætbræen*, lowest limit, . . . | 1480 |
| *Björnestegbræn*, lowest limit (descending, according to Naumann, to the bottom of the principal valley), | 1460 |
| *Nigaardsbræen*, lowest limit, . . . | 1090 |
| *Glaciers* of *Lodal* and *Trangedal*, . . | 1770 |
| *Skagstölstinderne* in Indre-Sogn :— | |
| Middle summit, . . . | 7650 |
| Eastern summit (*Hurungen*), . . | 8090 |
| *Glacier* of *Skagstölsbræ* in Indre-Sogn, . . | 4540 |
| *Suletind*, Filefjeld, . . . . | 5800 |
| *Maristuen*, post-station on the Filefjeld, . . | 2600 |

ROMSDALS-AMT.

| | |
|---|---|
| *Romsdalshorn*, . . . . . | 4120 |
| *Iis-Vand*, lake from which the Rep-Elv takes its rise, | 5020 |

SÖNDRE-TRONDHJEMS-AMT.

| | |
|---|---|
| *Dovre chain* :— | |
| *a. Kolla*, seven English miles, NW. from Jerkind, | 5550 |
| *b. Nunsfjeld*, . . . . | 6800 |
| *c. Rottesöhöe*, seven English miles NE. from Jerkind, . . . . . | 5410 |
| *d.* Pass between *Læssö* and *Repdalen*, . | 5770 |
| *Sylfjeld*, on the Swedish frontier, between Sælbo and Jæmtland, highest summit (*Syltoppen*), . | 5870 |
| *Kongsvold*, post-station on the Dovre, . . | 2990 |
| *Röraas*, mining town, . . . . | 2160 |
| *Lake of Oeresund*, or Aursund, above Röraas, . | 2320 |

NORDRE-TRONDHJEMS-AMT.

| | |
|---|---|
| *Jævsö-Fjeldene* in Inderöens-Fogderie, . . | 4320 |

NORDLANDS-AMT.

| | |
|---|---|
| *Sulitelma*, in the Fogderie of Salten, on the Swedish frontier (determined by Wahlenberg), . . | 6180 |
| *Boundary between Norway and Sweden*, mean height between boundary stones No. 207 and No. 208, *Vessen*, in the Fogderie of Helgeland, . | 3280 |

### Finmarkens-Amt.

| | |
|---|---|
| *Bensjortinden* in the Fogderie of Senjen and Tromsö, | 4000 |
| *North Cape*, island of Mageröe, . . . | 1000 |
| Highest point in the island of *Tromsö*, . . | 420 |
| *Tyvefjeld*, near Hammerfest, . . . | 1250 |
| Pass from the valley of Malanger through the ravine of Audje-Vaggie to the Torne Lake, . . . | 1390 |
| *Noonskar-fjeld*, near Talvig, . . . | 3550 |

### Height of the Snow-Line.

| | |
|---|---|
| On the high mountain range to the south of the *Ota-Vand*, in Guldbrandsdalen, . . . . . | 4740 |
| On the *Dovre chain*, . . . . | 5350 |
| *Lodalskaabe*, in Nordre Bergenhuus-Amt, . . | 5460 |
| *Storhougen*, between Lyster and Justedal, in Nordre Bergenhuus-Amt, . . . . . | 5350 |
| Between *Jölster* and *Indvigfjord* in Nordfjord, . | 4120 |
| Island of *Seiland*, north side, Finmarken, . . | 2970 |

### Limit of the Birch Tree.

| | |
|---|---|
| Near *Höigien*, a mountain in Quikne, Oesterdalen, . | 3970 |
| On the *Dovre chain*, . . . . . | 3470 |
| On the *Filefjeld*, . . . . . . | 3400 |
| *Gousta-Fjeld* in Tellemarken, . . . | 3390 |
| *Hardanger-Fjeld*, . . . . . | 3410 |
| Near *Röraas*, in the neighbourhood of the Langen Lake, | 3500 |
| Near the *Stue-See*, Söndre-Trondhjems-Amt, . | 2880 |
| On the north side of *Gusli Fjeld* in Inderöens Fogderie, Nordre Trondhjems-Amt, . . . | 2200 |
| Between *Jævsöen* and *Inderdal*, N. Trondh. A. . | 1840 |
| Between *Karasjok* and *Altenfjord* in Finmarken, . | 1600 |
| Near *Lödingen* in Salten, Nordlands-Amt, . . | 1560 |

### Limit of the Scotch Fir.

| | |
|---|---|
| Near *Finnebustölen*, above Grungedal, Tellemarken, | 3120 |
| In *Brækkedalen*, Lom, Guldbrandsdalen . . | 2720 |
| On the *Dovre chain* (Von Buch, i. p. 202), . | 3680 |
| (Von Buch speaks of lakes from which the Foldals-Elv takes its rise as the limit of the Scotch Fir; and if the *Vola Lake* be meant, then the height is only 2990 feet). | |
| On the south side of *Faxefjeld*, Swedish frontier, Oesterdalen, . . . . . . | 2350 |
| Near *Oie-Vand* in Lister, . . . . . | 2060 |
| In *Romsdalen*, . . . . . . | 2830 |
| On the Pass of *Inderdal*, in Inderöens Fogderie, Nordre-Trondhjems-Amt, . . . . . | 1790 |
| Near *Lippa-jervi*, Finmarken, on the frontier of Torneaa Lapmark, . . . . . | 1330 |
| Near *Lödingen*, Nordlands-Amt, . . . | 690 |

LIMIT OF THE SPRUCE FIR.

| | |
|---|---|
| In *Stavedalen*, Söndre-Ourdal, Valders, . . | 3140 |
| *Strandsæterkampen* in Ringeboe, Guldbrandsdalen, . | 2530 |
| Near *Förres-Vand* in Tellemarken, . . | 2450 |
| *Gousta Fjeld*, Tellemarken, . . . | 3030 |
| On the *north side* of the mountains between *Goundalen* and *Holden Lake*, Inderöens Fogderie, . . | 2000 |
| *South side* of the same mountains, . . . | 1590 |
| Between *Limingen Lake* and *Joma-Fjeld* in Nummedals-Fogderie, Nordre-Trondhjems-Amt, . . | 1770 |

*On the Physical Facts contained in the Bible compared with the Discoveries of the Modern Sciences.* By MARCEL DE SERRES.

The greater part of those who have meditated on the Sacred Writings, have turned their attention rather to the religious ideas contained in them, than to the accuracy and importance of the physical facts exhibited in their pages. Finding in these books, superior to all others that have been written, truths essential to the destiny and vocation of man, they did not think that they ought to seek in them light or information respecting the material world, which has been given to us as a subject for our researches and investigations. They have thought the less of this, because in the eyes of some of them such a consideration appeared alike futile and superfluous.

To make amends for this oversight, we shall concentrate our examination on the physical facts contained in the Bible, and which the sciences have made known to us only a short time antecedent to the present. This we are the more called upon to do, because we have here studied the Sacred Writings only in one point of view, namely, with regard to the positive notions they give us respecting the whole of creation. We cannot too often repeat, that, in the examination on which we are about to enter, we have looked upon Scripture with the eye of a natural philosopher, not of a theologian; the material world has alone attracted our regard.

The most important point, relative to the creation, and of which we have still no knowledge but from the Bible, is the distinction which it establishes between the creation of the universe and its co-ordination. Thus, in the beginning (*in principio*), all the matter which compose the earth and heavens was created ; afterwards, this matter was appropriated and formed the stellar and planetary bodies of the solar system, as well as those of other systems.

We have already shewn elsewhere on what grounds this interpretation rests ; it appears particularly obvious when we direct our attention not only to the first verse of Genesis, but to those that follow, particularly the 7th, 8th, 9th, and 10th verses of the first chapter. It is useless, therefore, to insist longer on this point. We shall merely observe, that physical facts demonstrate the accuracy of this interpretation. Undoubtedly the whole of matter had been created at the beginning of things, and probably no new matter is formed. But it was not co-ordinated nor organised at the origin of time in its universality ; for every day celestial bodies are produced, under our own eyes, which are the result of the condensation of this same matter. It will continue unceasingly to become condensed, and will form stars more or less complete, as long as any of it remains capable of assuming new forms and new dispositions.

If such concretions are still preparing and organising celestial bodies, it is evident such formations indicate to us that if matter proceeded from nothing at the first, it was not appropriated till a long while after its creation. This process is constantly carried on in the ordinary course of things ; far from being completed, many ages will elapse before it has reached its limit. It is with reason, therefore, that the Sacred Writings have distinguished the creation of matter from its posterior arrangement.

The chaos in which Genesis represents all matter to have been at the birth of the world (and particularly that which afterwards formed the earth), is a proof that Scripture rightly distinguishes creation and co-ordination. This matter, at first without form and void, from which the globe we inhabit arose, would appear to have been analogous to those nebulosities, the condensation of which produces, under our own eyes, new celestial bodies. At every period nature has thence derived the elements with which she has formed the celestial bodies composing the wonderful assemblage of the universe. It is likewise from the bosom of these masses of nebulosities, so abundantly diffused through space, that she draws the stellar and planetary bodies.

It is a remarkable fact, that the cosmogony given in Genesis, is the only one that has established this distinction between the primitive creation of all matter and its co-ordination. Not long since, our knowledge was not sufficiently advanced to enable us to appreciate these great differences in time and in things. Not less than seven thousand years were necessary to enable us to comprehend the reality of such a distinction, and to shew that it was founded on the nature of things. We can now follow step by step these transformations of nebulous matter, and see it pass through different states before producing stellar and planetary bodies analogous to those of the solar system.

This distinction,* established by Scripture, is founded on two orders of facts entirely independent of each other, and which, owing to that circumstance, have their weight and authority increased. The first refers to the transformations which take place, in space, between nebulosities and the new stars produced by their condensation. The second has reference to the space of time necessary for the light of the most distant nebulosities to reach us. This space is so considerable, that, according to the observation of facts, we must refer the first emission of this light to about a hundred thousand years before the appearance of man.

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* Not only does Genesis distinguish the creation of matter from its co-ordination, but the same thing is observable in all the other books of Scripture. Thus we find in Psalm xxxiii., verses 6th, 7th, and 9th, that "By the word of the Lord were the heavens made; and all the host of them by the breath of His mouth. He gathereth the waters of the sea together as an heap; he layeth up the deep in store-houses. He spake and it was done; He commanded and it stood fast." So much for the spontaneity of creation. With regard to the posterior co-ordination of the objects created at the beginning of time, we read in Psalm viii., verse 3d., "When I consider thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained."

If, then, the luminous rays emitted by nebulosities require so long an interval in order to become visible, the stars which transmit them to us must have been created before the last arrangements were made on the surface of our planet. Now, as these rays require about a hundred thousand years to reach us, and as the final dispositions made on the earth do not go back further than seven thousand or seven thousand five hundred years from the present epoch, the stars to which we owe this blessing must have been created at the commencement of things, or, to use the expression in Genesis, at the beginning—*in principio.* An immense interval must therefore have intervened between the creation of the celestial bodies and their co-ordination. This interval is still greater when we turn our attention, not to the stars of the solar system, but to those which form no part of it. In fact, the former are completely terminated ; but it is not so with the others. This work has, however, commenced at an era separated from ours by immense periods, and the succession of ages has not sufficed to complete it.

This co-ordination of a matter pre-existing since the origin of things, cannot be considered as a true creation. The latter could not take place unless the materials of which the celestial bodies are composed had been derived from nothing by the power and volition of the Creator. No doubt the condensation of the nebulous matter causes that matter to assume new forms ; but while acquiring these its nature is not changed ; it only passes through different states. This appropriation, and these different dispositions, assumed by a substance already formed, cannot be likened to a real creation. In this case there is, indeed, a change in the state and form of the original materials, but there is no new production. This production, however, would be necessary, in order that these changes and modifications could properly be regarded as acts emanating immediately from the creative power.

Matter being once created, secondary causes, under the direction of Divine Wisdom, would tend to make it assume determinate forms, and proceed in a regular course. Accordingly, the forces which Nature holds in some degree in reserve, in order that they may be brought into action when any disturbing cause threatens to interrupt the order and harmony of created things, she also destines for acts still more important. Their power, essentially conservative, brings the newly produced celestial bodies into a firm and stable condition—a character distinctive of stars arrived at their perfection.

If the proofs of so many facts, the first knowledge of which we owe to Moses, are written in indelible characters on the strata which form the crust of the globe, those of the truth of the first verse of Genesis are traced in characters of fire on the celestial vault. It is there that we discover the confirmation of it, and perceive its perfect accuracy.

When we turn our attention to the immense assemblage of nebulosities and stars sparkling in the firmament, the laws of which the sacred writer has so distinctly perceived, we are less surprised that he has discerned with the same sagacity those which regulate and determine their movements. Moses gives us to understand that the stability of the course of the celestial bodies depends on their mutual gravitation, and the extent of the distance which separates them.

It is true that he has not developed the system of attraction in all its extent; but he has fixed its principles, without expressing it in a scientific language which could not have been understood. He leads us at all times to understand that the law of gravitation regulates the phenomena of the universe, that it is sufficient for all, and maintains in it both order and variety. Emanating from Supreme Wisdom, this law has presided, since the origin of time, over the harmony of created things, and renders all disorder among them impossible.

The discovery which enabled Newton to demonstrate that bodies attract each other in the direct ratio of their mass, and in the inverse ratio of the square of distance, is the noblest triumph of the human mind. At the same time this law is only the reduction of the celestial movements to a mechanical law, the cause of which remains unknown. Newton did not regard it otherwise, since he has employed the word only conditionally, as presenting a sensible image of the phenomena observed, *quasi esset attractio.*

If we represent this universal force as depending on some more general mechanical conception, for example, the existence of an elastic ether diffused throughout the whole universe, there would still remain the *why* of this existence ; the second *why* would immediately lead us to another still more remote ; and the last of all must remain for ever inaccessible, not only to the efforts of our thoughts, but even of our imagination.

When Scripture speaks of the earth, it teaches us that God has laid the foundations of it, and that it shall never be shaken ; for he has fixed it upon its poles.* It then represents to us the terrestrial globe as having passed, in its earliest ages, through the state of a kind of vapour more subtile than the most attenuated and finest dust. If it speaks of its form, it represents its true spheroidal figure, and compares it to an immense globe or vast sphere.† When it speaks of its position in space, it represents it as suspended on nothing, or on a bottomless space. It also correctly describes its dimensions and size.‡

If it directs our attention to the heavens, it designates them by their extent, *rakiah*. Notwithstanding the accuracy of this interpretation, which represents the immensity of the celestial spaces, the Greeks, in the Septuagint version, as well as the Latins, in the Vulgate, have presumed to correct it,

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* See Psalm civ., verses 5–9, " God laid the foundations of the earth that it should not be removed for ever. The deep covered it as a garment ; the waters stood upon the mountains. At His rebuke they fled ; at the voice of His thunder they hasted away. They went up by the mountains ; they went down by the valleys unto the place he had founded for them. He has set a bound that they may not pass over ; that they turn not again to cover the earth."

† See Job chapter xxvi., verse 10 ; Proverbs viii., verse 27 ; Isaiah xl., verse 22. [Some of M. Marcel de Serres's views regarding certain passages of the Bible, are more fully borne out by Martin Luther's German version than by our English translation.—Ed.]

‡ The Hebrew text bears that " God has stretched over the void the vault of heaven, (*le septentrion*), and suspended the earth on nothing, (*al belimah*)." The Greek reads " Κρεμάζων γῆν ἐπὶ οὐδενὸ (Job xxvi. 7).

because they did not perceive the extent of its import, or because they could not understand it.

The heavens, in the Bible, are the immense, infinite space, through which the nebulous matter, the universal source of all the celestial bodies, is diffused. They constitute the *expansum* or immensity, and not the *firmamentum* of St Jerome, nor the στερέωμα of the Alexandrine interpreters, nor, finally, the eighth heaven of Aristotle and all the ancients, which they represent as firm, solid, crystalline, and incorruptible.

Moses alone has distinguished the primitive light from that whose benefits we derive from the sun. He has represented it to us as an element independent of this luminary, and as anterior by three epochs to that when it received its brilliant atmospheres. This particular in the account of the creation, was long considered as irreconcilable with physical facts. The distinction has brought many reproaches on the author of Genesis: those who uttered them, struck with the splendour of the great luminary which presides over the day, could not conceive that other sources of light existed both for the earth and for the rest of the universe. But the difficulties which have been felt, as to the accuracy of the Mosaic narration, have not kept their ground before the discoveries of science. In fact, an immense quantity of light is produced here below, and developed in an infinite variety of circumstances, altogether foreign from that we derive from the sun. Of this nature is the light emitted by volcanic fires; also that accumulated on the surface of clouds, which is not an intermittent, but continuous light. This light, produced by their phosphorescence, was sufficiently bright, aided especially by temperature, humidity, and electricity, all of which were more considerable in the first ages, to make vegetables grow, before the solar rays had caused their powerful influence to be felt.

Neither does Moses represent the light as created, as Biblical commentators have unreasonably supposed; but he represents it as bursting forth at the voice of God. The author of Genesis, therefore, is rather in harmony with the theory of vibrations or undulations, generally adopted, than with the theory of emission, which cannot explain the whole of the known facts.

In this point of view, the Hebrew lawgiver would have appeared superior to Newton, if that great genius had not himself been favourable to the hypothesis of vibrations, although, for his explanations and calculations, he adopted the theory of emission. It is in the letter written by him to Boyle that he has endeavoured to demonstrate that the vibrations of the ether, determining the phenomena of light, may furnish an explanation founded on those of weight or attraction.

The letter in which this great and beautiful conception appears, has been published by M. Frederick Maurice, in the *Bibliothèque Universelle de Genève.* This savant there shews how simple it is, and conformable to the laws of nature, to derive the principal and most important phenomena of the physical world, from the pre-existence of a single fluid eminently elastic and subtile. He shews us how, by means of this mystical tie, Newton designed to co-ordinate all the movements of the great bodies of the universe, and bring together the whole physical facts to that first unity which renders their co-ordination so admirable and wonderful.*

This same natural philosopher leads us to remark, that, in this reference made by Moses to light, as existing and shining with all its splendour, before there were any luminous bodies destined to shed it in a constant manner on the earth, it is difficult not to perceive a striking proof of the inspiration of the Book which announces such a fact.

While admitting a light independent of the great luminaries placed by the hand of God in the midst of the celestial spaces, Scripture does not fail to direct our attention to the magnificence and splendour of the solar rays. We are informed that man cannot endure their brightness, when the winds have cleared the sky, and when the north wind causes the golden sun to shine.

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* Newton's letter to the Royal Society of London, written in 1675, has been inserted in the History of that Society, published in 1756, by

When Moses turns his attention to the numerous stars which impart to night its magnificence and beauty, his knowledge appears superior to that of the ancient astronomers, who, in their imperfect observations, have classified only about a thousand.* He, on the contrary, multiplies them to infinitude, and regards them as innumerable. Thus, in a single word, he represents to us the immense quantity of stars which compose the milky way, or which are disseminated through the celestial spaces. Continuing the examination, he compares them, as Herschel might have done, to the grains of sand on the sea-shore. We might not, perhaps, have seen any thing else in these expressions but a simple figure, had not Scripture added, " God has scattered them with his hand in space like dust," and however great their numbers, " He names them all by their names." When not speaking of their numbers, but of the order and regularity of their movements, Scripture compares them to an army advancing to battle. It represents this celestial army as incomparable for the multitude of its soldiers, and the perfection of its evolutions. Filled with wonder at the magnificence of the heavens, the Sacred writer exclaims, in rapture, " They declare the glory of the Almighty ; and, although without words and voice, they do not the less proclaim his power and glory."

However brilliant the stars disseminated through the immensity of space, Scripture never supposes them to be animated, as the ancients imagined. Neither does it assign to them any influence over human affairs. It regards them as bodies called forth out of nothing by the voice of God, as inert pieces of matter, regulated and submissive, proceeding with the order, regularity, and unity, of an army advancing to battle, and executing the decrees of his Supreme Wisdom.

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Birch. With regard to that of Newton to Boyle, it has been translated by Pictet, and may be found in the *Bibliothèque Universelle de Genève* for 1822. In this letter Newton admits the propagation of light by means of the vibrations of an ether pre-existing and everywhere diffused.—See the 21st verse of the xxxvii. chapter of the Book of Job.

* According to Hipparchus, there are not more than 1022 stars in the heavens ; although the number was a little increased by Ptolemy, they did not amount, in the eyes of the latter astronomer, to more than 1026.

It is thus that the Bible represents to us Him whose majesty is above the heavens, and who humbles himself even when he looks upon the celestial vault. Between the animated representations which it gives us of this Infinite Being, whom the universe cannot contain, and those which have been handed down to us by the greatest geniuses of antiquity, the distance is so great that no comparison can be instituted. It is the same with the notions Scripture gives us and what the ancient theogonies have transmitted respecting God, as with what regards the material world and its formation.

Scripture is not less exact when it describes the different constellations. It represents the Pleiades as owing their lustre to a great number of stars placed close together. It speaks, on the contrary, of the stars of Orion as remote from each other, and in some measure, as it were, dispersed through the celestial vault. In alluding to the brilliant constellation of the Great Bear, it represents it as composed of an infinite number of resplendent stars.

It is not only when considered in relation to these great views, that Scripture appears in harmony with the discoveries of science ; the fact is even more conspicuous when we regard the phenomena of the material world in detail. Thus, when it speaks of the air, it represents it as possessing a certain weight, and surrounding the earth in moveable layers. In fact in that admirable song of Solomon's, where he describes the eternity of the Infinite Wisdom, does he not tell us that it existed when God established the air above the earth, when he assigned their equilibrium to the waters of the fountains, and laid the foundations of the earth ?*

In like manner, Scripture first informed us, " That God gave to the air its weight (*mischkal*), and to the waters their just measure." Yet this property of the aëriform fluid which surrounds the earth remained unknown till the time of Galileo and Torricelli. At the most, Aristotle had but a faint idea of it, just as, at a later period, Seneca had some notion of its resilience and elasticity.

This weight attributed to the air, has appeared so extra-

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* Proverbs, viii. 28, 29.

ordinary to all the interpreters of the Book of Job, where it is literally stated, that, from not being able to comprehend it, they have altogether misinterpreted it. All of them have translated the expression *rouach*, which properly signifies the air or the aëriform layer which environs the globe, by the term *wind*, although they have preserved its true sense to the word *mischkal*, that is to say, heaviness or weight.

They have been led to do this, because they were unable to conceive that the air could be heavy; and, knowing from experience that we encounter a certain resistance when moving against its beds or layers in motion, they have ascribed weight to it on account of its strength and power. Instead of following Scripture, and assigning to the air itself a certain weight, they have referred it to the agitation and impetuosity of its moveable strata.

The above interpretation once admitted, all commentators who have followed the first translators have adopted the same version, without attempting to ascertain whether it was conformable to the true sense of the Hebrew text.

If the old interpreters had understood the true sense of the 7th verse of the 135th Psalm, they would have found in it an additional proof of Scripture attributing weight to the air. The Psalmist there praises God, "Because he maketh lightnings for the rain, and because he causeth the vapours to ascend from the ends of the earth, and bringeth the winds out of his treasuries." The ascent of the aqueous vapours in the midst of the air, is the consequence of their lightness being greater than that of the atmospheric strata through which they pass. Both the one and the other of them are, therefore, heavy, and the excess of weight is here in favour of that which, at the first glance, would appear destitute of it.

As they are regarded by Scripture, the aqueous vapours are the source of clouds, whence the waters descend which fertilise the fields, or lay them waste when they are too abundant. They are, therefore, the cause of impetuous rains and storms, when they afford a free passage to the lightnings of thunder. Scripture thus recognises their density, and that of the aëriform stratum which affords them access to the middle of its interstices.

The Bible thus represents to us the aqueous vapours as constantly suspended in the air, and nature, by an admirable system of circulation, as employing these vapours in the production of clouds, the source of the rains which fecundate the earth.* Scripture assigns to the atmosphere and to the upper waters, that is to say, to the aqueous vapours suspended in its bosom, an importance which modern science alone has been able to establish. At least, according to the calculation of the greatest natural philosophers, the force annually employed by nature in the formation of clouds, is equal to an exertion which the whole human species could not accomplish in less than 200,000 years.†

This "separation of the upper waters from the lower waters," has taken place by means of the atmosphere, and not by a solid sphere, as the greater number of the interpreters of Genesis have erroneously supposed. In fact, the Hebrew word *rakiah*, which we have rendered by *interval* or *firmament*, is far from having the least relation to anything firm or indurated. It rather designates a vapoury space, that is to say, an aëriform layer, but by no means a heaven of metal, as Don Calmet has unreasonably imagined.

The Bible here indicates to us the importance of water in the formation of the earth. It further informs us that, besides the water diffused through the atmosphere, or which covers the greater part of the surface of the globe,‡ there exist quantities, not less considerable, in the interior of the globe. Its solid crust, it is stated, covers a great abyss : from

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* See Job, chap. xxvi. 8; xxxvi. 27; xxxvii. 11 and 12; xxxviii. 25 and 27; Ps. lxxvii. 17; Proverbs, viii. 28.

† The reader may consult on this subject the calculations of Leslie and Arago. The latter admits that about 800,000,000 of men form the half of the population of the globe. In the calculation, the result of which is given above, there would only be the half of that number engaged in the work destined for the formation of clouds (*Annuaire du Bureau des Longitudes*, 1835, p. 196).

‡ Psalm civ. 25, makes us acquainted with the grandeur of the ocean in these terms: *This great and spacious sea.* Zechariah describes its extent by saying, the Messiah shall reign "from sea to sea;" that is to say, throughout the whole earth, Zechariah, ix. 10. See Amos, viii. 12; Micah, vii. 12: Ps. lxxii. 8.

this abyss the waters made a violent eruption at the period of the Deluge, as at the time of chaos, and the innumerable ages which had preceded it.*

Thus the Sacred Scriptures, antecedently to modern discoveries, shew us the exterior crust of the earth issuing from the bosom of the waters, and this same crust enclosing in its interior an immense quantity of water in a liquid state.† These facts have been confirmed by observation and science. Is it not consistent with common experience, that subterranean waters are almost as abundant as those which flow on the surface of the earth? The globe would appear to contain in its interior, rivers, torrents, lakes, and perhaps even seas. When the Bible speaks of the Deluge, it represents it as produced by impetuous and violent rains, the flood-gates of heaven being opened. On the other hand, it describes the waters enclosed in the bowels of the earth, as having gushed up to the surface in torrents. They swelled, at the same time, the exterior waters, which accumulated and overflowed on every side, according to the energetic expression of Job. All these causes united produced this terrible catastrophe, which brought destruction on the human race, and which was followed by their renovation.‡ Such facts are still the cause, not indeed of deluges analogous to that the violence of which the Bible describes, but of inundations which afflict and desolate the earth at distant and

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* See Genesis, vii. 11; Ps. lxxvii.; civ.

† According to Ps. cxxxvi. 6, the earth is founded and stretched out above the waters: *Quis firmavit terram super aquas?*—"The Lord has founded the earth upon the seas, and established it upon the floods," Ps. xxiv. 2; "*Les géants gémissent sous les eaux,*" Job xxvi. 5. [The French and German versions of this passage differ from the English translation.—Ed.] Moses wishes for Joseph, "the blessings of the deep that coucheth beneath," that is to say, abundance of spring water, Deut. xxxiii. 13.—[Several references are here made by the author to passages of Scripture, which he regards as corroborating his statements. These references, probably from typographical errors, are, in many cases, obviously incorrect, and are therefore omitted.—Ed.]

‡ See Job xxxviii. 8; Genesis vii. 11 (*rupti sunt fontes abyssi et cataractes cœli aperiuntur*).

rare intervals. The waters of the heavens are incapable of producing them, as they were incapable of causing a cataclysm, such as that which occasioned the destruction of man. In fact, the quantity of aqueous vapour diffused through the atmosphere is too inconsiderable to produce deluges resembling that of Noah, the extent of which physical facts sufficiently attest.

Scripture does not confine itself to these particulars, in order to enable us to understand that, besides the great masses of water spread over the surface of the globe, there exist others not less considerable in the interior. The earth is founded and stretched out, it informs us, on the subterranean waters: they are there assembled, as in a mass, in the most secret places of its depth, whence they at times escape to impart fertility to the most barren soils.*

Thus, when it describes the riches of the country of Canaan, to which a wonderful exuberance of vegetation is promised for the latter times, it represents it not only as abounding in springs and fountains, but particularly in subterranean waters. It seems thereby to anticipate the process of perforation, by means of which the moderns have succeeded in fertilising the most barren fields and the most steril countries.

We find, moreover, in the Scriptures, proofs of the extent of the seas in the early ages; they even contain some succinct details respecting the animals which inhabited them, the greater part of which have preceded the species of the dry and uncovered land. Such facts have required long spaces of time for their operation. In truth, the numerous generations buried in the old strata of the globe, and to which the present existing races have succeeded, must have lived during periods of greater or less duration, in order to fulfil the end of their creation. This circumstance of itself proves that the word *iom* used in Genesis, and which is translated *day*, means rather indeterminate epochs, the duration of which it is impossible for us to fix.

While enabling us to understand the extent of the seas,

* See Ps. xxiv. 2; xxxiii. 7.

Scripture does not fail to declare to us that God has marked out their limits, and has fixed their boundaries and barriers, which they cannot pass over. In its poetical style it exclaims, "Sea, hitherto shalt thou come, and no further; and here shall thy proud waves be staid."

In other places it points out the depth of the sea, and refers to the greatness of its abysses, maintained by the waters which issue from the bosom of the clouds. The rains also quench the parched lands, and cause the grass of the meadow to spring. With regard to the waters, they are sometimes converted into ice, and become hard as a stone: their solidity thus accidentally gives solidity to the surface of the sea.

It represents the frost as spread over the earth like salt, and making the plants rough like the leaves of thistles. When the cold north wind blows, the water becomes as crystal. The frost rests on the whole mass of waters, and renders them like an impenetrable breastplate.

When the snow falls on the earth, it extends itself over it like a multitude of birds of passage lighting upon it in flocks; it spreads itself like hosts of locusts descending from the clouds. The eye admires the brilliancy of its whiteness; but the mind is alarmed at the inundations it threatens. Finally, when the bad weather ceases, the warm and moist winds become felt, and with them the snow and frost disappear. Thus, throughout, and at every step, Scripture indicates to us the influence of the waters diffused through space, and their effects on the earth.

The Bible, in order to give us an idea of the influence of the central heat, does not confine itself to speaking to us of that which it exercised on the waters of the Deluge; it gives us further information, when referring to the interior condition of our planet. In fact, according to it, if the surface of the earth furnishes to man the elements of his nourishment, beneath the solid crust, "The earth is," nevertheless, "on fire, and as it were turned up." * The greater part of

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* The Hebrew word *thakhthejah*, used by Job, chap. xxviii. 5, means *beneath it*. The text runs "It is from the earth that bread comes; and beneath it, it is turned up, and as on fire."

its crust, thus inflamed in the interior, is covered with water on the surface. Above this liquid mass, continents and mountains, which are its most elevated points, have risen up to afford an asylum to man, as well as to terrestrial animals and vegetables.

Who, then, has informed Job that the interior of the earth was filled with such a burning heat? Who has taught him the existence of the central fire, the possibility of which Buffon had conceived before the hypothesis had become a demonstrated fact? We do not reply to this question, on account of the point of view under which we have considered the Sacred Books.

We have reason to be surprised at thus finding in the Bible physical truths so long misunderstood, or so long unknown; namely, the weight of the air and the central fire. Notwithstanding the existence of this interior heat, the effects of which it appreciates, Scripture does not fail to admit the extent and thickness of the solid crust of the globe, which encloses immense quantities of water concealed in its depths.

The Sacred Books, it is true, in giving us an idea of these great facts, has not taught us them in the language of natural philosophers. Their language is never that of Copernicus, Newton, Kepler, or Laplace. The reason which has prevented the authors of these admirable books from doing this, is one of the strongest that can be conceived. If they had expressed themselves respecting the scenes of nature, not as these present themselves to our eyes, but according to the notions which philosophers of a future age might form of them, they would certainly not have been understood, even by the most enlightened minds.

Besides, the most advanced language of science is almost in every instance only the language of appearances. The visible and material world is, to a greater extent than is supposed, a scene of illusions and errors. What we call reality is often a mere figure, having a relation to a more hidden reality, or to an analysis carried a further length. Such an expression, in our mouths, has nothing absolute in it; it is a relative term, which we employ in proportion as we believe that we have ascended a new step in the profound scale of our ignorance.

Above all, it was necessary that Scripture should be intelligible to the most vulgar individuals, as well as to the most learned. Let us not, therefore be surprised that it expresses itself according to the habitual and familiar language of science, and that, with it, it speaks of the stars rising, the equinoxes retiring, the planets advancing and doubling their speed, standing still, and moving backwards. We need no longer be surprised that it speaks of the rising and the setting of the sun, since these modes of expression are sanctioned and adopted by the Annuaire of the bureau of longitudes.

One circumstance may well surprise us, and that is, to find in the Bible mountains distinguished into two classes, very nearly in the same manner as they are distinguished by science into primitive and secondary. Thus, in the 104th Psalm, a composition of incomparable poetical beauty, the prophet gives us an idea of the formation of the earth ; he represents it to us as still covered with the waters of the deep as with a garment. The waters stood above all the mountains, but many of these eminences became elevated, and rose above their level ; the waters then retired and fled. New mountains then appeared, and valleys and plains, the lowest parts of the globe, were formed at their feet. Two principal epochs, then, must have been in the mind of the prophet, from the time of the rising up of the heights which appear on all parts of the globe ; these two epochs correspond to the formation of primitive and secondary mountains.

Thus the prophet (Proverbs viii. 25) in speaking of the elevation of mountains and hills, says that these events, which have singularly modified the relief of the globe, had their separate eras. Further, in the 97th Psalm, Scripture represents the mountains to be melting like wax, nearly as those might have done who had seen the rocks of Auvergne or Cantal in a fluid state, or the basalt of the Giant's Causeway melted like water.

The Bible then represents to us the mass of mountains issuing from the bosom of the earth at the voice of God, and rising above the plains and valleys. It gives us an account of the process of their elevation, in terms which might have been used by a poetical geologist. "The mountains," is the enthusiastic language employed, "the mountains rise above the deep, and the valleys sink to the place which thou hast chosen for them."

Reference is even made to the force by which they have been elevated; it is represented as proportionate to the elevation to which these eminences have been raised, being most powerful when employed in elevating the mountains properly so called, and weaker when its efforts were limited to the raising of the hills above the valleys. In its figurative style, it compares the elevation of the former to the skipping of rams, and that of the second to the leaping of lambs.*

The earth is thus represented as being soft as clay, at the time of these great events. It is then described as having assumed a new face, and having adorned itself with a new garment,† a sort of allusion to the sedimentary deposits with which the superficial crust became covered.

When Scripture speaks of the electric fluid, it represents it to us as resounding throughout the whole space of the heavens, and causing its lightnings to shine even to the remotest parts of the earth. After their light the thunder roars, and its rolling sound is heard. The noise of the thunder, it says, announces that the wrath of God is about to fall on all that aspires to elevate itself. Scarcely has the sound been heard, when the bolt has already struck. Thus God breaks forth in the voice of his thunder; he who works such great and mighty wonders, traces his path in the thunder, and regulates the course of the tempests.

Such is the idea which it gives us of this phenomenon, the rapidity of which is even greater than that of light. In fact, according to Mr Becquerel's experiments on the rapidity of

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* See Job. xxviii, 4; Psalm xc. 2; xcvii. 5; civ. 6, 8, 9; cxliv. 5 Proverbs viii. 25; Ezekiel xlvii.; Zechariah xiv. 4, 8.

† See Job xxxviii. 14.

electricity, this fluid traversed ninety thousand leagues in a second. Its velocity is therefore greater than that of light, which is only at the rate of eighty thousand leagues in the same space of time.

The electric fluid not only exhibits the greatest velocity, but it enters in considerable quantity into the composition of the molecules of bodies. This quantity is indeed so immense, that the imagination is startled at it. The elements of a simple molecule of water appear to contain eight hundred thousand charges of an electric battery of eight jars two decimeters (about 8 inches) in height and six (about 2 feet) in circumference, obtained by thirty revolutions of a powerful electrical machine. If the quantity of electricity accumulated in the elements of a gramme (about 15½ grains) of water, happened to be suddenly set free in the middle of any building, the building would instantly be blown in pieces.

This power, compared with which steam is as nothing, whether we consider it as an extremely subtile matter, or rather as the result of a vibratory movement impressed on the ether, is only employed by nature in maintaining the combinations and molecular constitution of bodies. We ought not, therefore, to be surprised at the importance which Scripture assigns to thunder and lightning, which is one of the not least curious of its effects. There are few natural phenomena in which electricity does not act a part, and which are not more or less dependent upon it. How can it be otherwise, since each material molecule appears to be endowed not only with a certain quantity of heat and light, but also with electricity?

Genesis is not less exact when it calls our attention to the living beings which, by turns, have animated and embellished the surface of the earth. It delineates their succession, it teaches us that they have appeared in distinct generations, and in direct relation to the complexity of their organization. We are surprised to find such a law written in the Bible, a law equally to be traced in indelible characters in the bowels of the globe. This fact, clearly expressed in a Book which has existed from so old a date, has, notwithstanding, been known to us only for half a century. To the general idea thus connected by Moses with the appearance of living beings, this great legislator adds details, the accuracy of which is not less evident in our opinion, although assertions to the contrary have been made by many illustrious naturalists. According to him, terrestrial vegetables preceded the animals which inhabit the dry and uncovered land. In this particular, chemistry confirms the assertion of the sacred writer; but geological observations seem to be opposed to it. Accordingly, certain modern natural philosophers, far from admitting it as real and satisfactory, have regarded it as a manifest error. The question is to determine whether these observations are as conclusive as they are supposed to be, and if, according to the nature of things, vegetables must not have appeared before animals.

The researches by means of which it has been supposed possible to prove that vegetables have not preceded beings endowed with motion, are far from authorising the inference wished to be deduced from them. In fact, while terrestrial vegetables appear in great numbers in the transition formations, this is far from being the case with animals. Only a few individuals of the lower classes of the animal kingdom have been discovered in them; up to the present time the number does not exceed six species at most. And yet the most active researches have been made in all parts of the world to discover a greater number. But even although these beings had been observed in the same terrestrial strata, this would not have been a proof that they lived simultaneously. We are unacquainted with the time which may have been necessary for the precipitation of these ancient strata, as well as for their consolidation. Hence plants, although anterior to such or such species of animal, may have been embedded along with it in the same order of deposit, the latter having required more or less considerable intervals of time for its formation.

There is, therefore, more or less uncertainty with regard to the simultaneity of the period of the appearance of vegetables and animals, if we suppose that both were interred in formations of the same age. It is far from being demonstrated that terrestrial plants are not found in strata more ancient than those in which we discover animal species. Geological facts do not, therefore, contradict the progression indicated by the author of Genesis, in regard to the appearance of different living beings. This assertion of Moses is a geological consequence of high importance, confirmed by the observation of facts, as has been remarked by one of the greatest natural philosophers of our day.*

This consequence is, moreover, a rigorous, because it was a necessary one. Terrestrial animals derive their food from vegetables, even such of them as subsist on living prey. By devouring herbivorous species, they, in fact, support themselves by means of the herbaceous matter which these latter had assimilated and converted into their own substance. If, then, the herbivorous must have existed before the carnivorous races, to which they were to serve as food, both the one and the other must have been preceded by the plants which were to afford them the means of growth and development. By a consequence of the same kind, we may admit that omnivorous animals must have appeared last among living beings.

This conclusion, at which we arrive by a process of simple reasoning, is confirmed by observing the strata of the globe. It is remarkable to find this fact recorded in Genesis, written at least 3500 years ago. This book admits, in like manner, the gradual appearance of vegetables. It makes them commence with the least complicated species, to which succeed herbs, then shrubs, and finally trees. Posterior to all animals the sacred writer places the arrival of man, who crowns and terminates the great work of Creation.

Naturalists who have occupied themselves with this question, have not examined it with the view of justifying the author of Genesis; and this very consideration gives their opinion greater weight, for it has been forced on their minds by positive experience.

It is to this part of the subject that Herschel's beautiful thought is more particularly applicable. Struck with the

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* M. Dumas.

relations which the sciences are every day contracting with revelation, he says; "that all human discoveries seem to be made only for the purpose of confirming more strongly the truths come from on high, and contained in the Sacred Writings." This illustrious astronomer has seen in this agreement the most valuable triumph and most noble conquest of intelligence.

This scientific fact may be regarded even in a still more important light. It indicates that the author of Genesis has had just reason to look upon man as the last that appeared of living beings, and to regard him as the limit and completion of the creation. If plants have preceded herbivorous animals, because the latter must derive from these all that serves them for nourishment, herbivorous animals must, in like manner, have appeared before the carnivorous species. In truth, without the herbivorous races, the carnivora must have died of hunger. For similar reasons the omnivorous, or such races as live both on vegetables and animals, must have made their appearance at a later period. Accordingly man, who is omnivorous *par excellence*, must have appeared last among living beings, since he requires the presence of all kinds of nourishment.

On the other hand, when Scripture speaks of the creation of plants, it makes them vegetate and develop themselves before the appearance of the sun, and under conditions of light, heat, and humidity, different from those under which vegetables now flourish. It has thus disclosed to us, thousands of years ago, an order of things which the fossil botanist has found to exist with great exactness, and which he has endeavoured to explain by causes different from those whose action is now felt.* Scripture, therefore, has admitted, with reason, that the germination of vegetables commenced before the sun had received the power of shedding his light on the earth; it is thus by motives not less legitimate, and not less real, that it makes plants appear

* See Genesis i. 11 and 12; and our memoir on the Fossil Plants of the Coal Formation of the Polar regions, *Bibl. Univ.*, July 1834.

before animals, which they were destined to supply with nourishment. But let us consider whether Scripture has had equal reason for proclaiming the recent appearance of the human species as compared with other living species.

What we have already observed, is in some measure a proof that the arrival of man on the earth must have been posterior to that of the greater part of animals, whether vertebrate or invertebrate. Not many serious difficulties can be formed on this point. The examination of fossiliferous strata proves that the remains of our species do not begin to shew themselves till we come amongst diluvial deposits, which are the most recent of those belonging to geological eras. Man has, therefore, formed part of the new generations which have appeared on the surface of the earth; also the greater part of those with which he has been cotemporary have still their representatives among the living races.

But man may be recent, even the newest of beings, and yet the date of his appearance may go so far back as the 7500 years which Scripture assigns to him. Is it necessary to suppose with Scripture, that the last arrangement on the surface of the globe is more recent than the last and terrible catastrophe which laid it waste, a catastrophe followed by the renewal of the human race? Would it be reasonable for all ages, all people, and, in particular, our modern schools, to set themselves in opposition to a date which assigns so youthful an age to our haughty race? Assuredly not; geological investigations, the researches of history, and the study of monuments, all concur in demonstrating not only the recent date of man's appearance, but particularly that of his renovation.

Here, therefore, Scripture is exact and within the limits of truth. The term it assigns to the cradle of humanity, although not very remote from that in which civilization has arrived at a degree of remarkable splendour, is still sufficient to explain and comprehend the various phases of it. We may include in these 7500 years all that authentic historical traditions have told us respecting the progress of man in the path of civilization.

The Bible has, in like manner, acknowledged the unity of the human species. This truth, for a long time disputed, has been regarded in our own times both by the most illustrious physiologists aud most able anatomists as fully established. The intimate acquaintance of both these classes of observers with the proofs which demonstrate it, give the greatest authority to their opinion.

At some future period, not very remote, this question will probably cease to be open to any dispute. In fact, the black men who, by losing ground and going backwards in the path of civilization, have lost, in a great measure, the beauty of their primitive type, are now returning to the blessings of intelligence, and have established themselves as nations. They shew a tendency to remount to the point from which they receded: as the consequence of their progress in knowledge, and the improvement of their mental faculties, they will soon recover the type which they had lost. The development of their brain, the necessary consequence of the exercise of their minds, will make them acquire new forms; and soon they will cease to be distinguishable from the white race from which they sprung. With the advance of their intelligence, their language will become purer; their manners will undergo a corresponding improvement; and these men, not long since so debased, both in moral and physical qualities, will become the most manifest proof of the unity of the human species, as proclaimed by the first and most ancient historian.

This primitive unity must necessarily imply a uniformity in the language of mankind, or in the manner of making themselves understood, and communicating their thoughts to each other. The Bible intimates this; and we can go back with it to the precise period when the confusion of languages took place among the nations. A superficial study of the idioms of the primeval races has appeared, at first view, not very favourable to the idea of their having a common origin; but a more profound examination has shewn in what manner all the languages spoken came gradually to differ from each other. *(See note at the end of this article.)*

It is not less deserving of attention that the Bible is the first book in which we find notions of classification, analogous to those which naturalists employ in the study of the different natural bodies. In the 11th chapter of Leviticus, in particular, we find a sketch of a method of distinguishing pure animals from impure, the latter of which the Hebrews were forbidden to eat. God allowed the children of Israel to eat animals which ruminated and had the feet cloven; but they were interdicted from using others. Swine, and even camels, were included in the interdict; the former because they did not ruminate, the latter because they had not their feet divided like oxen and sheep.

Birds of prey were also, according to Scripture, impure animals, which the Hebrews were not permitted to use for food. They were allowed to make use only of long legged species (*Grallæ*, Linn.), and those whose feet were adapted for swimming. They might employ for food all the marine and fresh-water fishes provided with scales and fins; but they were not to eat such as were destitute of these appendages. In this ordination there can be no doubt that a great degree of wisdom is shewn; for the animals we now use for food belong to pure species; while, with the exception of the hog, those which Moses regards as impure are, in general, ill-fitted for human consumption. But what is most important to be remarked is, that in this arrangement there can be traced the basis of a natural classification, which is still adopted in the most common systems.

Scripture is not less precise when it turns its attention to the objects of detail relating to living beings. It is, in particular, in delineating the manners of animals, that these writings exhibit an accuracy and conciseness which the greatest naturalists have not surpassed. Its descriptions are so faithful and so precise, that they cannot be mistaken. Thus it represents to us the lioness couched in her cave, watching with a restless eye the prey about to pass, and waiting with the utmost anxiety on her young whelps. When she perceives the prey, we are told how she darts forth with the rapidity of the eagle, carrying her victim in her mouth to appease the hunger of her young ones. Very different from the young lions, the young ravens wander about from one place to another, oppressed by hunger; they call with loud noise on their mother, who finds her greatest delight in supplying them with food.

It indicates to us, in like manner, the time of gestation and delivery of the hinds and wild goats. These animals are represented as bowing themselves when they bring forth, and uttering sorrowful cries. The wild ass is spoken of as being singularly fierce, incapable of being subdued, and answering not to the voice of him who calls himself its master; free, and ranging the mountains as his pasture; his abode is in solitude, and his retreat the desert.

Man, it tells us, cannot subdue the oryx; he cannot force it to remain even for a single night in a stable; still less can he make it submit to the yoke, to open the furrows and harrow the fertile valleys. Notwithstanding his power, the strength of man is incapable of making this untameable animal assist him in his labours. He cannot make use of it to carry his harvests, or to gather them into his barns.*

The delineations of the manners of these animals are extremely true, and are expressed with remarkable conciseness. Such is the case with those the Bible gives us respecting the habits of the ostrich, a bird which it represents as void of affection for its young, which are in its eyes as if they were not its own. Forgetting her offspring, the ostrich

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* See Job xxxix. 1 to 11. We shall make only a single observation on these verses: it relates to the animal which the Hebrews called *Reem*, perhaps the oryx of the Greeks, spoken of by Martial and Oppian. This species appears to be the same as the Oryx antilope of naturalists; it is about the size of a stag, and its horns are slender, from two to three feet long. This antelope, or oryx of Elian, lives in large herds in the interior of Africa, and throughout the whole of Arabia.

M. Rosenmuller, as well as Bochart, has translated the Hebrew term *Reem* by oryx, with so much the more reason, because the notion of the unicorn has been formed from some individuals which had lost one of their horns. This circumstance is the more probable, since the oryx presents this peculiarity, as well as the algazel and leucoryx antelopes; all of these animals frequently become unicorn.

However this may be, the details which Scripture gives us respecting the animal which it calls *Reem*, agree perfectly with the Oryx antilope. See our *Observations on the Unicorn of the ancients (Mem. de la Société Linn. de Bordeaux.)*

leaves her eggs in the earth, and warmeth them in the dust. A foolish and thoughtless mother, she cares not what may become of them ; forgetting that the foot may crush them, or that they may be destroyed by the cruel jaws of the tigers of the desert. But when it is the proper time, she raises her wings into the air ; trusting to the strength of her legs, she scorneth the horse and his rider.*

The description of the horse is not less faithful : the Bible represents it to us as full of strength and vigour, and bounding like a grasshopper. His neck is adorned with a flowing mane, and he paweth the earth with his foot. He leaps forward with pride, and goeth forth to meet the armed men. His breathing scatters terror ; he mocketh at fear, neither turneth he back from the sword. When the quiver rattleth against him, the glittering spear and the shield, he swalloweth the ground with fierceness and rage. If he hears the sound of the trumpet, he exclaims, Let us advance ; he smelleth the battle afar off, the thunder of the captains and the shouting.†

At the command of the Eternal, Scripture states, the hawk darts into the air, and extends her wings towards the south. At His voice, the eagle rises to the clouds, and places her nest on the top of the mountains. This bird inhabits the hollows of the rock, and dwells in the most inaccessible cliffs of the crag. From these elevated heights the eagle watches her prey ; her piercing eyes discover it afar off. When she has seized it, she carries it to her young, who drink its blood. Under the guidance of their mother, the young eaglets soon descend to the places where the carcass lies. Images of death, these birds bear, in some degree, its livery on their plumage.‡

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* See Job xxxix. 13 to 18. The description of the ostrich in the Book of Job is remarkable for its extreme truthfulness, as may be seen by perusing the passage referred to. It is singular to see in so ancient a book this habit of ostriches noticed, of raising their wings into the air when they wish to run before the wind. They know, by instinct, that their wings, under such circumstances, will act as sails or oars.

† See Job xxxix. 19 to 25. This description of the horse is superior to all others that have since been written.

‡ See Job xxxix. 26 to 30. The Hebrew word *nescher* (eagle) is de-

Scripture often makes mention of the migrations undertaken by so many animals, particularly birds and fishes. It often compares the rapidity of birds of passage, as they cross the seas, to the speed of vessels using their large sails as if they were huge wings. It shews to us the extensive journeys performed by these light inhabitants of the air, their immense numbers, their fatigues, the consequence of their lengthened flight, and the promptitude with which they alight when they reach the end of their journey. Everything, in the delineation of the manners of these birds of passage, is rapid and animated as the movements themselves of the beings which people the aërial ocean.*

We have enumerated some of the principal physical facts contained in the Bible; we have endeavoured to shew the relations they bear to those with which science has recently made us acquainted It seems that nothing now remains for us to ascertain. There is, however, one essential point of which we have omitted to speak, and with this we shall terminate our researches. The Book of Wisdom, after having said that the almighty hand of God made the world out of nothing, adds, that he disposed all things by number, weight, and measure. By this we are led to understand, that we ought to consider natural bodies under three aspects; that is to say, under that of their extent, their

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rived from the verb *schour,* which properly signifies *to contemplate*. The authors of the Bible were not ignorant that the eagle could fix its eyes on the sun. The prophets had also correctly observed that when the eagle moults he loses almost all his feathers (Micah i. 16). Scripture is not less correct, when it speaks of the manners of animals. See, for example, Proverbs xxx. 25 to 28; Isaiah xxxiv. 14 and 15. The Proverbs contain details not less curious on inanimate bodies. Ezekiel (iii. 9, and x. 1) had remarked, that the diamond was the hardest of stones, as the sapphire was one of the most brilliant. Zechariah, likewise, when wishing to describe the impenitence of the Hebrews, says that they have hardened their heart like the diamond (vii. 12). This prophet was also acquainted with the mode of trying gold and purifying silver (xiii. 9). The 28th chapter of Job contains interesting details on the metals and precious stones.

* See Isaiah xlvi. 11; lx. 8; Hosea xi. 11; Joel ii. 25; also the Psalms.

weight, and the number of atoms or molecules which compose them. Perhaps it was thus meant to specify the principal modes of regarding bodies, or the principal branches of natural science. Physics would, in this way, be represented by measure, the mathematical sciences by number, and chemistry by weight.

Scripture describes, in a few words, the principal properties of bodies, and how we may sum up their different appearances and different characters. Thus God asks Job where he was when He laid the foundations of the earth, and when He established the measures thereof? where he was when He enclosed the sea with barriers, when it broke forth as a child which comes from the womb of its mother? or when, enveloping the clouds as with a garment, He surrounded it with darkness like the swaddling-bands of infancy? Has man ever known the paths of light, or the place of darkness?

The details into which we have entered seem to prove, with some degree of evidence, that the physical truths most essential to the knowledge of the material world, are almost all indicated in the first books of the Bible. They are never, indeed, fully developed, because Moses and his successors were not called upon to write scientific treatises. While speaking of God, and the works which proclaim his power, they have, as if in spite of themselves, allowed some gleams of their superior knowledge to break through. Their object, and almost their sole object, has been to point out their duties to the people they were called upon to direct, and, particularly, to fill their minds with the fear of the Lord. It was sufficient to unveil to them the principal facts of this visible world, to convince them of the wisdom of the Most High, so clearly imprinted on the works he has produced. Explaining them, accordingly, with an admirable conciseness, the greater part of these facts have escaped the notice of the first interpreters of Scripture, who, from inability to comprehend them, have not given to the Sacred Books all the importance they now possess in our eyes. Their errors, altogether involuntary, are so much the less to be wondered at, since the Bible contains particulars for which we cannot yet assign a reason in the present state of our knowledge. The constant progress of human science will soon render them intelligible. This is not the least of the advantages of the sciences, nor the least valuable inheritance we can leave to our descendants. They will not forget, more than we, that Scripture is a treasure open to all; and that it is the only book from which those that borrow run no risk of being accused of plagiarism. The ideas which they may draw from it have already belonged to millions of intelligences; but if they extend them, if they understand them better than their predecessors, they will so much the more belong to them, since they shall have been the first to perceive them.

*Note.*—We read, in Genesis, xi. 1. *Erat autem terra labii unius et sermonum eorumdem,* which may be translated thus:—"There was then upon the earth only one language and one speech." The unity of the primeval language is perhaps more difficult to establish than that of the human species. In fact, we are without the most essential data for solving the question. We shall, therefore, confine ourselves to a few observations.

If all the varieties or different races of men are derived from one stock, it follows, almost as a necessary consequence, that this must also have been the case with their language, however diversified it may be. Now, it is almost demonstrated that the White race is the most ancient. We ought, therefore, to find among the idioms used by this race this pre-eminently primitive language—the mother of all the rest.

The proof of the primitive unity of language is to be found, not only in the unity of the human species, but also in the confusion of languages which took place at the building of the tower of Babel. If confusion took place then, it could not have existed before.

The history of the human race informs us, that at its origin there was only one speech *(unus sermo.)* But it is difficult for us now to go back to that primitive stock, from which have sprung the various idioms which the different nations of the earth employ to express their ideas. All that is proved by the study of their characters, structure, and construction, is, that the most diverse among them have a family air and resemblance, which reveals a common origin.*

If we assert the contrary, we shall be forced to establish as many human races as there are idioms without analogy or mutual connection; that is it say, we should have to establish hundreds. This consequence would not be very philosophical; it would oblige us, at least, to multiply the races almost in the inverse ratio of the number of individuals who formed part of them. In fact, the smallest tribes, and the most subdivided of savage nations, often present the most notable and strongly

* The knowledge of this primitive language is of no consequence to Scripture; it only interests philosophers. The Bible, accordingly, contains no details in regard to it.

marked differences in their languages. As the consequence of this state of things, the interior of Africa, or the unexplored regions of Australia, would contain a greater number of races than the whole of Europe or Asia. The same thing would hold true of America, where, however, it appears to be demonstrated, that the numerous languages of the natives are derived from a common stock, these having been subjected to the laws of other families of spoken languages.

The most recent researches on the construction of different idioms, seem to have rendered it probable, that, after the violent separation of the human species, they formed themselves into groups, or, if the term be preferred, into families. These groups daily tend to approach each other, and thus more and more indicate their paternity and mutual affinities. They thus present the best proof of their first and single point of departure; they divide the human species into certain great characteristic families, the subsequent divisions of which come within the domain of history. These analogies and relations will become more and more apparent, in proportion as the philosophical study of nations, and the knowledge of their diverse idioms, acquire greater certainty and fuller development.

The languages which form the Semitic branch, in which may be included Hebrew, Chaldee, Phœnician, Syriac, Abyssinian, and Arabian, have been long recognised as having a common origin, and composing a great family.

The same thing may be said of the Chinese and Indo-Chinese languages, which compose a single group, in which all the monosyllabic languages of the east may be included.

With regard to the idioms known under the name of Indo-European, they compose a great family, including the Sanscrit or ancient and sacred language of India; the ancient and modern Persian, which was at first considered to be a Tartar dialect; the Teutonic, with its diverse dialects, such as the Slavonic, Greek, and Latin, with its numerous derivatives. The Celtic dialects, which, according to Prichard, have the closest relation to the Indo-European languages, must be arranged in this group.

Although the Sanscrit may appear, at first sight, to be a mother language, and to have only remote analogies with those which are somewhat modern, we arrive at another conclusion when we compare, with some attention, the Sanscrit and the Greek, for example. This examination is found to prove that numerous relations exist between these two idioms, which would at first appear to have nothing in common. Some curious details on this point will be found in a notice placed at the head of Burnouf's Greek Grammar.* Similar analogies are observable between the Sanscrit, the Persian, and all the old and new dialects of the north; as is also found to be the case between the first of these languages and the Hebrew. We shall find the proof of this assertion in the excellent German work published by Bopp. This skilful philologist has there compared all these languages with the Sanscrit. Now, as the Greek also appears to be derived from it, judging from the great number of words common to the two idioms, it will follow, that all are derived from one and the same language.

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* See page 10 of the 37th Edition. Paris, 1842.

The same thing would appear to be the case with the most ancient languages, such as the Hebrew, the Chaldee, the Phœnician, the Syriac, the Abyssinian, and the Arabic; among which may be included the Egyptian, the affinity of which to the Hebrew is not less manifest. The analogies of all these idioms are so numerous, that, according to M. Cellérier, a great number of modes of speech and foreign terms of expression, principally Arabian, are to be found in the Book of Job. He assures us that he has counted eighty-five words in that book which are not to be met with in any other of the Old Testament books. He has also noticed in it twelve Syriac expressions, eighteen Chaldean, and fifty-three Arabian. This observation, however, applies only to the poetical part; the prologue and epilogue are written in Mosaic Hebrew, and in the ordinary narrative style. (*Introduction to the Old Testament*, p. 494.)

The Latin, which, like the Greek, has a close relationship to the Sanscrit, is evidently a derivative and secondary idiom. The greater part of those of Europe, such as the Italian, Spanish, English, and French, are derived from it. At least, they exhibit such striking resemblances and such numerous agreements, that it is easy to recognise in them the traces of the language from which they have been derived.

It is difficult, therefore, in the actual state of things, to go back to the primitive stock from which all spoken languages have sprung. All that can be done, is to recognise affinities, more or less strongly marked between them, and to detect, as it were, distinct groups or families. Notwithstanding the great differences observable between certain idioms, we conclude, after an attentive examination, by discovering in them certain characters which reveal a common origin, and a primary and single stock.

The exertions of the most illustrious philologists of our times, have been directed to this important point in the history of language. Their researches on the signs, the structure, and construction of the numerous idioms which mankind have employed to communicate their thoughts, have proved, beyond a doubt, that these constitute distinct groups and many great families. Yet, they have found in them, considered collectively, too close analogies, and too obvious affinities, to admit of regarding them otherwise than as all derived from a single and primitive stock, or a mother language.

This appears so much the more probable, when we consider that we often discover stronger resemblances between the idioms spoken by nations situate at great distances from each other, than between those used by neighbouring tribes. This occurs at times, even between nations who have no historical connection, and who, accordingly, can afford us no reason for affinities existing between their respective languages. Klaproth, in his Asiatic Memoirs,* has mentioned numerous examples of these singular resemblances.

If, as the most eminent scientific individuals have supposed, the origin of language depends on the faculty given to man to express his thoughts by means of words and particular characters, this faculty must be indefinite. It would, in fact, appear to be so. This circumstance may permit us to conceive the numerous alterations and modifications which language has undergone; modifications of such a nature that often the words

* Paris 1824, tome i. p. 214.

of one idiom belong to one class, and its grammar to another. Even a new language sometimes results from this, differing from that whence it is derived, and further distinguished from it by the adoption of new grammatical forms altogether peculiar to itself.*

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*On Earthquakes and Extraordinary Movements of the Sea; and on remarkable Lunar Periodicities in Earthquakes, Oscillations of the Sea, and Great Atmospherical Changes.* By RICHARD EDMONDS, Jun., Esq.†

Mr Edmonds, in the former paper, after having noticed the earthquakes and extraordinary agitations of the sea which had previously occurred in Cornwall, described the oscillation of the 5th of July 1843, which he witnessed in Mount's-bay:—

"I arrived at Portleven, on the north-eastern part of the bay, an hour after its commencement, and found the inhabitants, in a state of excitement, observing the sea, which, in the *interior* of the harbour, was moving up and down in a most unaccountable manner, whilst at the mouth it was as smooth as usual. The *inner* basin of the harbour is about 150 yards long, lying N. and S.; the *outer* part is double that length, and lies W.S.W., opening like the mouth of a bell. The agitation extended about 300 yards from the northern shore of the harbour, but not the least disturbance could be seen in the outer part for a hundred yards within the pier-head. The sea rushed inwards from the middle of the outer harbour along the western arm, rising about four feet, and retired by the eastern arm, occupying between ten and fifteen minutes in the circuit. After a pause of eight or ten minutes, it rushed in and out again in the same manner, and so

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* From the *Bibliothèque Universelle de Genève*, No. 106, 1844, pp. 321–356.

† The two papers included in the above title, and from which we have extracted the more interesting portions, were read before the Royal Geographical Society of Cornwall, on the 13th October 1843, and 20th September 1844, and are printed in the Society's Transactions.—ED.

continued, but with gradually decreasing violence, until low-water. A fisherman came in to the harbour in his boat an hour after the commencement of the agitation ; and, from the calmness of the sea at the pier head, had no suspicion that there was any run within the pier, until some persons on shore called to him that it was dangerous to land ; and presently, as he entered the inner basin, one of the influxes carried his boat along with great impetuosity for a hundred yards towards the northern shore, and, retiring, left it dry on the beach."

The phenomenon is likewise described as it occurred in other parts of the bay, after which the writer observes :—

" It is remarkable that, in the recent disturbance in this bay, the agitation of the sea was apparently confined to a short distance from the shore, and at Portleven did not extend even to the pier-head. With a view to account for this, let us suppose that an upward shock takes place at the bottom of the sea, a few leagues from our coast, and that a shoal with one of its sides perpendicular to our shore is thereby made to vibrate. The shock thus communicated to the water will be transmitted with a velocity much greater than that with which sound travels through air, and may cause the water along the shore to rush up the beach in the same manner as a smart blow at one end of a line of marbles causes the marble at the opposite end to fly off, whilst all the others remain stationary. When this body of water falls back to the stationary or less disturbed part of the sea, it will, by the reaction, be driven a second time up the beach ; and thus the fluxes and refluxes, like the motion of a pendulum, may continue for a long time, although originated by a single shock.

Agitations beginning with an *influx* may be thus accounted for ; but they generally commence with an *efflux*, which may be produced by the inclined plane descending from the coast being made to vibrate by a shock upwards : the effect of which would be to drive a considerable body of water seaward.

The irregularity which often attends these oscillations may arise from a subsequent shock interfering with the effects of a preceding one, or from the inequalities of the submarine ground, or from the influence of strong tides.

Another of these extraordinary movements was observed at Penzance on the evening of the 30th of October (1843), the tide being nearly two hours flood, the sea smooth, and the wind blowing strong from the north-east, with rain. Three persons, who had watched the movement from the pier-head for three-quarters of an hour, informed me, that about five o'clock the sea suddenly rushed into the harbour, coming round the pier-head from the south-west, and causing a rise in the water of about five feet; it then rushed back in the same line. This occurred three times successively in about forty minutes. A small vessel which lay aground in the pier was suddenly floated and carried out several yards, directly against the wind, and immediately borne in again by the succeeding influx; after which, having been secured by a hawser, she was left aground on her side, and then again floated, twice within half-an-hour.

On the same evening a similar flux and reflux occurred at Plymouth, the velocity of which was estimated by the master of a vessel then lying there, at eight knots an hour."

Mr Edmonds, in his latter paper, states, "that the oscillation on the 5th of July 1843, which was observed at Penzance pier about half an hour before noon, was not confined to Mount's-bay, but occurred also at Scilly,* Falmouth, Plymouth, Bristol, along the eastern coast of Scotland, and at the Orkneys.

In Falmouth, as Mr Hunt informed me, it was observed between one and two P.M., along the shore between Falmouth quay and Penryn. At Plymouth it was noticed about eleven A.M.; at Bristol about two P.M.; at Dunbar a little after six P.M.; at North Berwick between one and two P.M., and twice afterwards on the same day; at Arbroath at five P.M.; at

* A gentleman of St Mary's, Scilly, informs me that the sea there was at "an unusual height," and "at a short distance from the most southern part of the island, was much agitated, as if some violent force from beneath were lifting the body of water above, while the surrounding water was perfectly calm and smooth."

the Orkneys on the following day at three A.M.; and at the Shetland Isles at ten A.M.

It was observed again, on the 6th and 7th, at Arbroath and other places on the east coast of Scotland, and at the Shetland Isles. On the 8th, at ten A.M., it occurred near Tynemouth, on the coast of Northumberland.

The storm which passed over Britain on the 5th of July 1843, was one "which for severity and extent has been rarely equalled."* In Mount's-bay it commenced with a sudden gale from the south, between two and three P.M., at which time the oscillation of the sea had not subsided. A violent thunder storm was experienced in Gloucester at three P.M.; at Sheffield and Liverpool between five and six P.M.; at York, Dumfries, Edinburgh, Glasgow, and Arbroath, at seven P.M., during the oscillation at the last of these places; at Aberdeen at eight P.M.; at Kinnaird's Head at nine P.M.; and in the same night at the Orkneys, where the agitation of the sea was observed at three o'clock the following morning.

The agitations of the sea on the 5th of July 1843, were very similar to those on the day of the great earthquake of 1755. On each occasion the atmosphere was in a most remarkable condition,—manifested in 1843 by the depressed state of the barometer and violent thunder storms; and in 1755 by the extraordinary height† of the barometer and the unusually calm and fine weather. And as the agitations generally of 1755 and 1843 arrived at different places at times corresponding in some degree to their respective distances from a supposed point,‡ they might all have resulted from local submarine shocks occurring progressively as the highly electrified state of the earth or air spread itself from some centre. That certain sea-ports were passed over without

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* Mr Milne, Edinburgh Royal Society Transactions, vol. xv. p. 622. From this paper I have derived most of the preceding particulars relative to the phenomena of the 5th of July.

† Higher than for three years before in Cornwall.—Borlase's Nat. Hist. of Cornwall, p. 53.

‡ Mr Milne, Jameson's Edinburgh Philosophical Journal, October 1841, pp. 263–269.

experiencing any agitations,*—that others experienced them at periods widely differing from the general rate of progress, —some having taken place in 1755 even half an hour before the great earthquake,—are circumstances, *mutatis mutandis*, common also in thunder storms. Shocks of earthquakes, when they occur in non-volcanic districts, have been considered by many as the effects of electrical discharges from the atmosphere into the earth,† or from the earth into the atmosphere.‡ But whether, during earthquakes, the electricity usually passes from the air into the earth, or from the earth into the air,—or whether it may not sometimes pass between two differently electrified portions of the earth, as lightning often does between two differently electrified portions of the atmosphere, are points which I believe have not yet been ascertained by observation.

On a former occasion§ I explained how an oscillation of the sea might be produced by a simple submarine shock or vibration, without any explosion, or the displacement of any portion of the bed of the sea. These submarine shocks must doubtless often happen without any indication of their occurrence, except the subsequent agitations of the sea. And shocks are often felt at low levels without being perceived at higher elevations, as was the case with the shock on 30th December 1832, which does not appear to have been felt anywhere in Cornwall except Hayle, on a spot only a few feet above the sea. Humboldt,‖ too, states that in Chili, Peru, and Terra Firma, the shocks follow the line of the shore, which is the lowest part of the land, and extend but little inwards; he also says that "sometimes in the same rock the superior strata form invincible obstacles to the propagation of the motion,—thus in the mines of Saxony we have seen workmen hasten up affrightened by oscillations which where not felt at the surface."

But in 1755, on the day of the great earthquake, shocks

* Mr Milne, Edinburgh Royal Society Transactions, vol. xv. p. 615.

† Rees' Cyclopædia.—Earthquake.

‡ Jameson's Edinburgh Philosophical Journal, October 1841, p. 309.

§ Cornwall Geol. Trans., 1843, p. 117.

‖ Personal Narrative, vol. ii. pp. 222, 224.

were actually felt in this island, and the waters of our ponds agitated, at the very time when some of the oscillations of the sea were taking place; which seems almost to establish the fact, that such oscillations are produced by local submarine shocks. I may also mention that in 1788, the sea at Dunbar suddenly receded a foot and a half on the day that a shock was experienced in the Isle of Man.* So also a shock was felt in Perthshire on the 10th of March 1842, and on the following day a disturbance of the sea (the effect, probably, of another shock) took place in the western isles of Scotland: and it has been observed in Perthshire that "shocks seldom occur single,"—but "come very frequently in groups."†

Mr Milne, however, thinks that the oscillations of 1843 may have been produced "partly by the mechanical pressure of the wind in the storm,—blowing first in one direction, and thereafter in an opposite direction,—and partly by the sudden diminution of atmospheric pressure accompanying its progress,"‡ without the intervention of submarine shocks: and he brings forward numerous examples to shew that such agitations are usually preceded or attended by violent storms or other proofs of great atmospheric disturbance: but these examples are quite as favourable to my hypothesis as to his own; for they are equally applicable to earthquakes which have often occurred during storms and hurricanes.§ The first earthquake which Humboldt felt at Cumana was during a severe thunder storm. "At the moment of the strongest electric explosion there were two considerable shocks of an earthquake."‖ And the excessive minima of the barometer which have been observed during oscillations of the sea have been also observed at the times of earthquakes:—thus Humboldt, on a certain occasion, observed

* Jameson's Edinburgh Philosophcal Journal, July 1841, p. 108.

† Ibid., October 1841, p. 286.

‡ In Cornwall and Devon the fall of one inchin the barometer corresponds with the rise of sixteen inches in the level of the sea, and *vice versa.*—Edin. R. S. Trans., vol. xv. pp. 635–637.

§ Jameson's Edinburgh Philosophical Journal, 1841, pp. 294-297.

‖ Personal Narrative, vol. iii. p. 316.

that "the mercury was *precisely* at its *minimum* height at the moment of the third and last shock."* On the 10th of November 1782, when Loch Rannoch was violently agitated, the barometer in Scotland sunk to within one-tenth of the bottom of the scale (probably 27.1 inches.) During the extraordinary depression of the barometer throughout Europe on the 25th of December 1821, a slight shock of an earthquake was felt at Mayence.†

Mr Milne has collected eighteen instances during the last hundred years, to prove the connection between great disturbances of the atmosphere and extraordinary oscillations of the sea. I have endeavoured to prove that the intermediate links of this connection are submarine shocks. I now proceed to shew that such disturbances in the air, earth, and sea, are probably often occasioned by the action of the moon.

I cannot better introduce the subject than by the following passage from Humboldt. "On the 5th November 1799, exactly at the same hour as the preceding day (when the earthquake already noticed took place during a severe thunder-storm) there was (on the 4th) a violent gust of wind attended by thunder and a few drops of rain. No shock was felt. The wind and storm returned for five or six days, at the same hour, almost at the same minute. The inhabitants of Cumana, and of many other places between the tropics, have long ago made the observation, that those atmospherical changes which appear the most accidental, follow, for whole weeks, a certain type with astonishing regularity. The same phenomenon exists in summer under the temperate zone; nor has it escaped the sagacity of astronomers, who often see clouds form in a serene sky, during three or four days together, at the same part of the firmament, take the same direction, and dissolve at the same height,—sometimes before, sometimes after, the passage of a star over the meridian; consequently within a few minutes of the same point of apparent time. M. Arago and I paid great attention to

* Personal Narrative, vol. iii. p. 319.

† Jameson's Edinburgh Phil. Journal, Oct. 1841, pp. 295, 296.

this phenomenon in the years 1809 and 1810, at the observatory of Paris."

Here is an example of *solar* periodicity in the recurrence of storms and great atmospherical changes, coincident with which, on one occasion, was an earthquake. The following are examples of *lunar* periodicities in the recurrence of storms and great atmospherical changes, coincident with which, on many occasions, were earthquakes, or extraordinary oscillations of the sea.

The first series of lunar periodicity begins with the 23d of October 1841, and consists of seven remarkable days, connected with one another by periods of four lunations each. The 1st, 2d, 5th, and 6th, of these days were remarkable for earthquakes in Scotland, Cornwall, and Guadaloupe; the 3d, for being the hottest day of the hottest June since 1826; the 4th, for the extraordinary maximum of the barometer; and the 7th, for an eruption of Vesuvius.

The next series of periods, of four lunations each, begins with the 11th of November 1842, and consists of six days; on the 1st of which was an unusual depression of the barometer; on the 2d, an earthquake at Manchester; on the 3d and 4th, oscillations of the sea; on the 5th and 6th, most unusual disturbances of the atmosphere.*

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* Two other such remarkable days (says Mr Edmonds, in a manuscript note) are to be added to this series. The four lunations immediately succeeding the great thunder-storm of 23d June 1844, terminated on the 18th of October, when the town of Buffalo on Lake Erie was almost destroyed by a hurricane. The maximum of the *thermometer* on that day at Chiswick was only 56°, less by 3° than it had been for several months before; and the *barometer* there on the 16th, was at a minimum of 28.940, lower than it had been since the 26th of February in that year.

The next period of four lunations expired on the 14th of February in the present year, when the state of the atmosphere was almost precisely the same at Penzance as on the 26th day of February 1844, three times four lunations previously. On each occasion, the weather was very squally with heavy showers of rain or hail, and the barometer for a day or two before remarkably ranging. On the 12th of February this year, the barometer at Penzance had risen rapidly to a maximum of 30.44, higher, I believe, than it had been for several months before; and the thermometer at Blackheath on the same day was 33½° below the freezing

Each of the above thirteen days was either that of the moon's first quarter, or the day before or after it, except the 9th of October 1842, which was the second day before it."

Here follow four tables of lunar periodicities, and also an account of some earthquakes in Cornwall. The paper concludes with the following paragraph:—"It has been seen that earthquakes, oscillations of the sea, great atmospherical changes, and electrical phenomena, are closely connected with each other: and I have endeavoured to shew that they may all result principally from the action of the moon. In support of this hypothesis, I have noticed two oscillations of the sea at and after the great earthquake of 1755, and two others at and after the great earthquake of 1761, the interval in each case being four lunations. I have also, in Table I., noticed eleven other such intervals,—six following each other in one series, and five in another. Each of the thirteen days forming these two series was remarkable for an earthquake, oscillation of the sea, or some very unusual state of the atmosphere, except on one occasion, when, however, an eruption of Vesuvius took place. In the same Table are many other similarly remarkable days, forming series of periods of single lunations, or of half or quarter lunations. All the remarkable days in Tables I. and IV., as well as those in the last two pages, connected with the earthquakes in Cornwall, occurred at or near the moon's quarters, and generally at or near her first quarters. But the remarkable days in Tables II. and III. did not happen near any of the four quarters, yet are, nevertheless, connected with each other by single lunations; so that the phenomena which occurred on these days were apparently as much influenced by the action of the moon as those which happened at or near her quarters."

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point, and when placed on snow 44° below that point. This great maximum of the barometer, and this most extraordinary minimum of the thermometer, occurred on the morning of the 12th, which is almost exactly four lunations after the great minimum of the barometer at Chiswick, on the 16th of October last.—PENZANCE, *March* 1. 1845.

## *On the Constitution of the Ichthyolites of Stromness.* By ANDREW FLEMING, A.M., M.D. Communicated by the Author.

In the month of August 1840, I enjoyed an opportunity, through the kindness of Robert Stevenson, Esq., Civil-Engineer, of visiting Stromness, in Orkney, and the quarries which have been opened in the Bituminous Schists of its neighbourhood. These schists have acquired considerable notoriety from the abundance of organic remains, chiefly belonging to the class of fishes, distributed throughout their beds.

The first attempt to determine the specific differences of these organisms was made by Messrs Sedgwick and Murchison, in their important paper, " On the Structure and Relations of the Deposits contained between the Primary Rocks, and the Oolitic Series in the North of Scotland," inserted in the *Transactions of the Geological Society of London*, second series, vol. iii., Part I., p. 125. Subsequently, and aided by the industry of several collectors, M. Agassiz has been able, satisfactorily, to determine the characters of a considerable number of species, several of which he has figured in his invaluable work on Fossil Fishes. My attention having been chiefly directed to the mineral state of the organisms, I shall confine the following remarks to this bearing of the subject.

The schists themselves, which include these organic remains, may be considered as thin slaty sandstones, in which the strata vary from a thickness less than a line to upwards of a foot. Even in the thickest strata, the facility of splitting into subordinate slabs, indicates the predominance of the slaty structure. In the portions where the strata are thickest, the rock is coarser, or more arenaceous, than in the thinner slaty strata, where the constituent sand is finer, and the clay more abundant. The structural character of the whole formation gives unequivocal indications of its deposition having taken place in comparatively still water, the coarser and finer varieties marking the limits of the disturbing causes.

The organic remains chiefly occupy the upper surfaces of the different layers. This circumstance would seem to indicate that the cause of the death of the fish which furnished these organisms, coexisted with, or may have depended upon, the cause of the succession of the deposits; yet these changes or alternations must have occurred through a very long period, and exercised their influence over an extended district.

These Ichthyolites when observed scattered over the surface of a stratum, exhibit the appearance of detached portions of coal. In many cases no trace of the fins can be perceived, even the individuality of their scales and bones has disappeared, and an imperfect outline is all that can lead the mind to refer the patches in question to an organic origin. Attracted by this singular feature of these remains, so imperfectly preserved as to form and structure, I was induced to examine more narrowly their actual state, for the purpose of ascertaining if any peculiarity in their composition or character could furnish any illustration. In making the attempt, however, considerable difficulty was experienced in obtaining portions of these altered organisms, sufficiently detached from the surrounding matrix. In the greater number of specimens, there is little difficulty in perceiving the existence of the matter of the surrounding stratum, more or less incorporated with the organisms, a circumstance which must influence, to some extent, the analytical results.

In the paper by Messrs Sedgwick and Murchison, the authors state, page 141,—" By chemical analysis, which was kindly undertaken by Mr Herschel, it appears, as might be expected, that the ichthyolites differ from each other considerably in composition. One of them gave the following result:—

| | |
|---|---|
| " Silex, | 68.1 |
| Alumine, | 7.2 |
| Protoxide of Iron, | 10.5 |
| Carbonate of Lime and Magnesia, | 14.2 |
| | 100.0 |

" The proportion of magnesia is very small. The blue matter of the fish is phosphate of iron, and the whole stone contains phosphoric acid, in the proportion of $\frac{1}{4}$ per cent., and a little carbonaceous and bituminous matter. The iron being a protoxide, the fresh fracture is black; but, by absorbing oxygen, it becomes yellow, and the phosphate passes into a perphosphate, becoming blue. Thus the fish are visibly marked with blue streaks on a yellow ground."

The small quantity of "carbonaceous and bituminous matter" referred to in the preceding analysis, seemed to indicate that the organism, though probably of the same species (for those which I principally examined, likewise appeared referrible to *Dipterus*, although the *Cocosteus* was also among the number of the most completely mineralized remains), had been subjected to peculiar influences. I could not, indeed, avoid suspecting that, even in the most thoroughly altered organisms of Stromness, the original animal matter had not been removed to so great an extent. Under this impression, the most completely mineralized portions were selected as the subjects of experiment, and they exhibited the following external characters:—

Colour, jet black, with a shining resinous lustre; in some cases inclining to vitreous; fracture more or less conchoidal; hardness = 3 of Mohs's scale, sp. gr. = **1.517**; the powder is of a brownish-black tint.

The general appearance of the mass bears a closer resemblance to cherry-coal than to any of the other varieties of that important mineral, and may, with some degree of propriety, be denominated *animal cherrycoal*, in contradistinction to that which occurs in beds in the coal formation, and appears to be of vegetable origin.

When a small piece of the coal was heated in the open air, on platinum foil, it took fire, and burnt with a white flame, leaving a considerable residue of a light-grey ash. The coal in powder, when heated in a glass tube over a spirit-lamp, evolved copious white fumes; and a yellow oil of a strongly bituminous odour was sublimed, which concreted on cooling. Litmus paper, moistened, and held in the tube, indicated an acid reaction. Being desirous to ascertain if any nitrogenized matter was contained in the coal, another portion of the powder was heated with a strong solution of potash, but no ammonia could, by the ordinary means, be detected.

Having thus ascertained the presence of a large quantity of bituminous matter in the coal, a portion of the surrounding rock was subjected to similar treatment, and, with like results, the bituminous matter, in the specimens examined, amounting to 18 per cent.

After ignition, the remaining ash dissolved with effervescence in diluted hydrochloric acid, with the exception of a portion of siliceous matter. Ammonia added to the acid solution, caused a copious gelatinous precipitate, presenting all the characters of phosphate of lime. Oxide of iron was present in minute quantity, probably in combination with sulphur, as traces of sulphuric acid were detected, when the ash was boiled with nitromuriatic acid. Chlorine could not be found. Carbonate of lime occurred in considerable quantity, and magnesia was also detected. Soda and potash were sought for, but without success.

A careful examination was instituted, in order, if possible, to detect the presence of fluorine, which is so constantly met with in fossil organic remains. Indeed, until of late, the researches of Rees, Girardin, and Pressier of Rouen, and others, seemed to indicate that the occurrence of fluorine was characteristic of fossils, and that it was not to be found at all as a normal ingredient of recent bones, as stated by Berzelius. More recently, however, the results of the analysis of that celebrated Swedish chemist have been verified by the investigations of Dr Daubeny and Mr Middleton.

On submitting a portion of the powdered coal to the action of a gentle heat, along with sulphuric acid, in a platinum crucible, covered with a plate of glass, coated on its lower surface with a thin layer of wax, in which lines were drawn with a pointed piece of wood, and kept cool by damp cloths, no traces of fluorine could be detected, the glass being left quite uncorroded. Having failed in this way, the powder was then ignited, as recommended by Dr Daubeny, in his most valuable paper in the Philosophical Magazine, vol. xxv. No. 164; the ash dissolved in muriatic acid, the phosphates, (along with the fluates, if any were present), thrown down by ammonia, and the precipitate, after being thoroughly washed and dried, submitted as before to the action of sulphuric acid, in a platinum crucible, covered with a plate of glass prepared in the manner above described. No heat was applied, the temperature being raised sufficiently high by the chemical action, and the glass plate was left on the crucible for six hours. On removing it, at the end of that period, distinct marks of the corrosion of the glass were observed, leaving no doubts as to the presence of fluorine in the substance under examination. I may here state, that, in this way, I have detected fluorine, with the greatest facility, in fossil bones from the rock of Gibraltar, in sharks' teeth from the London clay, and in a portion of a fossil bone from Tilgate forest. In two specimens of recent human bones, the one a femur, and the other an os ilium, fluorine was detected in the phosphates obtained in the way before mentioned.

The chief constituents, therefore, of these crusts of coaly matter are, phosphate of lime, carbonate of lime, and bituminous matter.

A qualitative analysis having thus been executed, it was thought desirable that the proportion of the different constituents should be ascertained; and for this purpose a carefully selected specimen was pounded, which, after drying over a water bath, weighed 9.2 grs. This was ignited for some time in a platinum crucible, and was found to have lost 4.32 grs. of bituminous matter. The ash was then treated with weak muriatic acid, which dissolved all, except a portion of silica (sand), which, when separated by filtration, washed and ignited, weighed 1.206. The phosphate of lime, precipitated by ammonia from the acid solution, weighed 1.998 grs. The lime was thrown down as oxalate, and, after careful ignition in the usual way, amounted to 1.208 grs. of carbonate of lime. To the remaining liquid, when reduced by concentration to a small bulk, phosphate of ammonia was added, and the precipitated magnesia, after ignition, weighed .594 grs. as phosphate, which corresponds to .450 grs. of carbonate of magnesia.

We have thus in a hundred parts :—

| | |
|---|---|
| Bituminous matter, | 46.956 |
| Siliceous matter (sand), with a trace of sulphuret of iron, | 13.108 |
| Phosphate of lime, with traces of fluate of lime, | 21.717 |
| Carbonate of lime, | 13.130 |
| Carbonate of magnesia, | 4.891 |
| Loss, | .198 |
| | 100. |

It is obvious, from the above analysis, that the greater portion of the original constituents of the organism had remained in connection with it; while it is equally evident that numerous transpositions have subsequently taken place among the ingredients of the mass, by which the limits of the separate parts have been obliterated. The same forces, however, which have annihilated all distinction between the surfaces of the scales, the viscera, and the bones, and even modified their constitutent parts, do not appear to have exerted any influence on the surrounding matrix; for the line of demarcation between the surface of the organism and the rock, is usually well marked in the cross fracture, although the adhesion is generally strong. There is, no doubt, a considerable amount of bituminous matter, forming an obvious ingredient in these schists; yet it would be rash to infer that it derived its origin directly either from the maceration of the ichthyolites, or their vaporized contents. The state of the beds at the period of their formation, and, perhaps, for a long time afterwards, appears to have been favourable for the mutual action of the different parts of the organism disposed for change, but not, by any means, for the abstraction or dispersion of the greater part of the more changeable ingredients. Instead, therefore, of the resultant consisting entirely of the earthy ingredients of the organism, as probably would have been the case had maceration prevailed to any great extent, or of these conjoined with the carbon, if igneous influence had been exerted, we have presented in the mass, not merely the original earthy salts, but the animal matter in a bituminous form, and the whole constituting a singularly homogeneous coal. But the subject is too obscure to warrant farther speculation.

Aberdeen, *March* 3. 1845.

*On the Determination of Heights by the Boiling Point of Water.* By JAMES D. FORBES, Esq., F.R.S., Sec. R.S. Ed., Corresponding Member of the Institute of France, and Professor of Natural Philosophy in the University of Edinburgh. With Two Plates.*

It was observed by Fahrenheit, that the boiling point of water depends on the height of the barometer, the pressure of the air hindering the conversion of water into steam by a resistance which must be overcome by an increase of heat. Deluc† and De Saussure‡ contrived apparatuses for making the observation in the open air, and at great heights, and appear to have contemplated the substitution of the thermometer for the barometer upon occasion. They, as well as Dr Horsley,§ Sir George Schuckburgh,|| and Mr Cavendish,¶ seem to have regarded the question as one which concerned the fixity of the point used in graduating thermometers, and its requisite corrections, rather than as applicable to barometric purposes generally. Several of them have given empirical tables for correcting the boiling point within the limits of the usual barometric variations, but one only, M. Deluc, has given a formula for connecting the indications of the barometer with the boiling point of water throughout the range which the barometer has been observed to vary on the earth's surface. This is the *only* formula immediately deduced from direct observations of the boiling point; and having been verified by De Saussure at a height greater than the limits for which it was constructed, and having elsewhere been declared by him to be so accurate as to supersede farther experiment on the subject, it might have been expected to be generally adopted, or at least known. We find, however, that though it has been occasionally copied into the formal articles of Encyclopædias, as a correction in

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* From Transactions of the Royal Society of Edinburgh, vol. xv., part iii.

† Modifications de l'Atmosphere, tome ii. ‡ Voyages, secs. 1275, 2011.

§ Phil. Trans. vol. lxiv. || Ibid., vol. lxix.

¶ Ibid., vol. lxvii. p. 816.

graduating thermometers, observers who have used the boiling point for the determination of heights, have always preferred the ordinary tables which give the *elasticity of steam* in terms of its temperature, determined from experiments of quite a different kind from the boiling of water.

Dr Dalton, indeed, has given a table from observation under the air-pump of the boiling point ;* and that table shews a manifest deviation from the elasticities and temperatures of vapour determined by himself, and now generally accepted as the most accurate below 212°. In boiling, the temperature requires to be *higher*, under a given pressure, than the temperature of steam which has the same tension. Thus, comparing Dalton's two tables—

| Temperature. | Pressure under which Water boils. | Tension of Vapour. | Difference. |
|---|---|---|---|
| 212 | 30·0 | 30·0 | 0·00 |
| 200 | 22·8 | 23·64 | + 0·84 |
| 190 | 18·6 | 19·00 | + 0·40 |
| 180 | 15·2 | 15·15 | — 0·05 |

it is exactly at the part of the scale where the difference is most practically important that it is most conspicuous, namely, between 190° and 212°. The method of observation used by Dr Dalton, does not admit of any great accuracy in observing the boiling points, and the numbers he has given are evidently only approximate. Still, from observations made under *naturally* low pressures (the only ones worthy of much confidence in this case), I have found the same nonconformity of the theoretical tension of steam and the atmospheric pressure.

In 1817, Archdeacon Wollaston described a thermometer destined particularly for the purpose of determining heights.†

* Meteorological Essays, 2d edit. p. 127.

† Phil. Trans. vol. cxx. p. 183.

But he seems not to have been aware of the progress which the subject had already made in the hands of Deluc and De Saussure. The latter used a thermometer indicating $\frac{1}{1000}$ of a degree of Reaumur. Wollaston's instrument, though a neat laboratory one, has almost every fault which a travelling instrument can have, excepting only its small dimensions, to which everything is sacrificed. It is apt to break, and still more apt to be deranged, the contrivance for extending the scale being excessively incommodious; finally, it is impossible to use it in windy weather, and its indications are in an arbitrary scale. Nor was the method of calculating the heights more happy. At first he contented himself with assuming the progression of height to be proportional to the fall of the boiling point, near 212°;* but he afterwards† extended his calculation from Dr Ure's table of tensions of vapour, expressly stating, that he had used the proportionality of 1° of Fahrenheit to 0·589 inches of the barometer, or 530 feet, merely as an approximation for small heights.

A reference in Boué's *Guide du Geologue Voyageur*, directed me to a paper by Mr Prinsep, in the Journal of the Asiatic Society of Bengal for April 1833. I hoped there to have found a table of boiling temperatures observed at great heights in India. But it only contains a modification of Tredgold's Formula of the Elasticities of Steam adapted to the measurement of heights by the thermometer, and no original observations.

During a late journey in Switzerland (in 1842), I made several observations on the boiling point of water at great heights. Having long since abandoned Wollaston's thermometrical barometer, as practically useless, I was led to resume the method, in consequence of a very ingenious and compact apparatus for chemical or culinary purposes having been shewn to me the preceding winter, by Mr Stevenson, instrument maker, under the name of a Russian furnace, and which was, I believe, introduced into the country from Russia by Dr Samuel Brown. It consists of a very thin cylindrical

* Phil., Trans. p. 192. † Ibid., vol. cx. p. 295.

Fig. 1.

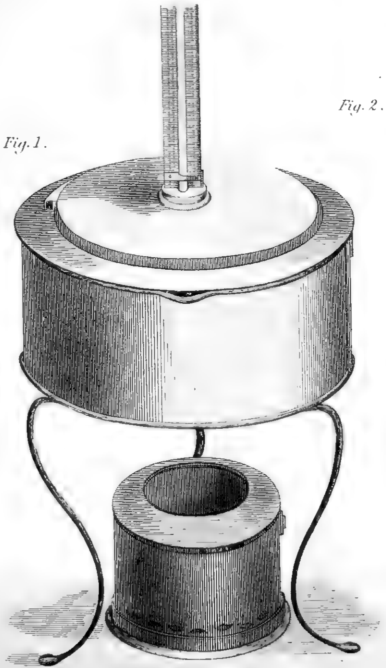
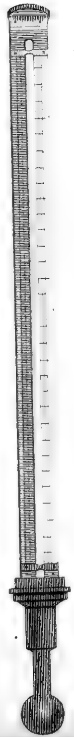


Fig. 2.



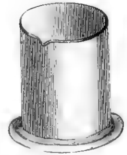


Fig. 5.

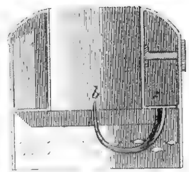



Fig. 4.

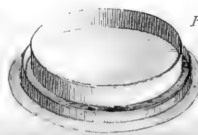


Fig. 3.

Fig. 8.

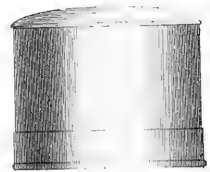


Fig. 7.

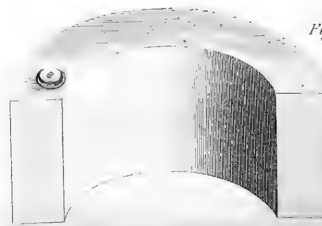


Fig. 6.

copper-pan for holding water, Fig. 1, plate VII., with three moveable wire-legs. The bottom is flat, so that the flame of a spirit-lamp plays fully upon it. This lamp or furnace consists of two parts, a flat dish or saucer, Fig. 3, containing a little alcohol, which is set on fire, and then covered by the double dome-shaped vessel, Fig. 4, also of thin copper, with an air-tight plug *a*, by which a certain quantity of spirit of wine is introduced, and the lower part communicating with a bent tube or nozzle *b*, by which alcohol in ebullition is violently projected by the pressure of its own vapour, when heated by the flame in the saucer. The jet of burning spirit thus thrown up like a volcanic explosion through the aperture of the dome, has such force as to resist the blast of a hurricane, and plays right upon the bottom of the cylindric boiler or pan. Two fluid ounces of spirit of wine will thus boil above a pint of water in still air in four minutes; and I have frequently first melted snow, and then brought it to boil to the amount of a pint, with little more alcohol, but, of course, in a longer time.

The furnace and boiling apparatus, together with a reservoir of alcohol, packs into the copper-pan, and that into a cylindrical leather case 4 inches high, and 6 in diameter. The thermometer, Fig. 2, is carried separately. It is 15 inches long and the degrees measure $\frac{3}{10}$ inch, which is quite sufficient in practice. Parallax is avoided, by having the scale repeated on each side of the tube on two pieces of copper not in the same plane.

Fig. 5 represents the spirit measure, Fig. 6 a reservoir for spirits, Fig. 7 a water measure or cup, Fig. 8 a handle which opens all the plugs, and serves also for lifting the lamp and pan when heated.

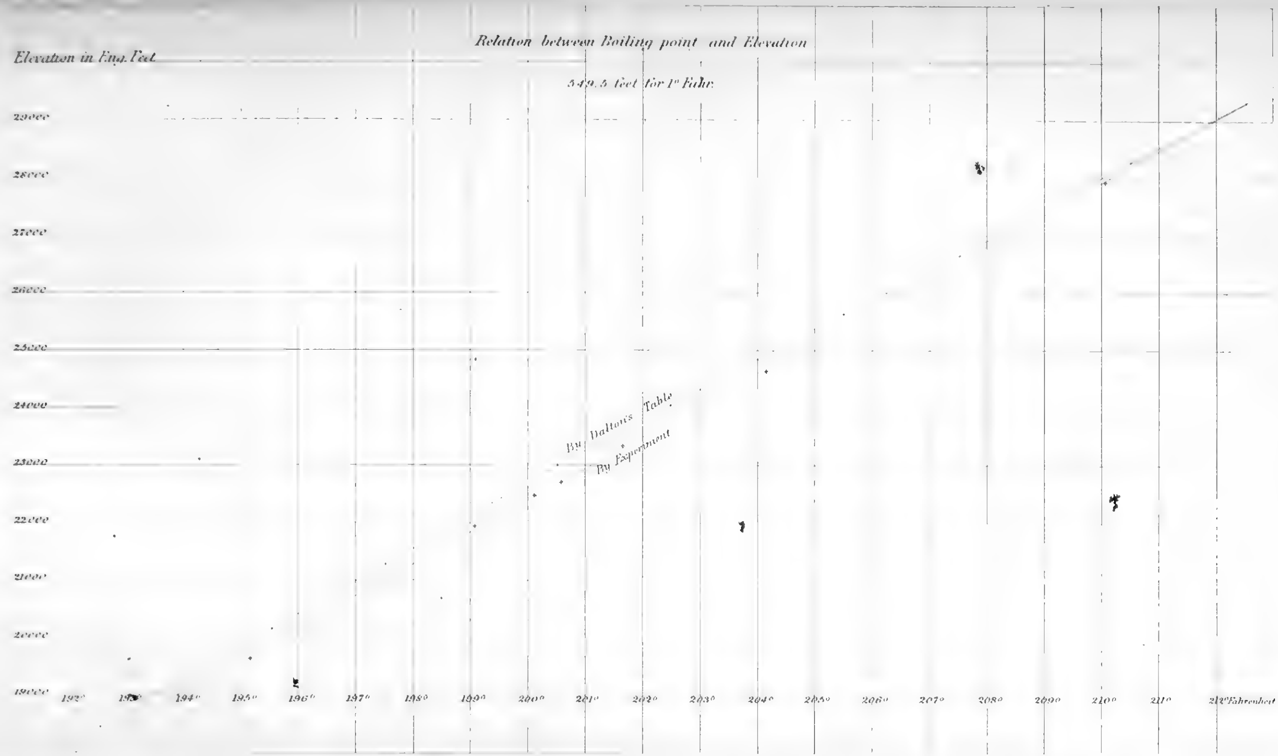
I immediately saw the value of the apparatus for determining the boiling point, and directed Mr Adie to adapt a thermometer to it, graduated from 185° to 214° of Fahrenheit's scale, divided to 10ths of a degree, the divisions admitting an estimation to 100ths. I am well assured, however, that in no circumstances, even the most favourable, is the observation true to less than $\frac{1}{20}$ of a degree. But this quantity corresponds to only 25 feet of elevation. and is therefore, accurate enough for most purposes. The minute subdivisions of Deluc's, De Saussure's, and Wollaston's instruments, are quite unavailing, as I have found by using the instrument of the latter with every precaution.

My barometer having been broken in the course of my journeys, I was glad to have recourse to the boiling point as a means of estimating (only roughly as I expected) some remarkable elevations not before measured. In several cases I had the advantage of comparing my thermometric boiling point with a barometer, and lately I resolved to discuss these observations empirically, without reference to any theory or tables, or previous observations.

I first projected the barometric pressures in terms of the corresponding thermometric observations. These were the following:—

| Date. | Place. | Boiling Point. | Barometer reduced to English inches, and to 32° |
|---|---|---|---|
| 1842. | | | |
| August 4, | Tacul | 200°·10 | 23·154 |
| ... 6, 7½ A.M. | Tacul | 200°·6 | 23·353 |
| ... 13, 8 A.M. | St Bernard | 199°·08 | 22·674 |
| ... 16, 8 P.M. | Prarayon | 201°·58 | 23·893 |
| ... 17, 9 A.M. | Col Collon | 195°·15 | 20·77 |
| ... 29, 11 A.M. | Gressony | 204°·20 | 25·143 |
| September 5, 7 P.M. | Martigny | 210°·12 | 28·489 |

I obtained a curve, which resembled a flattish logarithmic, the barometric numbers appearing to be in geometrical progression, whilst the temperatures varied uniformly. This recalled to me an idea which I had entertained some years ago, that the boiling point would be found to vary simply with the height, to which I was led from knowing Deluc's formula; but the idea had since escaped me, or been postponed to other occupations. Now, however, I projected the simple elevations of the points of observation (derived from the barometric pressures from the common tables for computing heights uncorrected for the temperature), in terms of the boiling points, as in Plate VIII., and I was gratified to find, that a straight line passed almost quite through the whole of them, *shewing that the temperature of the boiling*




J. O. Mitchell, Sc.

*point varies in a simple arithmetical proportion with the height,* namely, 549·5 feet for every degree of Fahrenheit; so that the calculation of height becomes one of simple arithmetic, without the use of logarithms, or of any table whatsoever.

When I had ascertained this fact, I looked back to Deluc's formula, and found my conjecture entirely confirmed. Its form is

$$a \log p + C = h,$$

$h$ being the height of a thermometer plunged in boiling water under a pressure $p$; $a$ and C constants. But the first side of this equation is the very form which gives elevations in terms of the barometric pressure. Hence the boiling temperature varies as the height. In other words, the pressure varies in a geometrical ratio, when the temperature of boiling water varies uniformly; but the pressure varies geometrically when the heights above the sea vary uniformly; hence the heights vary uniformly with the boiling temperatures.

It is very singular that so elegant and simple a result should have escaped every writer on the subject (so far as I know); even Deluc himself, who proposed the logarithmic law, and Wollaston, who unawares adopted the true law as a first approximation, and then took a wrong one.*

It is not to be supposed that the coincidence appears close, because the observations are not accurate enough to test it. Of seven observations between 195° and 210°, no one differs 80 feet of elevation from the mean line,—a

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* He says,—" Having occasion last summer of visiting Caernarvon, which would afford an opportunity of trying the instrument on the known height of Snowdon, and *being aware that in 3550 feet the variations of the boiling temperature were not to be considered uniform, as they might in small elevations,* on which alone I had before tried the experiment, I wished to provide myself previously with a table for making the necessary correction, and from Dr Ure's paper was supplied with data for calculation."—Phil. Trans. 1820, p. 295. The table given from Ure's law of tensions gives a gradually increasing number of feet, corresponding to every degree that the thermometer falls.

Since this paper was first printed, I find that Sir John Leslie has remarked the Arithmetical Law in his article, " Barometrical Measurements," in the Encyclopædia Britannica.

quantity corresponding to $\frac{3}{20}$ of a degree, an amount which cannot be considered as being beyond the possible errors of observations; and the small errors $\pm$ are well distributed throughout. On the contrary, when the tensions of vapour, from Dalton's Table, are projected beside them, as in the dotted curve of the figure, not only do they lie wholly above the line, but these tensions cannot be represented (when treated as representing barometric heights) as a straight line at all. They have a manifest curvature convex upwards. In short, as is well known, the tensions of steam cannot be represented by a geometrical progression in terms of the temperature; but when water boils in the free air, *the pressures are then exactly in geometrical progression.*

I never saw any ground for believing that the two laws must be the same. Our theory of vapours is not sufficiently perfect to admit of our drawing any such conclusion. Indeed I cannot help thinking that the influence of the pressure of the *air* upon the elasticity of *nascent steam*, is a fact not easily reconciled with Dalton's theory of the pressure of elastic fluids. It is one thing to ascertain the elasticity of steam of maximum density, which water of a given temperature can yield, and it is another to ascertain under what pressure of air water will yield steam of a given temperature. In practice I have observed the temperature of the boiling water, and not of the steam. The construction of the apparatus required this. But by moving the furnace to a side, so as to prevent the flame from disengaging the steam immediately under the thermometer, I have found the indications as steady as I believe can be got in any other way. The mass of the water and also of the thermometer favours this.

But I had a farther test of the exactness of the arithmetical progression above established, and that as severe as could be proposed. It was to compare De Saussure's observations on Mont Blanc, and the pressure there observed, with the result of my formula. But first, it was necessary to correct the zero point of his instrument, and to render it comparable to mine. De Saussure's boiling point, 80° of Reaumur, or 212° of Fahrenheit, was adjusted at 27 French inches, or 28.777 English.

At that pressure my thermometer (Adie) shews 210.58 F. De Saussure's stood, therefore, 1°.42 F. higher than mine. Now, on the top of Mont Blanc, the barometer stood at 17.133 English inches.

| | | |
|---|---|---|
| The boiling temperature by De Saussure was, | | 187°.234 Fahr. |
| Reduced to Adie, | | 185°.814 — |
| But the boiling point of Adie's thermometer, with the barometer at 30 inches, is | | 212°.62 |
| Subtract, | | 185°.81 |
| At Mont Blanc, below boiling point at 30 inches, | | 26°.71 |
| By Galbraith's Tables, | 30.000 inches | = 29228 feet |
| | 17.133 — | = 14593 |
| Height uncorrected for temperature, | | 14635 |

Now, by the proportion found empirically above,

Height uncorrected for temperature $= 26.71 \times 549.5 =$ 14677 feet,—a coincidence really surprising.

I have already stated, that De Saussure found Deluc's formula to conform accurately to his observation on Mont Blanc. It may therefore be concluded, that Deluc's formula and mine agree closely. In fact, if we take its conversion into English measures, as given by Dr Horsley,*

$$\frac{99}{8990000} \log z - 92.804,$$

which gives the boiling point, in degrees of Fahrenheit, *reckoned from* 32°, $z$ being the height of the barometer in *tenths of an English inch*, we find that this gives

544.7 English feet of ascent for 1° Fahr.

Practically, I consider it sufficient to find the difference of height, in feet, between two stations, to multiply the difference of the boiling points by 550, and then correct as in barometric observations for the temperature of the air.

If the barometer at one station is to be compared with the boiling point at another, the simplest way is to find what elevation the barometer expresses, compared to an imaginary

* Phil. Trans., vol. lxiv., p. 226.

station, where the barometer stands at 30 inches, the boiling point at 212°. Then the height of the station, where the thermometer has been observed, above the imaginary station, is found by the preceding rule.

For example: The corrected boiling point on the *Col d' Erin* between Evolena and Zermatt, in the Vallais, on the 19th August 1842, was 191°.93, the external thermometer 34°., the barometer (English) at Geneva was 28.73, and the temperature 72, required the height.

| | | |
|---|---|---|
| Then, by Galbraith's table, for 30 inches, | . | 29228 feet |
| 28,73 — | . | 28098 |
| Difference, . . . | | 1130 |

Consequently, supposing the *atmospheric temperature* 32°, the barometer stood at 30 inches, at a level 1130 feet below Geneva. The boiling point at the upper station was 20°.07 below 212°. The Col d'Erin was, therefore, 20.07 × 549.5 = 11028 feet above that imaginary station, or 9898 feet above Geneva. Corrected for temperature, this gives 10377; and Geneva being 1343 feet above the sea, the height of the Col d'Erin is 11720 feet.

This is purposely given as a complex case; but let us suppose that the boiling point, at the level of the sea, is assumed to be 212°, then the approximate height of the Col d'Erin is 549.5 × 20°.07 = 11028 feet; and supposing the mean temperature of the column 54°, the height will be 11586 feet above the sea.

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## *Remarks on the Cirripedia, with Descriptions of several Species found adhering to Vessels from Ichaboe, on the West Coast of Southern Africa.* By WILLIAM MACGILLIVRAY, A.M., LL.D., Professor of Natural History in Marischal College and University, Aberdeen. (Communicated by the Author.)

A considerable degree of interest has always been attached to the Cirripedal animals, not only on account of the widely extended, though preposterous belief of their being the eggs of geese, but also because of their peculiar structure and habits, the rapidity with which they grow, and especially the metamorphoses which they have been found, first by Mr Thompson, and subsequently by Burmeister, Wagner, and Audouin, to undergo in their earlier stages. In the part of Scotland in which I am at present located, the pedunculate species, of which only one, Scalpellum vulgare, appears to be truly indigenous, are of so rare occurrence, that the recent arrival of the multitudes which crowded the uncoppered submersed portions of the hulls of some vessels with guano from Ichaboe, could not fail to afford great pleasure. These animals, now clearly shewn to belong to the great type of the Entomozoa, and to approximate to certain Crustacea, have not, I think, been well described by any of the excellent naturalists who have written upon them in our country; and therefore I have thought, that a full description of those so fortunately brought under notice may be not without use, if not to the present race of compilers, at least to their successors, and to those younger zoologists who may not have equal opportunities of observing them.

The six vessels on which the cirripedia to be described were found, had been absent from seven to nine months; in which time they had traversed the Atlantic Ocean, by the Azores and Brazil, to near the Cape of Good Hope; and, after remaining several weeks at Ichaboe, a small islet, not far from Cabo Negro, on the west coast of Southern Africa, and in lat. 15° 26′ S., had returned by St Helena and the Cape Verd Islands. None of the species are peculiar to Ichaboe, where, on the contrary, they seemed less healthy than they had previously been. They began to be observable at about the end of the first fortnight of the voyage out, and became sickly on the homeward route, to the north of the Azores. When the vessels arrived at Aberdeen, they were all dead, although on two they were perfectly fresh and plump. It is probable, however, that in summer they would have been alive; and that their death was caused by the severe frost which then prevailed, as they were mostly liable to occasional emersion.

It may be unnecessary to remind the expert zoologist, but it is proper to intimate to those readers who have not made this class of animals a special study, that the cirripedia, all of which that I have examined, agree with each other more closely in their structure than the members of any other class of the great type to which they belong, are distinguished by the following characters.

Their body is soft, enveloped in a membranaceous integument, incurved, and placed with the back beneath, and the hind part above. It is enclosed in a thin mantle, and a membranous or coriaceous tegmen, in which are formed several calcareous plates, varying in the different genera, and wanting only in one; subovate at its lower or anterior part; very convex on the back; attenuated and subarticulated at the upper or posterior end. It has attached to it, on either side, six limbs, each terminated by two long, slender, horny, many-jointed cirri. The first pair of these limbs, placed not far from the mouth, represent the thoracic feet of the crustacea; the rest may be considered as analogous to their abdominal false feet. The intestinal canal has two apertures; the oral with a prominent arched lip, a pair of palpi, and three pairs of maxillary appendages, expanded and ciliate at the end; the anal subterminal and dorsal; the œsophagus is short; the stomach large, with bursiform appendages; the intestine wide. They have a complete double circulation, with white blood, and respire by branchiæ, varying in form, but usually placed at the base of the lower cirri. Their nervous system is composed of a double series of ganglia, as in the crustacea. They have no distinct head, eyes, or tentacula. The individuals are bisexual; the ova are fecundated in their passage, and escape by a long, very slender, contractile tube, placed at the extremity of the body, between the last two pairs of cirri.

In some, the envelope or tegmen is composed of several calcareous pieces, disposed in two lateral plates, with a medial or dorsal piece, or of a membranous or coriaceous epidermic covering, in which are developed small or rudimentary calcareous pieces, together with a flexible, and somewhat contractile peduncle. In others it is membranous, with four or two lateral pieces at the top, and inclosed in a calcareous conical tube, composed of six or fewer contiguous or united pieces, open above, and closed below by a membranous lamina or a calcareous plate. The mantle in all is open above, in the form of a slit, by which the cirri may be protruded.

These cirri are constantly in rapid motion, and are the means of impelling the water into the cavity between the body and the mantle, both for respiration, and as containing the animal matters on which they feed. The body is affixed to the tegmen or shell by a transverse muscle, placed at its lower part, and by muscular fasciculi, which spread over the mass of the viscera.

The young, at first free, locomotive, and resembling the larvæ of certain crustacea, undergo various changes, both before and after they become fixed. But, as in these notes, I intend to confine myself exclusively to what I have personally examined, I am unable at present to say anything on this subject.

These animals, all of which inhabit the sea, are naturally arranged into two orders, *Pedunculata* and *Sessilia*, each of which contains a single family.

The Cirripedia Pedunculata, commonly named Barnacles, have the body supported by a tubular, fleshy, somewhat contractile and extensile peduncle, of which the base is attached to some firm substance. To this series belong the genera *Lepas*, *Cineras* and *Otion*, which; with others, form the family of the *Lepadina*.

In it the animal is oval or oblong, generally compressed, very convex on the back, narrowed behind, suspended in a testaceous or membranous envelope, to which it adheres by a transverse muscle, situated near the lower edge of the aperture; the mantle open at the upper part only, and with the cuticle prolonged at the other end to form a fleshy peduncle; the branchiæ simple, tapering, at the base of the lower cirri.

## Lepas. Barnacle.

Animal subovate, compressed, gibboso-convex on the back, incurvate, with the mouth very prominent, and furnished with a pair of external, partially adnate palpi, and three pairs of incurvate, compressed, maxillary appendages, of which the thin terminal lamina is ciliated with spines or bristles; the body narrowed behind, with twelve pairs of pedicellate, long, slender, incurvate, multiarticulate, lobulate, bifariously ciliate cirri; two unequal, slender, tapering branchial filaments on each side; one from the base of the pedicle of the first pair of cirri, the other from the side of the body near it; the ovarian tube tapering, annulated, longer than the last cirri.

Tegmen compressed, subovate, with two large calcareous plates on each side, and a single, elongated, curved dorsal piece; the aperture in the form of a slit, occupying the upper half of the ventral border; peduncle cylindrical, contractile, fleshy: its epidermic coat continuous with the tegmen; its inner dermic tube continuous with the mantle or dermal lining of the tegmen, on the inner surface of which is a delicate layer of pigment.

This genus being generally considered the typical group of the Barnacles, or Pedunculated Cirripedia, it ought to give its name to the family. Linnæus's genus *Lepas* is equivalent to almost the entire class, he having, in his Systema Naturæ, only one other genus, containing a single species, and now generally named *Alepas*, but to which the priority-of-nomenclature naturalists must restore its proper name *Triton*, which has been given to a genus of Batrachian reptiles, and also to a genus of Gasteropodous mollusca. The sessile species were first separated under the generic name of *Balanus*, but now form a family, *Balanina*, of which Balanus restricted is typical. To be consistent, the pedunculated species ought to have retained the name Lepas, agreeably to the practice of Montagu and others; and as they now form a family, it ought to be named *Lepadina*, of which Lepas restricted is typical. Bruguiere and Lamarck, however, call Lepas *Anatifa*, a specific Linnæan name altered and mutilated. Dr Leach calls it *Pentelasmis*, and Blainville *Pentalepas;* in which cases, the family name should be Anatifina, or Pentalasmina, or Pentalepina. As naturalists are not yet agreed as to nomenclature, and the general meeting proposed some years ago, for the purpose of settling such important matters, has not yet taken place, isolated persons like myself must employ some such names as are intelligible.

The Lepades, Anatifæ, Pentelasmides, or Pentalepades, then, live affixed to wood, cork, bark, fuci, crustacea, fishes, and other bodies, as well as to each other, and to various pedunculate and sessile cirripedia. Their fleshy peduncle varies in length and colour, even in the same species. The tegmen also presents considerable differences as to the form, thickness, and markings of its pieces. They are more abundant in warm than in temperate climates, and rare in the colder regions, into which, however, they are often carried, by the currents and winds, along with the bodies to which they adhere.

Of this genus three species have occurred: two of them long known, but very imperfectly described; the other not hitherto observed, or at least distinguished, in our seas.

1. *Lepas anatifera.* Common Barnacle.

Tegmen ovate, much compressed, obliquely truncate ; the lateral plates very thin, fragile, bluish-white, faintly iridescent, obsoletely rugoso-striate, with minute radiating striulæ ; the lower plate subovato-tetragonal, with the basal margin oblique and nearly straight, the posterior shorter and convex, the sutural straight or slightly concave, the apex rather obtuse ; the upper plate oblong, obtuse at both ends, with the supra-umbonal side shorter than the anterior ; the dorsal piece linear-oblong, obtusely carinate, sulcate, or striate ; the peduncle rugose, pale, the epidermic portion of the tegmen scarlet, orange, or yellow ; the cirri pale yellowish-grey.

The body of the animal is ovate, compressed, incurvate, very convex on the back, narrow behind ; anteriorly soft, with a membranous integument, which becomes horny on the hind part, where it is marked beneath with faint transverse depressions. The mouth prominent, with an induplicate or somewhat semilunar, bullate, rounded lip, with two thick, pointed palpi, which are adnate until toward the end, directed forwards or downwards, with the tip free and ciliate, and three pairs of incurvate, compressed maxillar appendages, lamelliform at the end. The first or outer pair, with the terminal lamina oblong, acute, with six external, marginal, long, acuminate teeth or serratures, of which the posterior are longest ; the second with the lamina broad, with five short, broad teeth or lobes, and several bristles ; the third, inner or medial, narrower, and ciliate.

The first pair of feet, in the form of oblong, compressed bodies, are placed immediately above or behind the mouth, and bear each a pair of unequal, tapering, compressed, horny, articulated, incurvate cirri. The second pair are at some distance from the first, and the rest close together, subcylindrical, compressed, biarticulate ; their cirri longer. All the cirri are lobed and ciliate on the anterior or lower border, convex on the dorsal side, with a few very small bristles at each joint. The first pair of cirri with eighteen joints, the last with thirty-five joints and lobes, on each of which are generally about sixteen unequal ciliary bristles, in two divergent series.

On each side, on a prominence at the base of the first foot, externally, is a long, subulate, soft, and flexible filament ; and at some distance from it, on the side of the body, towards the back, is another, about half its length.

The narrowed part of the body to which the five pairs of abdominal feet are laterally attached, is marked beneath with faint, irregular, transverse depressions between the feet, and thus perhaps subarticulated. It ends in a very long, slender, tapering flesh-coloured tube, usually curved inwards, but, when extended, exceeding the last cirri in length. At the base of this tube, on the dorsal aspect, is the anus, over which are two oblong, mobile, horny plates.

The general colour of the body is pale purplish yellow, partly flesh-colour ; the cirri yellowish-grey, or light horn-colour.

A large round muscle, attached to the anterior part of the body, under the mouth, extends from one of the large calcareous plates of the tegmen to the other, like one of the adductor muscles of a bivalve shell. The body is also attached to the tegmen by muscular fasciculi, which expand beneath its integument over the viscera.

The subsidiary dermal envelope or mantle is very thin, whitish, margined at the aperture with an elastic scarlet or orange-coloured filament. Between it and the epidermic envelope or shell is a very delicate film of pale purplish-brown pigment, appearing like a film of China ink or neutral tint, divided into minute polygonal or circular fragments.

The tegmen testaceous, much compressed, ovate, with the base somewhat oblique and straight, the ventral margin convex, sinuate toward the end; the dorsal margin uniformly curved in about the fifth of a circle; the apex obliquely truncate.

The lower lateral plate little convex, subovato-tetragonal, very thin, fragile, white, faintly iridescent, glossy, concentrically rugoso-striate, divergently-minutely striulate; the basal margin straight, or slightly-concave or convex, the umbonal or basi-ventral angle projecting a little; the ventral margin convex, the dorsal convex scarcely half the length of the basal; the sutural margin straight; the apex rather acute.

The upper lateral plate oblongo-triangular, flat, somewhat concave, very thin, fragile, white, faintly iridescent, concentrically striate, divergently minutely striulate; the ventral margin slightly concave; the sutural margin straight; the dorsal slightly convex, but with the umbonal point sensibly projecting, and about half the length of the ventral margin from the upper angle, which is rounded; the lower angle narrow, but rather obtuse.

The dorsal plate curved, linear-oblong, convex, with a slight medial groove, or obtusely carinate, striate, narrower and incurvate below, with a transverse arcuate or semilunar base; the apex obtuse, extending to the middle of the lateral plate.

The epidermis on the margins of the calcareous plates is bright scarlet; between the plates, and at the base of the tegmen, scarlet or orange, often inclining to yellowish-grey.

The peduncle short, about the length of the tegmen, sometimes shorter, sometimes half as long again, rugoso-granulate, light greyish-yellow or flesh coloured, orange or scarlet, becoming bright scarlet at the upper part; its internal or dermal tube pale greyish.

Very young individuals, two-twelfths of an inch in length, and others up to half an inch or more, have the peduncle and membranes yellowish-white; the tegmen and its plates of the same form as in the adult, but the plates extremely thin, almost membranous at the margins.

Considerable variations occur in the outline of the tegmen; in the form of the plates, and especially of the upper as well as the dorsal; in the thickness of the plates, and the convexity of the lower; and in distinctness of the striæ.

Generally ovate, the tegmen has its basal line straight, or somewhat convex, rarely a little concave; the ventral line convex for half its length, then sinuate or slightly concave; the dorsal line more or less convex; the apex generally obliquely truncate, or obtuse, or even acute. The lower plate sometimes has the ridge from the umbo to the point very prominent, but generally inconspicuous, its sutural margin generally a little concave, sometimes straight. In the upper plate, the umbonal angle is sometimes distinct or even prominent, sometimes inapparent, whence the apex may be obliquely truncate, or the dorsal line may run in a uniform curve to the end, or the tip may even be acute. The dorsal piece may be broader or narrower, more or less convex, sometimes nearly flat, but generally with an obtuse keel, sometimes having a medial groove; One or more series of depressed dots sometimes extend from the umbo to the suture-margin of the lower plate, as has been noticed by Chemnitz and Philippi. The striæ are sometimes very distinct, although fine, sometimes faint or somewhat obsolete.

The bluish tint of the plates is entirely owing to the pigment and mantle, for when they are removed the colour is pure white, or reddish-white.

The application of the term lævis, smooth, as specific, by Lamarck and others, is improper, inasmuch as the valves are always striate.

Of the descriptions of Anatifa lævis or Lepas anatifera given by authors, those which agree best with our specimens are by Philippi and Dr Gould. Cuvier's figure differs a little, and his specimens must have been much older. His figures of the structure are very rude, and those of the cirri in particular very incorrect.

The following references are all which I can apply to this species, as it presents itself on the Ichaboe vessels:—

Lepas anatifera. Linn. Syst. Nat. 1109. Very probably.
Lepas anatifera. Chemn. Conch. viii. 340, plate 100, fig. 853–4–5.
Lepas anatifera. Penn. Brit. Zool. iv. 74, plate 38. fig. 9.
Lepas anatifera. Turt. Conch. Dict. 71. Excluding his varieties, which yet belong to the same species.
Anatifa lævis. Lamk. Anim. sans Vert. v. 404.
Anatifa lævis. Gould, Invert. Massach. 19, woodcut p. 11.
Anatifa lævis. Philippi, Moll. Sicil. 252.
Anatifa lævis. Brown, Illustr. plate 4, fig. 3, 4.
Lepas anatifera. Donov. Brit. Sh. plate 7.
Lepas anatifera. Mont. Test. Brit. 15.
Pentalepas lævis. Blainv. Malac. plate 84, fig. 3.

The following are the dimensions of several individuals:—

| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
|---|---|---|---|---|---|
| Length, . . | 1 4 | 1 6 | 1 2 | 1 1 | 0 6 |
| Depth, . . | 0 10 | 1 0 | 0 9¼ | 0 8 | 0 3¼ |
| Breadth, . . | 0 3½ | 0 3¾ | 0 3 | 0 2 | 0 1 |
| Peduncle, . | 1 6 | 2 0 | 1 2 | 0 6 | 0 4 |

2. *Lepas Nauta.* Sailor Barnacle.

Tegmen ovate, compressed, obliquely truncate; the lateral plates rather thick, bluish-white, glossy, obsoletely rugose, with distinct radiating striulæ; the lower plate subtriangular, with the basal margin very oblique, straight, the posterior half its length and convex, the sutural straight, the apex rather acute; the upper plate oblong, subrectangular at the tip, narrow, and rather acute at the lower end, the supraumbonal side of about the same length as the anterior; the dorsal piece linear-lanceolate, carinate, deeply sulcate, extending to more than half the length of the upper lateral piece, abruptly inflexed at the base; the peduncle rugose, dusky-brown, the epidermic portion of the tegmen scarlet or orange; the cirri greyish-brown.

The body of the animal is ovate, compressed, incurvate, very convex on the back, narrow behind; anteriorly soft, with a membranous integument which becomes horny on the hind part. The mouth prominent, with an induplicate or vaulted, bullate, rounded lip, with two thick adnate palpi, free at the end, where they are conico-compressed, and end in a long incurvate, acute prickle, and three pairs of incurvate, compressed, maxillar appendages. The first or outer pair with the terminal lamina oblong, acute, with six external marginal, acuminate teeth or serratures, of which the posterior is much larger, the rest gradually decreasing. The second with the lamina broad, with five short, broad teeth, and ciliate. The third or inner narrower, pointed, and ciliate.

The first pair of feet close to the mouth, with the cirri unequal, of about 15 joints; the rest crowded, the last with 45 joints; all ciliate, with long unequal bristles in two series, generally from 12 to 16 on each lobe.

Two branchial tapering filaments on each side, the longer attached to the prominence at the base of the first foot, and shorter than its cirri, the other smaller, on the side of the body.

The ovarian tube very slender, longer than the last cirri.

The colour of the body light brown, dotted with darker; that of the cirri greyish-brown; the pigment dusky brown. In other respects, the structure is the same as in Lepas anatifera.

The tegmen testaceous, compressed, ovate, with the base very oblique, straight or slightly concave, the ventral margin convex, slightly sinuate toward the end, the dorsal margin curved in the fifth of a circle to the angle of the upper plate, then abrupt.

The lower lateral plate subtriangular, rather convex, rather thick, bluish-white, faintly iridescent, highly glossed, concentrically obsoletely rugose, with distinct small diverging striæ; the basal margin straight or slightly concave, with a small reflexed rim, the umbonal angle not projecting, the ventral margin gently convex, the dorsal convex, about half the length of the basal, the sutural margin straight; the apex truncate or rectangular.

The upper lateral plate oblongo-tetragonal, nearly flat, or slightly convex, bluish-white, concentrically obsoletely rugose, divergently distinctly striulate, the ventral margin straight, the dorsal distinctly angulate, the umbonal point being prominent, the space between it and the point straight or concave, and about equal in length to the ventral margin, the lower angle very narrow and acute.

The dorsal plate gently curved, linear-oblong, rising into a prominent keel, its sides concave or sloping, deeply grooved, the grooves often forming slight denticulations on the keel, the apex very narrow, extending nearly to the umbonal angle of the upper plates, its base narrowed, abruptly incurved at the end, expanded and emarginate.

The epidermis on the margins of the calcareous plates very narrow, bright scarlet, at the base of the lower plates often forming a regular series of angular shreds; between the plates, where it is very narrow, and at the base of the tegmen dusky.

The peduncle shorter than the tegmen, dusky or blackish-brown, rugose, minutely granulate, its internal tube dark grey or brownish.

It varies considerably; but in every form or age is easily distinguishable from Lepas anatifera, into which it does not graduate. Generally broadly ovate, the tegmen has its basal line oblique in various degrees, sometimes straight, often more or less concave, never convex; the ventral line convex to the end of the large plate, then straight or convex; the dorsal line gently convex; the apex sometimes obtuse, generally rectangular, sometimes extended, acute or obtuse. The lower plate has always a prominent ridge from the umbo to the apex, and is more or less convex below. In the upper plate the umbonal angle may be more or less prominent, and the margin beyond is straight, concave, or rarely convex. The dorsal plate, always sulcate and carinate, may have the keel continuous, but generally undulate or denticulate. One or more series of depressed dots sometimes extend from the umbo to the suture-margin of the lower plate. The striæ are sometimes strongly marked, generally moderate, sometimes faintly, always more distinctly than in Lepas anatifera.

The bluish tint of the plates is entirely owing to the pigment and mantle, for when they are removed the colour is pure white, with a slight tinge of lilac-purple.

This species differs from Lepas anatifera in having the tegmen smaller, more convex, more oblique at the base, and more distinctly striated. The plates are thicker, the lower more convex, with a much more prominent angular ridge; the upper more pointed at its lower end, the posterior more prominent, more deeply sulcate, and quite differently curved at the base, it being there suddenly inflexed. Lepas anatifera has a wide membranous space between the dorsal plate and the dorsal margin of the lower plate; Lepas incurvata has also a wide space there; but in Lepas striata there is scarcely any, the margins of all the plates being almost in contact. The dorsal plate in Lepas incurvata extends one-third up the upper plate, in L. anatifera half-way, in L. striata two-thirds.

The species here described is the same as one which I have frequently met with on planks, logs, and tangles, in the Outer Hebrides. It does not, however, grow on the tangles in their natural state, it being only when they have been floating in the sea, after having been dried on the sands, that they form upon them. The same species I have also found on corks on the east coast of Scotland. It is that described as Lepas striata in the Mollusca of Aberdeenshire.

It is not easy to find references for this species. Although referred by many to Lepas anserifera of Linnæus, it certainly is not that species; nor is it Anatifa striata of Bruguiere, Lamarck, or Philippi, which they refer to Lepas anserifera, and has the valves "argute striatæ." It is very certainly Anatifa striata of Dr Gould, his descriptions agreeing in every particular and circumstance. I find no other specific name for it than Anserifera and Striata, to neither of which can it lay claim, and therefore am obliged to get it a new name, until some priority person find an old one for it.

It occurred in small numbers, along with Lepas anatifera and L. incurvata, in the midst of a dense mass of Otion and Cineras, on the bows and sides of a Fraserburgh brig, which came to Aberdeen in the beginning of January 1845.

Lepas anserifera. Mont. Test. Brit. 16.
Lepas anserifera. Turt. Conch. Dict. 72.
Lepas striata. MacG. Mollusca of Aberdeenshire, 357.
Anatifa striata. Gould, Invert. Massach. 20.

The dimensions of several individuals are:—

| | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|
| Length, . . | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 10 | 0 | 9 |
| Depth, . . | 0 | 9 | 0 | 7 | 0 | 8 | 0 | 5½ | 0 | 6 |
| Breadth, . | 0 | 4½ | 0 | 3 | 0 | 4 | 0 | 2½ | 0 | 2½ |
| Peduncle, . | 0 | 10 | 0 | 4 | 0 | 5 | 0 | 4 | 0 | 5 |

3. *Lepas incurvata.* Incurvate Barnacle.
*Anatifa elongata.* Quoy et Gaimard.

Tegmen semicordate or ovato-oblong, with the anterior margin straight or recurvate, compressed, tumid below, obtuse; the lateral plates very thin, fragile, bluish-white, slightly glossed or dull, obsoletely rugose, with very minute radiating striulæ; the lower plate subovato-tetragonal, with the basal margin convex, the posterior rounded and equal, the sutural convex, the apex acute; the upper plate oblongo-tetragonal, obtuse at both ends, with the supraumbonal side as long as the anterior; the dorsal piece narrow-oblong, convex, sulcate or striate; the peduncle rugose, minutely granulate, brownish-black, the epidermic portion of the tegmen partly dull scarlet or dingy orange; the cirri dusky.

The body of the animal is ovate, very convex on the back, narrow behind; anteriorly soft, with a membranous integument, which becomes horny on the hind part, where it is marked beneath with faint transverse depressions. The mouth very prominent, with an induplicate or somewhat semilunar, bullate, rounded lip, with two thick, pointed palpi, which are adnate, until toward the end, directed forwards and inwards, with the tip free, and terminating in a recurved spine, and three pairs of incurvate compressed maxillar appendages, lamelliform at the end. The first or outer pair, with the terminal lamina oblong, acute, with six external, marginal, acuminate, teeth or serratures, of which the posterior is much larger. The second, with the lamina broad, with four ciliated lobes. The third or inner, less compressed, ciliato-dentate.

The first pair of feet, oblong, compressed, placed immediately behind the mouth, and bearing each a pair of unequal, tapering, compressed, horny, articulated, incurvate cirri. The second pair at some distance, and the rest close together, subcylindrical, compressed, biarticulate, their cirri longer. All the cirri are lobed and ciliate on the anterior border, convex on the dorsal side, with a few very small bristles at each joint. The first pair with seventeen joints, of which the last five are very slender, the last with forty-five joints and lobes, on each of which are generally five, or from four to six ciliæ on each side, arranged in two divergent series.

On each side, on a prominence at the base of the first foot externally, is a long, subulate branchial filament; and at some distance from it, on the side of the body, is another about half its length.

The narrowed part of the body to which the five pairs of abdominal feet are attached is marked beneath, and on the sides, with faint transverse depressions between the feet. It ends in a very long, slender, tapering, dusky tube, of about the length of the last cirri. At the base of this tube, on the dorsal aspect, is the anus, over which are two oblong, mobile, horny plates.

The general colour of the body is light brown, or dark yellowish-grey, often dotted with dusky; paler on the sides; the cirri dusky brown, pale along the back, and with the ciliary bristles brownish-grey.

The transverse muscle, and subcutaneous muscular layer, as in the last species.

The subsidiary dermal envelope or mantle very thin, dusky-brown, margined at the aperture with a yellowish filament. Between it and the testaceous tegmen is a film of dark-brown pigment disposed in irregular roundish or polygonal fragments.

The tegmen compressed, tumid below, semicordate, somewhat incurved, with the basal margin convex, the ventral direct, gently sinuate, at the end somewhat recurvate, the dorsal uniformly curved in the fifth of a circle, the apex obtuse.

The lower lateral plate considerably convex, subovato-tetragonal, very thin, fragile, bluish-white, or greyish-blue, concentrically rugose, and faintly striulate, divergently obsoletely striulate; the basal margin convex, the umbonal angle considerably prominent, the ventral margin sinuate, the dorsal convex, as long as the basal or longer, the sutural margin very slightly convex, the apex acute.

The upper lateral plate oblongo-tetragonal, flat, somewhat concave, very thin, fragile, white, concentrically rugose and striulate, divergently obsoletely striulate, the ventral margin straight, or a little concave, less than half the length of the sutural, which is slightly concave, the dorsal margin convex, with the umbonal point scarcely prominent, its distance from the tip less than the length of the ventral margin, the upper angle rounded, the lower obtuse.

The dorsal plate curved, narrow-oblong, convex, with a slight rounded carina, striate, narrowed and incurvate toward the base, which is expanded and emarginate, the apex obtuse, extending only to a third of the length of the upper lateral plate.

The epidermis on the margins of the calcareous plates is generally bright scarlet, between the plates dusky, sometimes pale, rarely scarlet.

The peduncle short, about the length of the tegmen, rugoso-granulate, with very small, unequal, roundish, flattened tubercles, greyish or brownish-black, at the base often pale grey, at the top reddish; its internal or dermal tube greyish-brown.

Very young individuals, two-twelfths of an inch in length, and others up to half an inch, have the peduncle and membranes generally dusky, being only of a lighter tint than in the adult.

Very considerable variations occur in the outline of the tegmen; in the form of the plates, and especially of the upper, as well as the dorsal; in the convexity of the lower, and the prominence of its umbonal angle; and in the lustre and distinctness of the striæ; but, in all the varieties, there is no possibility of mistaking the species, or of not seeing that it is very distinct from any other.

Generally semicordate, the tegmen never varies in the convexity of its basal line; but the ventral line may be quite straight, generally sinuate, more or less recurved at the end, sometimes remarkably so, the apex generally obtuse, sometimes obliquely truncate, rarely narrowly and directly truncate. The lower plate has the ridge from the umbo to the point obsolete, slight, scarcely ever very prominent, always very close to the margin, and nearly parallel to it; its sutural margin almost always convex, rarely straight. In the upper plate, the umbonal angle is sometimes obsolete, sometimes distinct. The dorsal piece may be broader or narrower, always convex, and sulcate, generally with a keel more prominent toward the base. The striæ sometimes pretty distinct, the lustre glossy, seldom iridescent, often dull.

The bluish tint of the plates is entirely owing to the dark pigment and mantle; for when they are removed the colour is pure white, with a faint tinge of reddish-purple.

It is needless to compare this species with Lepas anatifera, or any other known to me, as it is readily distinguishable. Its semicordate, subrecurvate form, the greater convexity of its basal plates, the greater breadth and less elongation of its dorsal piece, and other characters, might be noticed. The cirri are much longer, and have more joints; and their colour, as well as that of the body, is much darker.

Lepas tegmine ovato-oblongo, subincurvato, basi convexo, rotundato, apice obtuso, cirrisultimis articulis 45 nigrescentibus, &c.

Lepas tegmine ovato, basi compresso, subrecto, apice oblique truncato, cirris articulis 35, flavicantibus, &c.

The following are the dimensions of several individuals:—

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length, . . . . | 1′ | 4″ | 1′ | 2″ | 1′ | 3″ | 1′ | 1″ | 1′ | 0″ | 1′ | 4″ |
| Depth, . . . . | 0 | 9 | 0 | 8 | 0 | 9½ | 0 | 8 | 0 | 7 | 0 | 9½ |
| Width, . . . . . | 0 | 4 | 0 | 4 | 0 | 4½ | 0 | 4 | 0 | 3 | 0 | 4½ |
| Peduncle, . . . . | 0 | 10 | 0 | 10 | 0 | 8 | 0 | 6 | 0 | 5 | 0 | 9 |

This species was more abundant than the others, and its peculiar form struck me the moment I saw it, as being very different from that of any other species known to me. As to its specific rank there can be no doubt; and if it has already been described, no harm can ensue from my having given so long an account of it. The naming of a new species is not a matter for which I would make a great scramble; for it is disgusting, as well as ludicrous, to see with what eagerness some people tear the small shreds of knowledge out of each others mouths.

It is not very improbable that it may be *Anatifa elongata* of Quoy and Gaimard, which is said to inhabit the coasts of New Zealand, and of which the specific character given in the second edition of Lamarck is: A. testa compressa, elongato-ovali, postice subtruncata, cinereo-cœrulescente, margine lutea; pedunculo mediocri, tuberculato.

The cirri of all the Cirripedia known to me, namely about twenty species of the genera Lepas, Pollicipes, Otion, Cineras, Balanus, and Coronula, have a tube filled with fluid along the back, distinct from the more compressed, anterior, concave, ciliated, part. They are extended partially or entirely by the propulsion of this fluid. On removing the pressure they resume their curvature. It seems probable, that the muscles in the pedicle or foot propel the fluid, and perhaps there may be filaments for curving the cirri. At all events, the mechanism is most simple and efficient.

Another fact is, that the application of heat and light changes the dark colour of the epidermis, whether of the stem or peduncle, to scarlet. If the mantle and dermal tube of the peduncle be removed from the darkest Barnacle, the epidermis will almost always become red in drying. So that for all the importance which Dr Gould attributes to the colour of the stem, as a distinctive character, it is really not much worth.

A third and more important fact is, that on the epidermis of many specimens of Lepas incurvata and L. Nauta, I find a kind of small calcareous spicula, which at first sight one might take to be a species of Pedicellaria. These objects, generally considered as organic portions of the sea-urchins and star-fishes, on which they are found in vast numbers, would therefore have to be also viewed as organic appendicules of Barnacles, or else distinct beings, parasitic on the Cirripedia, as well as the Echinodermata. It is on the membrane between the calcareous plates, and on the peduncle, that they occur. They do not, however, resemble the Pedicellariæ which are seen on our Echinodermata, but present the appearance of single or aggregated spicula, often divergent or radiate, and mostly covered by a pellicle of the epidermis. Whether crystallizations or aggregations of calcareous particles, or organic beings, these objects require a more minute examination than I am able to bestow upon them at present.

Some species of the genera Cineras and Otion come next in order.

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*On the Intellectual Character of the Esquimaux.* By RICHARD KING, M.D.* (Communicated by the Ethnological Society.)

Vitruvius states, that "the northern nations, from cold and moisture, have large bodies, a white skin, red hair, grey eyes, and much blood, and, breathing a thick and cold air, are dull and slow of understanding."† "The frigidity of the North Americans," writes Lord Kames, "men and women, differing in that particular from all other savages, is to me evidence of a separate race."‡

According to Herder, "The blood of man, near the pole, circulates but slowly, the heart beats but languidly; consequently, the unmarried live chastely, the women almost require compulsion to take upon them the troubles of a married life; and the mother suckles her infant a long time, with all the profound tenacious affection of animal maternity. So hard is their fate, that, in winter, they are often obliged to support themselves in their caves by sucking their own blood." M. Lesson says of the habits of the Hyperborean people, "The rigour of the climate has obliged them to dig for themselves subterraneous abodes. They sew with nerves their winter garments, made of the skins of seals, and make their summer dresses of the intestine of the largest whales. The Esquimaux is skilful in the chace of foxes and sables, whose skin serves him for clothing and for barter. Their loose morality renders the men addicted to polygamy, and indifferent to the virtue of their wives and daughters."§ The French historian, Charlevoix, asserts that the Esquimaux "are the only savages known who eat raw flesh; that they wear their hair in great disorder; that their beard is so thick that it is difficult to discover the features; that there is something terrifying in their face, and that their whole exterior shews the animal, or is very brutish; that of all people in America, there is none who correspond more with our European idea of a savage, for they are ferocious, wild, defying,

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* Read before the Ethnological Society, June 19. 1844.

† Quoted by Lord Kames, pages 51 and 52. ‡ Kames, p. 52.

§ Quoted by Prichard, p. 502.

restless, and always inclined to do mischief to the stranger; and that they have little intercourse and commerce with their nearest neighbours."*

Such are the authorities upheld by Dr Prichard in the present day, and such are the materials used by Dr Beke for establishing this hypothesis: "That the origin of the numerous and widely differing races of man is to be referred to a single parent stock, possessed of a high degree of cultivation, the following principle presents itself. That the culture, or the degradation of an aboriginal race, will be in proportion to the geographical distance of its residence from the common centre of dispersion. For instance, if we take the primitive residence of the post-diluvian race to have been in the north-west portion of Mesopotamia, it will be seen that the countries more immediately surrounding that central point, viz., Assyria, Chaldea, Egypt, Phœnicia, and Asia Minor, are those whose inhabitants were, in the earliest ages, possessed of the highest degree of culture; whilst, on the other hand, at the points most distant from the same centre, the Papuans, the Hottentots, the Esquimaux, and other savage races, have degenerated almost to the lowest state compatible with the retention of rational endowments."†

In order to test the correctness of the data, as far as the Esquimaux are concerned, upon which Dr Beke has established his hypothesis; and upon which Kames, Herder, and Prichard, have wasted considerable learning and ingenious reasoning, I refer to the papers laid before the Society on the physical character, and arts and manufactures of the Esquimaux. It will be found that I have added six inches to the stature assigned to them by the authors mentioned; that I have proved they did not, could not, dig subterraneous abodes; and that from the same cause they were obliged, although not the only known savages who eat raw flesh, sometimes to eat their provision raw; and I adduced the evidence of Cook, Kotzebue, Parry, Franklin, Lyon, Ross, and

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* Quoted by Prichard, p. 502.

† Chas. F. Beke, in an article in the Edinburgh New Philosophical Journal.

others, that they preferred it cooked, when blessed with the means; that the wearing the hair in great disorder was almost a solitary exception, and not a general rule; that in contradiction to the terrifying face and animal and brutish exterior, I have quoted Cook, Parry, Franklin, Lyon, and Richardson; that if anything remarkable was observable in the beard, it was in deficiency, and not in excess; that their winter garments were not made of seals' skins, nor their summer dresses of the intestines of whales; that they were not skilful in the chace of sables, and did not either use its skin for clothes or for barter; for the very evident reason that no such animal is found in their country.

And I now proceed to adduce additional facts, arranged under the head of intellectual character. It will thus be seen which of the philosophers are correct, whether Lord Kames, who states "the women require compulsion to take upon them the troubles of a married life;" I had almost forgotten Lord Byron who says in allusion to frigidity, "happy the nations of the moral north;"—or M. Lesson, who asserts that "their loose morality renders them addicted to polygamy, and indifferent to the virtue of their wives and daughters;" whether they are "dull or stupid," as Vitruvius will have it; or "degenerated almost to the lowest state compatible with the retention of rational endowments," for which Dr Beke contends. The sucking of their own blood, and the suckling of their infants, with all the profound tenacious affection of animal maternity, scarcely demands attention, notwithstanding it appears in Dr Prichard's work; but it may be necessary to state that the cause which Vitruvius assigns for their dulness and stupidity, "that of breathing a thick air," does not exist. The arctic atmosphere is as thin and as elastic as that of any part of the globe, and the sky is Italian. So free of moisture is the atmosphere during the winter that a few hours' exposure of linen, wet from the wash-tub, renders it so dry as not to require airing prior to being worn.

That the natives of Labrador were, to a certain extent, at the time Charlevoix wrote, the ferocious people he has described, I am not prepared to deny; but I will neither admit that such is their general disposition, nor that the whole race are to be accountable for so small a portion of the Esquimaux family. When they were visited by the Norwegians, and the early travellers, in search of a north-west passage, they were a peaceable and hospitable people; and in return for a good disposition and friendly conduct to their discoverers and subsequent visitors, Thorsin, the Icelander, and Sir Martin Frobisher, our own countryman, as well as others, committed upon them the most gross acts of cruelty. The natives of Greenland were subject to the same inhuman treatment at the hands of both the Danes and the English; and had that good man Hans Egede been a Charlevoix, these inoffensive people would, from their spirited retaliation upon their enemies, have been branded with the same infamy that the French historian and Dr Prichard have endeavoured to fix upon the poor inhabitants of Labrador. But we can spare them the dreadful ordeal of public censure, for they also had an Egede in the person of Captain Cartwright,* who passed many years among them, yet Dr Prichard makes no allusion to that traveller. The Esquimaux of Labrador, says Captain Cartwright, are "the best tempered people I ever met with, and most docile—a nation with whom I would sooner trust my person and property than that of any other."

Sir Edward Parry found the natives of Melville Peninsula entitled to the same encomium. It is true that Hans Egede, of the natives of Greenland, and Sir Edward Parry and Captain Lyon, of those of Melville Peninsula, have borne testimony to the carelessness with which the aged and destitute are treated; but these people, we know, form exceptions to the nation at large, and their more erratic mode of life, compared with that of the rest of the race, is no doubt the cause of this; a kind of life which necessarily consigns the sick and infirm of all uncivilized races to desertion, and consequent starvation. Self preservation is inherent in man, civilized or uncivilized; and I have no hesitation in saying, that it is self preservation which obliges the Esquimaux of Melville Peninsula to act as they do.

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* Cartwright's Journal of his Residence on the Coast of Labrador.

Of their general disposition regarding their social relations among themselves, all who have visited them speak in the most favourable terms. They are uniformly described as most scrupulously honest, careful of the aged, affectionate to their children, devotedly attached to each other, and fond of their domestic animals. So little are they inclined to quarrel, that, after two years' acquaintance with the natives of Melville Peninsula, Sir Edward Parry has only related one case where it extended to blows; and Captain Lyon remarks, in his private journal, in speaking of the same community, that their evenness of temper is not surpassed, if equalled, by any other nation. In pain, cold, starvation, disappointment, or under rough treatment, their good humour is rarely ruffled. Few have ever shewn symptoms of sulkiness, and even these for a short time only. Those who have, for an instant, felt anger at neglect, or at being punished for some offence, are in a few moments as lively and as well disposed to the persons who offended them as if nothing had occurred; consequently that detestable passion revenge, so common to uncivilized man in general, is not known to them. Captain Lyon could learn of no instance of any one man having killed another, or of a son imbibing from his father any dislike towards particular persons; and Sir John Ross informs us that, among the natives of Regent's Inlet, there is but a solitary case on record of a murder having been committed, and that occurred in hot blood.

With respect to their disposition in relation to strangers, hospitality is their leading virtue, and petty thieving their greatest vice. The narratives of all the travellers who have visited the Esquimaux teem with accounts of the hospitality they have received from them. When a stranger approaches their dwellings, it is the custom for one of the party to attach himself to the visitor, to carry his baggage, to point out the best road, to help him over the streams of water or fissures in the ice, and to attend him wherever he goes during his stay. On his arrival at the dwelling, he is supplied by the women with dry boots, and, if necessary, skin dresses, and then handed to the place of honour, a deer-skin seat. If reparation is wanted in the pulled-off clothes, they are immediately attended to, and if the host is short of bedding, he or she, as the case may be, is contented to sit up while the guest sleeps. A poor old woman having received Sir Edward Parry as her guest, gave up her bed, as well as a large deer-skin blanket which she rolled up for his pillow, and felt contented in dozing away the night in a sitting posture before her lamp.* That they are not always so polite, though equally hospitable, we are obliged to confess, from a circumstance which happened to Captain Lyon. On one occasion he "was awakened from his slumbers by a feeling of great warmth, and to his surprise found lying beside him, under the same blanket, his Esquimaux host and his two wives, with their favourite puppy, all fast asleep and stark naked. Supposing this was all according to rule, Captain Lyon left them to repose in peace, and again resigned himself to rest."†

Although among themselves, and, in the first instance, with foreigners, they are scrupulously honest, after a short acquaintance with the latter, the reverse is often found to be the case. Does it not, then, become a matter of question, whether, after all, the strangers are not the most in fault? For instance, the disposition for thieving is found to be very great among the natives of Hudson's Strait and of Prince William's Sound, whilst along the coast of North America the propensity decreases from west to east; and at its most eastern discovered limit that vice is not known. Here, it is evident, that even with foreigners it is not natural to them to be dishonest; for where they are most exposed to European trade, as at Hudson's Strait and the north-west corner of America, the vice is notoriously common, while at Regent's Inlet it is altogether unknown. Between Regent's Inlet and Hudson's Strait there is an intermediate state of things, if the trifling cases of theft related by Sir Edward Parry and Captain Lyon are to be taken into account. Out of two hundred of the natives of Melville Peninsula, the amount of those officers' acquaintance in that locality, only three of their number were considered as determined thieves, and they are said to have performed their work so clumsily as

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* Parry's Second Expedition, p. 205.

† Lyon's Private Journal, p. 246.

to have been instantly detected. One was a woman who endeavoured to secrete a nine-inch block in her boot, and the second was a man who was detected making off with the last piece of corned beef belonging to the midshipmen. Upon being chased, he practised a feint by dropping a piece of fat and kicking snow over it, as if the whole was buried.* The third was Ooming, the wife of the latter, who, by being all attention, succeeded in picking an officer's pocket of his handkerchief. To weigh with these, both Sir Edward Parry and Captain Lyon† have mentioned numerous instances of extreme honesty; "which," adds Sir Edward Parry, "when we consider the amazing temptations constantly thrown in their way, in the shape of wood and iron, substances esteemed by them as highly as we do gold or jewels, we know how to appreciate their honesty."

Before leaving this part of my subject I wish to correct some travellers in their assertion, that there is no such thing as gratitude amongst this people. It is evident they have been led into error, from taking too cursory a view of their peculiar customs. It is because they do not apply that virtue in the same way we do, that it has been thought to be wanting. For instance, it is their custom to express themselves grateful, only when their tendered favours are accepted. But, in urgent cases, it is evident they possess the feeling of gratitude after our own fashion. A party of Mountain Indians, jealous of Sir John Franklin, in consequence of his having traded with the Esquimaux, determined to attack him at a particular spot. This became known to an old Esquimaux, to whom had been given a knife, and some other trifling articles, on the preceding day; upon which he called aside two young men of his tribe, and said to them, "These people have been kind to us, and they are few in number; why should we suffer them to be killed? You are active young men, run and tell them to depart instantly." The young men suggested that the White men had guns, and could defend themselves. "True," said the old Esquimaux, "against a small force, but not against so large a body of Indians as are now assembled, who are like-

* Lyon's Private Journal, p. 174.

† Parry's Second Expedition, p. 163; Lyon's Private Journal p. 347.

wise armed with guns, and who will crawl under cover of the drift timber, so as to surround them before they are aware; run, therefore, and tell them not to lose a moment in making their escape." Notwithstanding this, and much more which I could bring forward if necessary, Dr Prichard can reconcile unto himself his quotation from Charlevoix,—"That, of all people in America, there is none who correspond more with our European idea of a savage; for they are ferocious, wild, defying, and restless, and always inclined to do mischief to the stranger."

Additionally, let us review the information which the various travellers who have visited this interesting people have laid before us. Tooloak, a youth, and two pleasing little girls, of nine and eleven years of age, natives of Melville Peninsula, are said to have possessed a capacity equal to any thing they chose to take an interest in learning. "Indeed, it required," says Sir Edward Parry, "no long acquaintance to convince us, that art and education might easily have made them equal or superior to ourselves." Sauer* has mentioned a native woman of Prince William's Sound, who learned to speak Russian fluently in rather less than twelve months. In allusion to the natives of Labrador, Sir Martin Frobisher found them "in nature very subtle and sharp-witted, ready to conceive our meaning by signs, and to make answer well to be understood again; and if they have not seen the thing whereof you ask them, then they will wink, or cover their eyes with their hands, as who would say, it hath been hid from their sight. If they understand you not whereof you ask them, they will stop their ears."† The natives of Melville Peninsula make use of winks and nods in conversing; the former conveying a negative meaning, and the latter, as with us, an affirmative. The natives of Schismareff Inlet, when urged to an interview by Kotzebue, hit their heads with both hands, and then fell down as if dead; as much as to say that their lives were not safe: and, in order to make him understand the time it would take him to reach a particular spot, one of the little community

* Sauer's Account of an Expedition into the North Parts of Russia.

† Richard Hakluyt's Collection of Curious Voyages.

performed the following pantomime. He seated himself on the ground, and made the motion of rowing, by the necessary movements of his arms; this business he interrupted nine times, closing his eyes as often, and resting his head on his hand. Thus Kotzebue learned that it would take him nine days to get to his destined haven.

Captain Beechy obtained a knowledge of the coast he was surveying from a native of the same locality, after the following very ingenious and intelligible manner. The coast line was first marked out with a stick on the sand, and the distances regulated by the day's journey. The hills and ranges of mountains were next shewn by elevations of sand or stone, and the islands represented by heaps of pebbles, their proportions being duly attended to. Where the mountains and islands were erected, the villages and fishing-stations were marked by a number of sticks placed upright, in imitation of those which are put up on the coast wherever these people fix their abode. Thus, a complete topographical plan of the desired coast was, in the most intelligible manner, clearly laid down. The Esquimaux are, moreover, equally ready at comprehending similar methods adopted by Europeans, as Sir John Ross proved, when, in order to fix with the natives of Regent's Inlet the date of an appointment, he drew on the snow the form which the moon would then present. These people, we are further informed, at once adopted the use of the knife and fork, and all the paraphernalia of refined society connected with the table.* A little boy at Melville Peninsula could imitate the cries of almost all the birds and animals he was acquainted with; the young ducks answering the distant call of the mother, having all the effect of ventriloquism. Every sound from the angry growl of a bear to the sharp hum of a musquitoe, we are informed, he was able to express in a wonderful manner.

This art is turned to account in the chase of the deer, by imitating the peculiar bellow of these animals from behind a large piece of rock or some other natural screen; and thus

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* Sir John Ross's Expedition in the Victory.

they are led by curiosity to within gun-shot.* Boys from 12 to 16 years of age at once comprehend the mechanism of the gun, and will discharge it for the first time with perfect steadiness; and the men, with very little practice, soon become superior marksmen.† A case is recorded of a native of Labrador who killed an animal with the first shot he ever fired.‡ The same individual, in company with two of his countrymen, while on a visit to Lord George Sutton at Kelham in Nottinghamshire, in 1772, was in at the death of a fox, which happened in an open field, with three couples and a-half of hounds out of twenty-five, a proof how hard they must have driven him, although neither of them had been on horseback more than three times before.§

A disposition for aping European gait and manners was apparent among the natives of Kotzebue's Sound,‖ the River Clyde,¶ Melville Peninsula,** and Regent's Inlet.†† A favourite mode of shewing this propensity was by aping the English custom of walking up and down the deck of a ship. A shrewd, observing, merry fellow of Kotzebue's Sound, perceiving the officers of Captain Beechy's ship thus employed, determined to turn them into ridicule, by seizing a young midshipman by the hand, and strutting with him up and down the deck in a most ludicrous manner, to the great diversion of all present; and two native women of Melville Peninsula insisted upon walking arm-in-arm with Captain Lyon, in consequence of having been told that such was the practice of the Kabloona ladies, as they term our fair countrywomen. The father of a young female of Kotzebue's Sound shewed this kind of talent in another way. Observing Captain Beechy sketching his daughter's portrait, he seated himself down with a piece of flat board and plumbago, and very good humouredly commenced a portrait of him, aping his manner, and tracing every feature with the most affected care, whimsically applying, at

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* Lyon's Private Journal.
† Parry's Second Expedition.
‡ Cartwright's Journal.
§ Idem.
‖ Beechy.
¶ Parry's First Expedition.
** Lyon's Private Journal.
†† Ross's Expedition in the Victory.

the same time, his finger to the point of his pencil, instead of a penknife, to the great diversion of his wife and daughter. Captain Beechy has not informed us of the extent of his talent as a portrait-painter; but it appears that he omitted the hat which Captain Beechy wore, and he was extremely puzzled to know how to place it upon the head he had drawn.

A lively little boy of Melville Peninsula, of four years of age, performed an aping trick after nearly the same fashion. Having witnessed an officer noting down the names of persons and things in a memorandum-book, he took it up, with the pencil, and then walked to every person in the hut, and gravely asked him his name, affecting, at the same time, to write it down;* and a very amusing application of the art was practised by a native of the River Clyde. Sir Edward Parry had placed him on a stool for the purpose of taking his portrait; and as he from time to time became weary, he was reminded to keep his position by Sir Edward Parry putting himself in the proper attitude, and assuming a grave and demure look. These actions the native always imitated in such a manner as to create considerable diversion among all present, and then very quietly kept his seat.† The mimicry of the Esquimaux, however, is said to be complete when the women form themselves into groups in order to gossip and talk scandal; they then ape in perfection the manner of the persons of whom they speak, interlarding at the same time their stories with jokes at the expense of the absentees, though to their own infinite amusement.‡

The natives of Kotzebue Sound are considered by Captain Beechy very superior to the South Sea Islanders in recognising plates of natural history, if they represent those creatures with which they are acquainted—a talent which Sir Edward Parry turned to good account at Melville Peninsula, by obtaining from a native woman named Iligluik, a knowledge of the habitat of the *Larus sabina*, a species of gull which led to his adding that *rara avis* to his natural historical collection.§ The same intelligence was observed among others of the same

* Lyon's Private Journal.

† Parry's First Expedition.

‡ Parry's Second Expedition.

§ Ibid.

community; and one of them named Toolemak learned himself to draw very fairly. So it was with Augustus, Sir John Franklin's interpreter; and Sacheuse, who filled the same office in Sir John Ross's expedition to Baffin's Bay in 1818, became sufficiently master of the art as to make a drawing of the first interview of the exploring party with the Esquimaux of Regent's Bay, which, from its value, was engraved as an illustration to the narrative of that expedition.

We have the strongest evidence that their geographical knowledge is as perfect as the most civilized being could possibly attain, unassisted by nautical instruments. Iligluik, and a native man of the same tribe with herself, drew the coast-line from Winter Island to Igloolik, and pointed out the existence of the Fury and Hecla Strait, "with peculiar intelligence and extraordinary precision;"* and two natives of Regent's Inlet, named Ikmallik and Tiagashu, were no less accurate in the delineation of that extraordinary neck of land, the Isthmus of Boothia.†

The art of domesticating animals, and turning them to account, is no mean proof of intellectual power; an art which we find in perfection amongst these people in regard to the dog, the only animal they can turn to account in the inhospitable regions they inhabit. Further, if we agree with the eminent historian Robertson, that tact in commerce, and correct ideas of property, are evidence of a considerable progress towards civilization, we must give the Esquimaux credit for great intelligence. More of this hereafter. Again, the neat mode of arranging their hair and dress, and the women being required to labour less than the men—the very reverse of that which is generally the case with uncivilized tribes—is further proof of intelligence.

As a test of intellectual power, it is both interesting and important to study the first impressions of the uncivilized, relative to the arts of civilization. A favourable opportunity to watch this trait of character occurred in two men, with each a wife and child, natives of Labrador, brought to England

* Parry's Second Expedition.

† Ross's Expedition in the Victory.

by Captain Cartwright in 1772. The number of shipping they saw at London Bridge greatly astonished them, but the bridge itself, they passed through without taking the least notice of it. It was soon discovered they had taken it for a natural rock which extended across the river. They laughed at Captain Cartwright when he told them it was the work of man; nor could they be persuaded to the fact until they came to Blackfriars' Bridge, which he caused them to examine with more attention; shewing them the joints, and pointing out the marks of the chisels upon the stones. They no sooner, however, comprehended by what means such a structure could be raised, than they expressed their wonder with astonishing significancy of countenance. St Paul's, also, they supposed to be a natural production; and they were quite lost in amazement when they were taken to the top, and convinced that it was a work of art. The people below they compared to mice, and insisted that it must be at least as high as Cape Charles, a mountain of considerable altitude. The exquisite nose of the hound, the sagacity and steadiness of the pointer, and the speed of the greyhound, were matters of great astonishment to them. But above all, they were most struck with the strength, beauty, and utility, of that noble animal the horse. At first the multiplicity and variety of objects confused them, and on one occasion, one of the men named Attiock, after a long walk, remained very pensive, and then turning up his head, and fixing his eyes upon the ceiling, he broke out into this soliloquy, "Oh! I am tired. Here are too many houses; too much smoke; too many people; Labrador is very good; seals are plentiful there; I wish I was back again." The longer, however, they continued in England the greater was their admiration in proportion, their ideas gradually expanding till at length they began more clearly to comprehend the use, beauty, and mechanism, of what they saw.

They attracted great notice during their stay in this country. On witnessing a review by His Majesty they were so surrounded by the crowd as to incommode their view, which attracting the notice of the King, he gave orders for their admission into the reserved ground. Here his Majesty rode slowly past them, and condescended to salute them by taking off his hat, accompanied with a gracious smile; honours which they were highly pleased with, and often mentioned afterwards with great exultation. Provided with cloth dresses after their own fashion, instead of seal-skin, they were taken to Court by Royal command, where their behaviour and dress rendered them conspicuous objects. They were at the opera when their Majesties were there, and chancing to sit by Mr Coleman, the manager of Covent Garden Theatre, he invited them to a play. He fixed upon Cymbeline, and they were greatly delighted with the representation. But their pride was most highly gratified at being received with a most thundering applause, by the audience on entering the box. The men observed to their wives, that they were placed in the King's box, and received in the same manner as their Majesties at the opera, which added considerably to their pleasure. They returned with Captain Cartwright to their country and friends to all appearance well; but in the ensuing Autumn they died of small-pox.

Travellers who have visited the Esquimaux at their own homes, have also furnished us with some interesting facts regarding their first impressions. Kotzebue informs us, that nothing attracted the attention of the St Lawrence Islanders so much as his telescope. The same admiration of that instrument was observed of the Esquimaux of the Mackenzie. They called it eetee-yaw-gah (far eyes), the name that they give to the wooden shade which is used to protect their eyes from the glare of the snow, which, from the smallness of its aperture, enables them to see distant objects more clearly.* The report of a gun astonished them much, and an echo from some neighburing pieces of ice, made them think that the ball had struck the shore then upwards of a mile distant;† while the Esquimaux of the Coppermine River, when fired upon by Hearne's party ran and picked up the musket-balls, supposing them to be thrown to them as presents.‡ Perceiving fumes of tobacco issuing from the mouth of a person smoking, they

* Franklin's Second Journey. † Idem.

‡ Hearne's Journey to the Frozen Ocean.

called out ookah, ookah (fire, fire), and demanded to be told what he was doing.* European clothing they conceived to be made out of the skins of animals; and since they had none such in their country, they asked what sort of animals they were and where they were to be found.† Not recognising themselves in a looking-glass, the natives east of the Coppermine River, endeavoured to find the stranger by peeping round the corner of the glass.‡ At seeing Captain Ross and Lieutenant Parry drawn on sledges by their men, they laughed heartily;§ a proof they had no knowledge of difference of rank. They doubtless took them for children of an older growth at play. Glass they took for ice,‖ biscuit for the dried flesh of the musk-ox;¶ watches, and musical instruments, for living creatures; a musical snuff-box being, in their opinion, the child of an hand-organ;** a little terrier dog was looked upon with contempt by the natives of Regent's Bay, as being too small to draw a sledge; but had they known its intelligence, they would probably have been as desirous of obtaining it as the natives of Prince Williams Sound were a spaniel belonging to Captain Billings. That animal took a particular dislike to the natives, and being one day on shore tented with his master, he had an opportunity of displaying it. The cabin-boy had carelessly placed the tea-board, so that part of it with spoons, &c. were seen on the outside of the tent. One of the natives, perceiving this, appropriated the spoons to himself, which no one observed but the dog, who sprang up, leaped over those in the tent, seized the thief by the hand with the spoons in it, and held him fast till Captain Billings told him to let go; a circumstance which kept the whole community honest ever afterwards in the dog's presence.††

A little black cat, belonging to Captain Lyon, afforded the natives of Melville Peninsula an unceasing fund of amuse-

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* Dr Richardson's narrative in Franklin's Second Journey.

† Captain Ross's First Expedition.

‡ Kotzebue; Franklin. § Ross's first expedition. ‖ Idem.

¶ Parry. ** Lyon's Private Journal.

†† Sauer's Account of an Expedition into the North parts of Russia.

ment; and when the animal jumped over the arms folded for the purpose, their admiration was expressed by slowly and forcibly inhaling their breath and quickly nodding their head.* A sailor, walking upon his hands along the deck of Lieut. Chappel's vessel, in Hudson's Straits, threw them into a violent fit of jumping and shouting;† and a mixture of mirth and admiration was excited by the effects of a winch, at which one man easily mastered and drew towards him ten or twelve others who held by a rope, using all their strength, and grinning with exertion and determination till conquered.‡

The natives of Regent's Bay shrunk back, as if in terror, from a pig whose pricked ears and ferocious aspect presented a somewhat formidable appearance. The animal happening to grunt, one of them was so terrified that he became from that moment uneasy, and appeared impatient to get away, and all the rest took to their heels in alarm at witnessing the exhibition of some juggler's tricks.§ When the women of Winter Island were informed that the Kabloona ladies were not tattooed, they were astonished at their being so devoid of taste; but when told that they never wore breeches, a general cry was raised "how cold they must be."‖ On a royal salute being fired, three or four hĕy-yaī's (our "dear me"), were the sum-total of their remarks; and before the salute was ended, the whole party of Esquimaux, who were assembled for the purpose, became tired of it, although none of them had ever heard a great gun or seen a flag. Captain Lyon led an old woman to the side of a 24-pounder carronade, and entered into conversation with her, when he observed that at the explosion she did not even wink her eyes, but very earnestly continued a long story about a pair of boots for which some of his people had not contented her.¶

From an anecdote, related by Captain Beechy, of the

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* Lyon's Private Journal, p. 145.

† Narrative of a Voyage to Hudson's Bay, p. 66.

‡ Lyon's Private Journal, p. 140.

§ Ross's First Expedition.

‖ Lyon's Private Journal, p. 251. ¶ Idem, p. 402.

natives of Kotzebue Sound, he has come to a different conclusion regarding their nervous sensibility. He states, that the people of that vicinity were very inquisitive about his firearms, and to satisfy one of them, he made him fire off a musket that was loaded with ball, towards a large tree that was lying upon the beach. "The explosion, and the simple operation of touching the trigger," he adds, "so alarmed the native, that he turned pale, and put away the gun. As his fear subsided he laughed heartily, as did all his party, and went to examine the wood, which was found to be perforated by the ball, and afforded a fair specimen of the capability of our arms; but he could not be prevailed upon to repeat the operation."

Surely it is quite clear, upon Captain Beechy's own shewing, that it was *the recoil of the musket*, and not the *simple operation of touching the trigger*, that alarmed the native, for he struck the object he aimed at. That the musket was either overloaded or a kicker is evident; and I question if it would be deemed a *simple operation* to pull the trigger of a thoroughpaced kicker. That the perforation of the wood afforded the natives a fair specimen of the capabilities of Captain Beechy's firearms, I am quite prepared to believe; but the circumstance which forced itself upon my mind, on reading the anecdote, was, that the youth should have struck the object he aimed at with his first shot, which, it appears, made no impression upon Captain Beechy.

In stating, that if, according to the historian, Robertson, tact in commerce is an evidence of a considerable progress toward civilization, we must give the Esquimaux credit for great intelligence, I had reference not only to their commercial transactions amongst themselves, but with the neighbouring Red men and Europeans; and my reasons for again alluding to the subject is to remove the impression, "that they have little intercourse and commerce with their nearest neighbours." The fact is, that there are no people in either of the continents of America whose commercial system is so well organized as that of the Esquimaux. Sir John Franklin, and, more recently, Messrs Dease and Simpson have informed us that trade is carried on between the Esquimaux of the Mackenzie, and the Loucheux, and Hare Indians, and that along the whole line of coast from the Mackenzie River to the Russian settlements in North Western America, furs on the one side, and European manufactures on the other, are annually exchanged at regularly established fairs; and thus pass from tribe to tribe, until, about the close of summer, they reach their respective limits.

Of the Esquimaux of the west coast of Greenland, Crantz observes, "that amongst themselves they hold a kind of fair. The Winter Festival of the Sun is frequented by persons who expose their wares to view, and make known what commodities they want in exchange. Any one disposed to purchase, brings the goods in request, and the bargain is complete. The principal trade is in vessels of Weichsteen, which is not to be met with in every place. And since the Southlanders have no whales, while the inhabitants of the north coast are in want of wood, numerous companies of Greenlanders make every summer a voyage of from five hundred to one thousand miles to the north, and even from the east coast to Disko, in new Caiaks, and Oomiaks. They barter their lading of wood for the horns of the narwhale, the teeth, bones, and sinews of the whale, which they, in part, sell again during their return homewards. To the factors, the Greenlanders carry fox and seal skins, but particularly blubber."*

Captain Graah, in describing the island of Attuk, remarks, that "an annual fair is held by the Eastlanders and Westlanders of Fredericsthal, who go there in the summer for the purpose of catching seals of the Cristata species.† The articles of barter are bear, seal, and dog skins for articles of European manufacture, and especially for spear and arrow heads, knives, needles, handkerchiefs, and tobacco."‡ I have also stated, that the Esquimaux of Churchill in Hudson's Bay, and of the Great Fish River, meet annually near the head waters of the latter, for the purpose of trading among themselves, and with the Chipewyans.

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* Crantz's History of Greenland, pp. 160 and 161.

† Narrative of an expedition to the east coast of Greenland, by Captain W. A. Graah, p. 66. ‡ Idem, p. 81.

The estimation in which women are held among the Esquimaux is something greater than is usual in savage life,* if we except the natives of Greenland,† who are not only physically, but mentally, inferior to the most of their brethren. It is a very general custom for parents to betroth their children in infancy; and this compact being understood, the parties, whenever they are inclined and able to keep house, may begin living as man and wife, the husband being thenceforth bound to labour for their support; and this is not unfrequently the case at thirteen or fourteen years.‡ Where previous engagements are not made, the men select their wives amongst their relations or connections, paying but little regard to beauty of face or to person. Young men naturally prefer youthful females; but the middle-aged will connect themselves with old widows, as being more skilled in household duties, and better able to take care of their mutual comforts.

The marriage ceremony is very simple. The youth declares his passion to the parents and relatives on both sides; and, having obtained their consent, he immediately repairs to the habitation of the bride to take her away, if he considers himself strong enough; but if not, he presses into the service two or more old women, whose duty it is to convey the bride to her new home,—a work of no little difficulty; for, though ever so anxious for the union, it is incumbent upon her to appear otherwise, and she must contend with the messengers with all her might, or she will lose caste for modesty. After due, though prudent, reluctance, she at last yields, and is conveyed to her husband's home, where further ceremony must be gone through. For some time she keeps at a distance, sits retired in some corner upon the bench, with her hair dishevelled, and her face covered. In the mean while the bridegroom uses all the rhetoric of which he is master, and spares no pains to bring her to a compliance with his wishes. This is generally successful, and the wedding is concluded.§

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* Parry, 526; Richardson; Curtis.

† Crantz.

‡ Lyon, 352; Parry, 378; Ross, 251.

§ Egede; Parry.

It is not always mere dissimulation on the part of the bride; for sometimes she faints, sometimes elopes among the mountains, and not unfrequently cuts off her hair,—an act of greater importance to an Esquimaux woman than that of assuming the veil to an European, for she is then doomed to perpetual celibacy, whatever her after inclinations may be. If, however, she has not gone to the last extreme, the women go after her, and drag her by force to her suitor, who, in this case, uses to his utmost his persuasive powers, and when no kind and courteous behaviour will avail, compulsion is had recourse to. If she should then say, with Falstaff, "Not by compulsion," and she should not speedily get a husband, neglect is succeeded only by death from starvation.*

A very amusing anecdote is related by Captain Cartwright, of a little love-making on his part. Eketcheak, a native of Labrador, married a second wife, a young girl about sixteen years of age. "I took," says Captain Cartwright, "a fancy to her, and desired that he would spare her for me, as I had no wife, and in great want of one. He replied, 'You are welcome to her, but I am afraid she will not please you, as her temper is very bad, and she is so idle that she will do no work, nor can she use a needle; but my other wife is the best tempered creature in the world; an excellent sempstress, is industry itself, and above all, she has two children, all of whom are much at your service; or, if you please, you shall have both, and when I return next year, if you do not like either the one or the other, I will take them back again.' I thanked him for his extreme politeness aud generosity, and told him that I could not think of depriving him of the good wife and two children, but would be contented with the bad one. 'You shall have her,' said the native; 'but before we proceed any farther in this business, I wish you would mention it to her relations, and obtain their consent.' Her father being dead, I sent for her mother and two uncles, who readily gave their consent, and expressed great pleasure at the honour of the alliance. I then communicated my wishes to the young lady; but she no sooner understood what they were, than she

* Crantz; Parry.

began to knit her brows; and the instant I had concluded my speech, in which I expatiated on the pleasure, elegance, and affluence which she would experience as my wife, to what she enjoyed in her present state, she contemptuously replied, 'You are an old fellow, and I will have nothing to say to you!'" Here ended the courtship.

Egede informs us, that, in Greenland, if the father of the youth is rich enough he gives a matrimonial feast, and prizes, to be contended for by running matches, a feast which lasts for two days.

The Esquimaux are polygamists, but they rarely have more than two wives, and only one if she have issue; and the women have the same privilege as to the number of husbands.* Sir John Ross found two brothers at Regent's Inlet, having one wife between them.†

With the exception of the Greenlanders the women are treated well; are rarely, if ever, beaten; are never compelled to work, and are always allowed an equal authority in the household affairs with the men. Though a phlegmatic people, the Esquimaux may be said to treat them with fondness; and young couples are frequently seen rubbing noses, their favourite mark of affection, with an air of tenderness.‡ Okotook and his wife Iligliuk were frequently observed taking each other by the hand from mutual affection; a convincing proof, in Captain Lyon's mind, not only that Iligliuk was treated with great tenderness, but that she loved her husband.§ In allusion to an illness which Okotook laboured under, Captain Parry remarks of Iligliuk, that nothing could exceed the attention which she paid to her husband; she kept her eyes almost constantly fixed upon him, and seemed anxious to anticipate every want.‖ It sometimes occurs, from inequality in a numerical point of view between the sexes, that a man journeys to a distant tribe in search of a wife. A native of Regent's Inlet had a propensity this way on a grand scale. He had discovered a tribe to the westward, where the females were most numerous; and when a wife was wanted for some of his party he transferred to him his own wife and went for another to himself; a friendly service which,

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* Crantz; Ross. † Ross, 356. ‡ Lyon, 353.
§ Lyon, 150. ‖ Parry, 217.

we are informed, he had performed no less than six times.* The advantage of this, as far as he was concerned, was obvious; for in each of the six families he had a son or two, so that in his old age he might, according to custom, claim support from all or any of them, or from the most successful in hunting, as he was entitled to the share of a father.

At Igloolik and Regent's Inlet, cousins are allowed to marry,† but a man will not wed two sisters;‡ while at Greenland, marriage between cousins is rare, and there are instances of men having taken to wife two sisters at the same time, and even mother and daughter. Sir Edward Parry has related two instances which occurred at Igloolik of the father and son being married to sisters.§ A son or daughter in law does not consider father or mother in law in the light of relations.‖ If a boy and a girl, although in no way related, have been brought up in the same family, they are looked upon as brother and sister, and are not allowed to marry.

The Esquimaux sometimes repudiate their wives, from real or supposed bad behaviour;¶ or, as is more generally the case, owing to their having no issue. The ceremony is very simple. The arctic lord bestows a cross look upon his lady, and then leaves his home. The lady at once understands him, packs up her traps, and domiciles herself with her former protectors.

Instead, however, of repudiating their wives for want of issue, they more frequently adopt the children of others. This custom was found to be extensively practised at Melville Peninsula, and the advantage is obviously that of providing for a man's own subsistence in advanced life; and it is, consequently, confined almost exclusively to the adoption of boys, who can alone contribute materially to the support of the aged and infirm. When a man adopts the son of another as his own, he is said to "tego," or take him; and, at whatever age this is done (though it generally happens in infancy), the child then lives with his new protectors, calls them father and mother, and is himself looked upon as the rising head of the household.** The agreement is almost always made between

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* Ross. † Lyon; Ross. ‡ Lyon, p. 352. § Parry, 528.

‖ Lyon; Ross. ¶ Lyon. ** Lyon, 353; Parry, 532.

the fathers. Toolemak, an angetkook, or priest, having lost all his own children, was found by Sir Edward Parry to have adopted some of the finest male children of the tribe. For the same reason, a widow with a family never pines for want of a husband. It is on record, that a happy widow with five children was received with open arms as the partner of another, almost immediately after the death of her husband.* If she has no family by this second husband, and she has no partiality for him, as soon as her sons are grown up, and become seal-catchers, she can desert her old benefactor; for by law she has absolute power over her sons' labour. It is evident, therefore, in Esquimaux land, that the widows with families have it all their own way.

And now let us consider the position of the childless widow, or, what is the same thing with the Esquimaux, the widow with infants of that tender age that they are not likely to be soon turned to account, as suppliers of provision. Poor creature! her fate is a hard one. While bewailing the loss of her husband to distraction, his effects are clandestinely purloined by her guests, who, at the same time, bear the compliments of condolence on their tongue. The bereaved widow has no resource, but to endeavour to ingratiate herself with him who has been her greatest plunderer. He will keep her a while, and, when he is tired of her, she must try to insinuate herself into the favour of another. But at last she and her children are left to their hard fate. A little longer, perhaps, they protract life by eating shell fish, and sea-grass; but finally they die from starvation. In Captain Parry's narrative of his second voyage, a very affecting case of this kind is recorded.

Self-preservation has evidently given rise to this custom; for the most able hunters at certain seasons have great difficulty in providing for themselves; and since neglect must fall heavily upon some, it is natural to suppose that a man will first cling to his wife and children. But I have no excuse for the cruel system of robbery which custom entails upon the weak and the friendless.

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* Ross, 515.

When there are no children it is considered a reproach to both parties, but the poor woman generally gets the most blame, and is very ill treated, except she is a wise woman, and then she obtains a second husband and has another chance.

Nothing can exceed the affection of the Esquimaux for their children; which is displayed, not in the mere passive indulgence and abstinence from corporal punishment, but by a thousand playful endearments, such as parents and nurses practise in our own country. Nor, indeed, is severity necessary; for the gentleness and docility of the children are such as to occasion their parents little trouble. Even from their earliest infancy the Esquimaux possess that quiet disposition, gentleness of demeanour, and uncommon evenness of temper, for which, in more mature age, they are for the most part distinguished. Disobedience is scarcely ever known; a word or even a look from a parent is enough; frowardness and disposition to mischief, so common to our youth, form no part of their disposition. They never cry for trifling accidents, and sometimes not even from very severe hurts, at which an English child would sob for an hour. It is, indeed, astonishing with what indifference even tender infants bear the numerous blows they accidentally receive while carried at their mothers' backs.*

It has been asserted by a late traveller, that the Esquimaux will barter their children for some trifling present;† but, believe me, and I have been at some pains to determine that point, there is no ground for such an assertion. Sir Edward Parry was at first inclined to fall into this error, but upon a better acquaintance with the people, he discovered his mistake; and, let it be said to his praise, he has freely and publicly corrected himself.‡

Esquimaux youth are as fond of play as any other young people and of the same kind; only, that, while an English child draws a cart of wood, an Esquimaux of the same age has a sledge of whalebone; and, for the superb baby-house of the former, the latter builds a miniature hut of snow, and begs a lighted wick of her mother's lamp to illuminate the little dwell-

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* Lyon. † Back. ‡ Parry, p. 531.

ing. Their parents make for them, as dolls, little figures of men and women habited in the true Esquimaux costume, as well as a variety of other toys; many of these having some reference to their future occupations in life, such as canoes, spears, and bows and arrows. They sometimes serrate the edges of two strips of whalebone, and whirl them round their heads, just as boys do in England, to make the same peculiar humming sound. They will dispose one piece of wood on another as an axis, in such a manner that the wind turns it round like the arms of a windmill; and so of many other toys of the same simple kind. These, and possibly the smaller puppies, are the distinct property of the children, who sometimes sell them, while their parents look on without interfering or expecting to be consulted.

The education of children, according to Crantz, is thus conducted:—As soon as the boy can make use of his hands and feet, his father puts a little bow and arrow into his hand, that he may exercise himself by shooting at a target, and also instructs him in throwing stones at a mark. Towards his tenth year he provides him with a caiak, to practise rowing, oversetting, and rising, fowling, and fishing, by himself, or in company with other boys. In his fifteenth or sixteenth year he must go out with his father to catch seals. The first seal he takes is consecrated to make a festivity for the family and neighbourhod. During the repast, the young champion must relate his noble achievement, and how he managed to catch the creature. The guests admire his dexterity and prowess, pronounce the meat to be particularly good flavoured; and from this day the females begin to think of finding him a bride. At the age of twenty years he must make his own caiak, implements, and weapons, and fully equip himself for his profession; and if he is successful, he marries. To acquire perfection in the use of the caiak is no mean part of his education. Few become proficients; many, in consequence, are the lives that are lost by drowning.

The girls do nothing till they are fourteen years of age, but chatter, sing, and dance, with the exception of fetching water, and perhaps waiting on a child. But afterwards they must sew, cook, dress leather, and, when they advance further in years and strength, help to row the woman's boat, where these are in use ; and, in Greenland, even build houses. From the twentieth year of a woman's life to her death, her life is a continuation of fear, indigence, and lamentation. If her father dies, her supplies are cut off, and she must serve in other families. She is thus secured abundance of provisions, but she will want good clothing ; and for want of this, especially if she be not handsome in person, or dexterous in her work, she must remain single. Should any one take her to wife, she fluctuates between hope and fear for the first year, lest from want of children she should be repudiated, and then her character is lost ; she must return to servitude, and perhaps purchase the support of life at a scandalous rate. If her husband retains her, she must now and then take a blow in good part, must submit to the yoke of a mother-in-law, or must submit to his having another wife or two. If her husband dies, she has no other jointure but what she brought with her ; and, for her children's sake, must serve in another family more submissively than a single woman, who can go where she will. But if she has any grown up sons, she is then better off than any married woman, because she can regulate the domestic affairs as she pleases. If a woman advances to a great age, and has no family to keep up her respect, she must pass for a witch ; which, being attended with some profit, she by no means dislikes.

Notwithstanding all the hard labour, fear, trouble, and vexation, the women commonly reach a greater age than the men, who are so worn out and enfeebled by passing most of their time at sea, in snow and rain, heat and cold, during the severest winters as well as summers ; by strenuous labour ; and by alternate fastings and feastings, that they seldom attain the age of 50. Many also lose their lives in the water, so that there are everywhere fewer men than women. The women frequently live till they are 70, and even 80 and upwards.

The Esquimaux believe in future rewards and punishments, and, like most other uncivilized races, have traditions concerning the creation and the deluge. They have their priests, in whose sayings and doings they put implicit belief, and their superstitions. As far as we know, no kind of religious worship exists amongst them.

The dead are dressed in their best clothes, and conveyed, not by the regular entry, but through the window.* The persons performing these duties, put on gloves, and stop their nostrils with skin or hair. Infants have their feet placed towards the rising sun, or east; half-grown children south-east; men and women in their prime with their feet to the meridian sun; middle-aged persons to the south-west; and very old people the reverse of children, or west.† It is customary to place weapons at the grave of a man, and culinary utensils and sewing materials at the grave of a woman;‡ and in Greenland, according to Egede, the head of a dog is placed near the graves of little children, as a guide to the land of souls. Dishevelled hair, and abstinence from the duties of the toilette, and from all gaiety, for a time, is adopted as a mourning rite; and the graves of the departed are frequently visited. At Melville Peninsula, it is usual to walk round the grave in the direction of the sun, and to chant forth inquiries as to the welfare of the departed soul,—Whether it has reached the land of spirits? If it has plenty of food?§ At the funeral of the inhabitants of Greenland, it is usual for a woman to brandish a lighted stick, at the same time calling out—*Piklerrukpok,* "Here is no more to be got." ‖

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*Ninth Letter on Glaciers; addressed to Professor Jameson. Remarks on the Recent Observations made on the Glacier of the Aar (in* 1844) *by direction of M. Agassiz.* By Professor FORBES, F.R.S., Corresponding Member of the Institute of France. Communicated by the Author.

EDINBURGH, *7th March* 1845.

MY DEAR SIR,—However satisfied one may be with the conclusiveness of their own experiments, it is always pleasing when they are confirmed by others even in their minuter

* Lyon, 370; Egede, 153. † Lyon, 371. ‡ Lyon, 371; Egede, 151.
§ Lyon, 371. ‖ Egede, 153.

particulars, especially if the observations have been made in circumstances at all different. In this respect, I find with pleasure, from a communication read at the Institute on the 9th December last, that M. Agassiz's coadjutors on the glacier of the Aar, have obtained results so perfectly accordant with those which you have done me the favour of publishing on former occasions, that they would have satisfactorily established, had earlier observations been awanting, the viscous theory of glacier motion with which alone they are reconcilable; the single seeming antagonism to my own measurements being one which tells still more in favour of that view.

I propose to give a brief summary of these results, and to shew their correspondence with my own. This correspondence—amounting almost to coincidence—is, of course, *to me*, a satisfactory guarantee for their accuracy, as far as they go. By others, the goodness of the instruments, and the expertness of the observers, must, in the mean time, be taken for granted.

It is hardly necessary to premise that M. Agassiz and his friends now admit that all glaciers move fastest at the centre, and slowest at the sides.

But a new fact still less reconcilable with the dilatation theory resulted from the first attempt to apply geometrical measurement to the motions of this glacier; viz.,

I. The glacier of the Aar moves *fastest* in its middle region, and slower in its upper and lower regions (*i. e.* towards the origin and termination). The slowness in the upper region does not so plainly follow from the facts at present before us, but the retardation towards the termination of the glacier is undoubted. The following are the motions originally ascertained, in $\frac{3}{4}$ of a year, or, more exactly, 289 days. We prefer retaining the original measures in *Swiss feet;* the stations are in *descending* order, and a quarter of league (4000 feet) apart* (the second in order indicates the rock called Hôtel des Neufchâtelois.)

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* Bulletin de la Societé de Neufchâtel, 8th Nov. 1843.

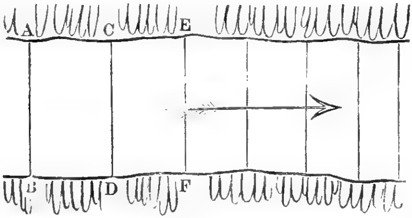
169.2 Swiss feet
177.1
141.3
150.1
133.1
83.7
58.3

This result is very different *numerically* from that which I obtained on the Mer de Glace of Chamouni, but the difference is of the kind which might have been expected from their great diversity of situation and circumstances. I never expected, or pretended to find in the Mer de Glace the same peculiarities of velocity as in other glaciers ; on the contrary, I endeavoured to shew* what were the *local peculiarities* as to slope, and breadth, which probably produced the law of variation of the motion which I observed, slowest in the middle, and quickest towards either end, precisely the reverse of that observed by M. Agassiz ; but I neither depreciate the accuracy of his surveyor, nor contend that one cause of motion sways the glacier of the Aar, and another that of the Montanvert. On the contrary, the difference appears to me entirely conformable to the viscous theory ; and the glacier of the Aar, in this respect, a more instructive example than the Mer de Glace of Chamouni.

I have shewn in one of the passages of my work just cited, that the velocities of the different portions of the glacier depend, among other things, on their inclination or slope ; and hence, I should have inferred, that in a glacier which did not slope faster and faster towards its lower end, till it becomes almost precipitous, there would be accumulating resistance due to the friction of the ice on the bed of a long, nearly uniform, gently sloping valley, such as that which contains the glacier of the lower Aar, which must magnify the tendency which the ice has to be squeezed *forwards and upwards* against the mass immediately in advance of it, which produces the *frontal dip* of the ribboned structure or

* Travels in the Alps, p. 145, 371.

slaty cleavage of the ice, in the way that I have explained in my Seventh Letter. In a glacier then, whose slope is nearly constant and small, I should expect a *condensation* of the ice longitudinally, and a swelling of the surface depending upon the motion of the plastic ice in the direction of least resistance. Now this is exactly what we have in the results of measurement. If the annexed figure represent the plan




of the glacier, and the ice be divided into imaginary compartments by vertical sections; since, whilst AB moves 177 feet, CD moves but 141 feet, there is a *condensation* of the mass of ice A B C D, from back to front, of no less than 36 feet in that time, and so for the successive slices E F, &c. How, then, is this shrinking to be accounted for? Not by the mere internal melting, for that would produce merely a lowering of the surface, and a *subsidence* of the level of the ice; such as I have shewn* actually takes place in other glaciers whose sections move with increasing velocity on the whole. There is only a *vis à tergo* which can approximate the sections together, and, as we read in the Comptes Rendus, *squeeze the moraine* longitudinally, giving it a greater breadth,† and condense the entire body of the ice so as to make it more compact in texture.‡

If we take a *vertical section* instead of a plan (see next page), the slice *a b c d* must be condensed into the higher and shorter solid *c d e f*, and so of the rest, and the surface

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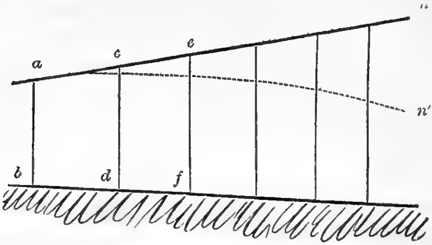
* Travels, p. 153.

† Les "Moraines médianes s'élargissent dans la même proportion que le mouvement se ralentit." Comptes Rendus, 9th Dec. 1844, p. 1301.

‡ Ib. p. 1306, line 29.

will be a swelling one, as *a c e n*, which might even rise to-




wards valley, but generally need only be less sloped than the bed. The effect of superficial thaw, and internal subsidence, diminishes this again, and gives it the form of the dotted curve *a n'*.

In these diagrams the varying velocity in different parts of the transverse section is, for simplicity, kept out of view.

A retardation of the foremost portion of a viscid stream, and consequent heaping of its surface, is exactly imitated in the models formed of plaster of Paris, which I have elsewere described, and which, though of uniform fluidity from end to end, and therefore not subject to the objection arising from the cooling of lava, where a precisely similar fact is observed, reproduce faithfully the motions of the glacier of the Aar.

The fact established on the glacier of the Aar satisfactorily refutes the notion that a predominant state of compression in a glacier is incompatible with the existence of transverse crevasses.

II. *Continuity of motion.* Until recently it was a question entirely unresolved, whether the glaciers move by insensible and nearly uniform degrees, or whether they start forward by short jerks, as might be expected if the movement in their irregular channels were effected by piecemeal fractures, local subsidences, and the justling of independent fragments. Accordingly when I determined, for the first time, in June 1842, the absolute continuity of the motion down even to the interval of an hour,* it seemed impossible to reconcile this

* See first Letter on Glaciers in this Journal, October 1842, p. 340.

to the only modification of De Saussure's theory applicable to the case, and the fact seemed to point, as a necessary consequence, to an insensible yielding of parts throughout the whole mass, which therefore moves *as a whole,* and not by jerks occasioned by strains upon a nearly rigid mass when they attain the limit consistent with the small play of flexibility of the particles, as some authors would have us believe.*

It is satisfactory to have an entire confirmation of these particulars, from the observations made on the glacier of the Aar in 1844. The observations were made "to the accuracy of a millimetre on the movement of the glacier *from hour to hour,*"† and "at the lower extremity of the glacier, as in the upper part of its course, the glacier does not advance abruptly, by jerks (*saccades*) as formerly‡ supposed, but its march is *gradual and continuous.*"§

III. *The influence of warm and damp weather in accelerating the continuous march of the glacier,* and of cold weather in checking it, I deduced in 1842 from a careful comparison of its motion for three months with the state of the thermometer, and exhibited the result in numbers and diagrams.‖ Here, again, the observers on the Aar glacier have confirmed this fact, so important in a theoretical point of view. "The advancement of the glacier," they say, "was far from uniform; it varied considerably, according to the condition of the atmosphere." During nine days of cold snowy weather in August 1844, the mean daily advance was 155 millimetres, but during the sixteen fine days which followed, it moved through 230 millimetres per day.¶

* Mr Hopkins's experiment of a box full of ice descending an even plane, does not apply to this case, because, though it moves *as a whole,* it does so without change of figure, and without the resistance arising from the irregularity of the channel of a glacier; and hence the seeming analogy to a glacier entirely fails.

† Comptes Rendus, p. 1302, line 12.

‡ *Jadis.* It is to be inferred that the writer meant previous to 1842.

§ Comptes Rendus, p. 1303, line 9.

‖ Travels in the Alps, p. 148.

¶ Comptes Rendus, p. 1301, at the bottom.

It is worthy of remark, that the entire annual motion of the part in question of the glacier of the Aar, was ascertained to be 60 metres, or 164 millimetres per day.* Now the mean motion during 35 days of August and September, was 203 millimetres, or but *one-fourth* above the annual mean (and during part of the time, we have seen, it fell to 155 millimetres, or *below* the annual mean); proving sufficiently that the annual motion is not entirely effected during the warm season, and that even in winter it must bear a very sensible proportion to its summer motion, as has been directly proved in the case of the Mer de Glace of Chamouni.†

IV. *The extreme inequality of motion of the central and lateral parts of glaciers* is the best direct proof of the very considerable plasticity of their mass; and in the paper before us this is shewn, in a still more striking manner, than in the experiments which I have published. A glacier, like the Mer de Glace of Chamouni, has so considerable a velocity (on an average at least three times that of the glacier of the Aar), that the ice is impetuously borne along, and torn from the sides at the expense of innumerable lacerations and crevasses. So that in the whole extent of the middle and lower regions of that glacier, in no place do the ice and ground meet without the former being more or less fissured by rents. But the contrary is the case on the great glaciers which move on small slopes, and with smaller velocities; and the discovery of this fact rewarded me for the labour of a short visit which I made the Great Aletsch glacier, in July 1844, when I ascertained, not merely the small daily progress of the mass of the glacier, but the astonishing retardation produced by the sides, whilst the surface remained compact and wholly undivided by longitudinal crevasses. In that case, I found that, "whilst the velocity of the ice at 1300 feet, or about a quarter of a mile from the side, is 14 inches in 24 hours, at 300 feet distant from the side it

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* Comptes Rendus, p. 1301, line 29.

† Travels in the Alps, p. 151, 420; and Fifth Letter on Glaciers Edin. Phil. Journal, April 1844.

was but 3 inches in the same time; and close to the side it had nearly, if not entirely, vanished."* Now this observation, a hasty one, and which, therefore, I am happy to have confirmed, is more than borne out by the observations on the glacier of the Aar, detailed in the Comptes Rendus, and which were made shortly after. The movement of the centre of the glacier is to that of a point 5 metres from the edge as FOURTEEN to ONE; such is the effect of plasticity! *Thirteen-fourteenths of the motion of the glacier of the Aar, are due to the sliding of the ice over its own particles, and one-fourteenth only to its motion over the soil.*

V. *Motion of Glaciers of the Second Order.* It is a question of considerable interest to know how those small glaciers, called by De Saussure glaciers of the second order, advance, compared to the great ice masses which fill the bottoms of valleys. These little glaciers, on the contrary, are usually isolated, extending but a small way, occupying a nook or niche in a mountain side, and though persisting in their occupancy, and shewing signs of motion and activity, like other glaciers, yet stretch forward but a small way, then cease abruptly, as if foiled in the struggle to join their icy contribution to the magnificent glacier which often fills the valley immediately below them.† Their isolated position, their great absolute height, and their usually very steep declivity and small surface, give considerable interest to the determination of their rate of motion, at least approximately. Accordingly I seized the occasion of spending some days in July 1844, at the Hospice of the Simplon (already at a height of 6600 feet above the sea), to examine and measure the progress of the small glacier which hangs from the slope of the Schönhorn, immediately behind it, and 1400 feet higher. I intend to give elsewhere a minute account of this glacier, and my observations upon it; but in the mean time I may state that one of the marks observed, at a point having an inclination of 10°, moved at the rate of 1.4 inches

* Eighth Letter on Glaciers, Edin. Phil. Journal, Oct. 1844.

† See a Plate, giving a correct idea of a glacier of the second order, in my Travels, plate ix.

in 24 hours; and another, at an inclination of 20°, moved 1.8 inches in the same time. This small result is quite conformable with the dry and powdery condition of such elevated glaciers, yielding little water, and capable of exerting, on their under parts, a very trifling hydrostatic pressure.*

Exactly analogous results were obtained by M. Agassiz's coadjutors at a somewhat later period of the same year. The experiments are fully detailed in the Comptes Rendus;† and the conclusions which are deducible from them are (1), that the daily motions of these small glaciers, which, rested on beds so highly inclined as from 15° up to 33°, are included between 20 and 72 millimetres (0.79 to 2.84 English inches) *per diem.* (2.) The observers think that their observations go to prove that when these glaciers are prolonged far enough to meet the main glacier below, and to unite their streams, then the lower part of the tributary glacier, or that nearest the point of union, moves SLOWER than the upper part, or that nearest the origin of the little glacier; but, on the contrary, if the glacier be pendant on the slope, and the lower end decays away without joining the principal, then the inferior extremity moves FASTER than the origin. Now the cause of this variation in the two cases (should the fact really appear to be general, as is not unlikely, provided the lower station be always chosen low enough), seems to be, that the main glacier resists the interference of its tributary with its course, and consequently *represses* its stream, causing a heaping up in front, such as mere friction on a low inclination alone produces, and is thus in conformity with the viscous theory. In the other case, that of the *free* glacier of the second order, the difference of velocity at the upper and lower station (*one-seventh* part only) is not more than the difference of slope (15° and 25°) will readily explain.

VI. *Movements of Bas-Névés or Snow-beds.* One observation remains which completes my analysis of the measures of M. Agassiz's coadjutors. It is one of considerable interest, and I believe is new. It is the establishment of the fact that the

* This experiment is briefly mentioned at the close of my Eighth Letter on Glaciers.

† p. 1303 and two following pages.

highly inclined beds of old snow, formed by avalanches, which lie unmelted in the ravines, without assuming any external trace of glacial structure, have a proper motion of their own. This, though to me not unexpected, is very interesting; for the most attached advocate of either the dilatation or the sliding theory, will hardly maintain, on the one hand, that the congelation of soft snow could act here as a propelling force, or on the other, that the motion can take place without acceleration in the totality of a mass, inclined (in this case) at an angle even of 43°, over the bed on which it rests: especially since the actual movement under this enormous inclination was only 7 millimetres, or *three-tenths of an inch*, per day;* or *one-thirtieth* of that of the great glacier under an inclination of but a few degrees. The velocity increased towards the lower extremity, as in the free glacier of the second order. On the Plastic theory, this evidently presents the extreme case of a body, approaching in its nature to a soft heavy powder slightly moistened, which gives way by the yielding of its parts, and so far resembles a fluid (as a bank of earth, slightly glutinous, rather than sand does); and the slowness of movement is in conformity with the imperfectness of the fluid pressure, and with the fact already stated (under Head III. above) that the velocity of any glacier is proportional to the completeness of its saturation with water at the time. The *bas-névés*, or old avalanches, furnish very little water at their lower extremities.

I have now gone through these observations, made by persons, it may be assumed, not particularly desirous to find results confirming a theory which they have opposed, but which it may be hoped they will oppose no longer, when their own results speak in language so unequivocal. My analysis has been succinct, but complete and impartial. The facts are stated as given, without selection or suppression.—I am, dear Sir, yours sincerely,

James D. Forbes.

Professor Jameson.

* Comptes Rendus, p. 1305, line 32; and p. 1306.

*Note on the Crystallization of Carbonate of Lime.* By JOHN DAVY, M.D., F.R.S. Lond. and Edin. Communicated by the Author.

When the lime in lime-water is rapidly precipitated by passing into it carbonic acid gas, as by blowing on it with air from the lungs, the precipitate examined with the microscope, is found to consist of exceedingly minute particles, too minute, indeed, to allow of their form being distinguished, being about $\frac{1}{300000}$ inch in diameter, either dispersed or collected in groups.

When precipitated in part in this way, if the jar of lime-water be covered with a plate of glass, so as to admit the access of air slowly, the crust formed after two or three hours' rest, similarly examined, will be found to consist of granular globules, or of little masses approaching the globular form, about $\frac{1}{1000}$ of an inch in diameter, in which the granules or minute particles exhibit an arrangement somewhat symmetrical.

If the jar still containing lime in solution, be again covered with glass, and allowed to remain tranquil from twelve to twenty-four hours, the pellicle of carbonate of lime formed at the end of this time, will be found in some points to differ from the preceding; the globules will be found mixed with distinct cubical crystals, varying in size from about $\frac{1}{12000}$ of an inch to $\frac{1}{4000}$ and $\frac{1}{1000}$; the intermediate size the most common. The smallest, it may be remarked, require a nice adjustment to be seen distinctly.

*Lastly*, if the jar be covered with a plate of glass in the first instance, so as to permit very slowly the entrance of air, the pellicle of carbonate of lime formed, will consist entirely of crystals, and these chiefly cubical, connected together, and varying in size from about $\frac{1}{4000}$ to $\frac{1}{1000}$ of an inch in diameter.

By adding to the lime-water different substances, the form of the carbonate of lime in the pellicle resulting from the absorption of carbonic acid from the atmosphere, is found to be altered, and that variously. I may mention a few instances of the effect of substances added, which have no power of decomposing the lime-water,—or, if possessed of such power, added in so small a quantity as to leave lime in excess, to yield a crust of carbonate of lime.

1. Serum of sheep's blood. Lime-water after admixture with a small quantity of this, put aside for a few hours, the jar covered with a glass plate, yielded, besides cubical crystals, some of a prismatic form and some pyramidal. In this instance and the following, the portion of pellicle examined was confined between two slips of glass, so as to prevent the formation of adventitious crystals by evaporation.

2. Nitrate of barytes. Lime-water, to which a few drops of this salt in solution had been added, treated like the preceding, yielded tabular crystals variously truncated, and some pyramidal.

3. Muriate of lime. The crystals obtained in this instance, a few drops of the salt in solution having been mixed with the lime-water, were cubical and pyramidal,—with which granular globules were intermixed.

4. Chlorate of potash. The crust formed on the lime-water, to which a very little of this salt had been added, consisted chiefly of little spindle-form masses, with plates of comparatively large size and great thinness, most of them imperfectly formed, their outline being in part irregular.

Do not these results admit of application? May they not serve to illustrate the extraordinary variety of form in which carbonate of lime, in its mineral state, is found in nature?

It occurred to me, as not improbable, that carbonate of lime, formed without previous solution of the lime, viz., from the combination of the lime of the hydrate with carbonic acid, might present itself in a crystalline form, the tendency to assume this form being so great. But I have not, on trial, found it to be so. Recent carbonate of lime, obtained by exposing quenched lime to the atmosphere, has appeared, under the microscope, to be only minutely granular, as is the hydrate itself; and a mortar of nearly pure carbonate of lime, attached to a stone, on which are hieroglyphics, from the walls of ancient Thebes, has exhibited the same minutely granular character. This fact, I may remark, is not in favour of the idea of homogeneous particles, exerting an attractive force on each other, independent of solution, capable of originating motion, or change of position, such as is implied in the conversion of an amorphous into a crystalline mass.

THE OAKS, AMBLESIDE,
*March* 11. 1845.

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*On the Origin of Quartz and Metalliferous Veins.* By Professor GUSTAV BISCHOF, of Bonn.*

It is not possible that the quartz veins, in the various stratified formations—as in greywacke, in clay-slate, in hornblende-slate, &c.—could have been formed by the agency of a smelting heat. Even presuming that it is in the power of nature to fuse quartz, which, taken alone, is infusible in the heat of our most intense furnaces, a mass of such excessive heat as molten silica must have fused the adjacent rock to a greater or less distance, according to the width of the quartz vein. *Silicates* must have been formed, much more fusible than the substance of the quartz vein. These silicates (felspar, mica, &c.), the bases for which (alumina, potash, soda, oxide of iron, &c.) had been furnished by the adjacent rock, must, however, have been found not only between the vein stuff and the rock, and far into this latter, but also penetrating into the quartzose vein stuff itself; for, the constituents of the adjacent rock, fused by the molten silica, would have penetrated into the interior of the vein stuff, and have formed silicates.

Suppose only, for example, that molten silver is poured into a leaden mould, of such thickness that only that portion of the mould in the vicinity of the silver poured in should melt, there would not be found, after the cooling of the molten metal, a single particle of pure silver, but only a mixture of silver and lead. But the difference, in fusibility, between silica and rocks such as clay-slate, is certainly still greater than that between silver and lead; and the affinity of silica to the bases in the rocks, or the propensity of the latter to form silicates with the former, is certainly not less than the affinity of silver for lead.

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* Translated by Lewis D. B. Gordon, Esq., Professor of Civil Engineering in the University of Glasgow.

It must, therefore, be considered as a necessary consequence, that if ever fused silica had been injected into a vein fissure in clay-slate, there would have been formed, after the gradual cooling and consolidation, not a vein of pure quartz, but a crystalline vein stuff, of the nature of granite, in as far as the adjacent rock could have furnished the necessary bases for the production of granite. If, therefore, we could suppose that ever pure quartz in fusion rose up from beneath, we might also, on the other hand, conclude, that a granite vein, in a country of clay-slate, would be produced; but not that a quartz vein could have been formed in such a manner.

To these difficulties of conceiving the rising of fused silica in a vein fissure, comes this again, that quartz veins frequently consist of very thin strings, of half an inch wide, or even less. Were it, then, still conceivable that molten quartz, of a foot or more in width, could rise in a fissure or rent, without solidifying in the course it must have travelled from unknown depths, yet it would be quite inconceivable that a mass, of scarcely half an inch in thickness, should flow through the cold rock without being immediately chilled. This were equally impossible as to attempt, by pouring melted iron into a channel some hundred feet long, and half an inch wide, to form an iron rail or plate.

If we lay aside the notion of the production of quartz veins in stratified formations by the agency of a smelting heat, there remains no other assumption but that these veins have been formed by the agency of water. In fact, there is not one phenomenon presented by quartz veins that is inconsistent with this assumption. On the contrary, every circumstance may be explained, by its aid, in a simple and unforced manner.

There is scarcely any water, whether it be spring or river water, which does not contain silica in solution, though frequently in very small quantities. Should such water penetrate through the narrowest cleft, there is the possibility that more or less of the dissolved silica may be deposited in it. It is true, that such a deposition supposes that the water, either, being hot, cools during circulation in the cleft, or evaporates; or that other substances maintaining the silica in solution are precipitated ; but we must not overlook other circumstances from which this precipitation may arise. Very many phenomena shew that there exists a peculiar affinity between *silica and organic substances or organic remains.* As an example, I may mention that, in the wooden piles of Trajan's Bridge, near Vienna, quartz concretions—agates even of half an inch in thickness—have been found ;* and that, according to observations of Glocker, it is only on a lichen that *Hyalite* is formed on the Serpentine of the Zobtenberg.† If, now, in the above instances, the wood of the bridge pile has induced a precipitation of silica from an extremely dilute solution, such as the water of the Danube presents—if, in like manner, a lichen has occasioned such a precipitation, from, probably, equally dilute solutions, then it is easy to understand, that organic remains in a Neptunian rock, as in clay-slate, may likewise effect a precipitation of silica.

It may be said, in opposition, that the supposed effect of organic remains must cease in the rock as soon as the thinnest covering of precipitated silica has been formed ; but it is known, that, as soon as a deposition of a dissolved substance has begun from whatever cause, it goes on, although this cause may no longer be in action. I am, however, far from alleging, that the presence of organic remains in geological formations, has always induced the deposition of silica in quartz veins. If such were the case, this effect could only be considered as acting in quartz veins in Neptunian formations, and would have no application to such veins in the crystalline formations.

It becomes, however, necessary to inquire into the causes by which deposits of silica from watery solutions may have been effected. Is it not sufficient to refer to the numberless quartzy formations which must unquestionably have had their origin in the wet way ? Can we, in the frequent silicification of organic substances—of wood in *wood-opal*, for

* Breislak's Geologie, Bd. ii., p. 492.

† Verhandlungen, der K. L. C. Akad. d. Naturforscher, Bd. xiv. Abth. ii., p. 545. Compare also Von Buch on the Silicification of Organic Substances in the Abhandlungen, der K. Acad. d. W. zu. Berlin, 1828, p. 43, " Where" says Von Buch, " there is no organic substance, there is never silicification to be found."

example—entertain, even remotely, the idea of formation by heat. Ehrenberg found, as he told me, a Vermetus, an inch long, in *fire-opal.*

The deposit of silica in quartz veins can be conceived to have taken place by *two modes.* Either springs rose up in the vein cleft, from which it was deposited, or water, containing silicic acid, penetrated from the adjacent rocks into the vein cleft. Both processes occur at the present day, although deposits of pure silica from springs are rarities. Examples, too, are not wanting of the locality of the discharge of the spring changing, or of the discharge completely ceasing. Both cases, doubtless, arise most frequently *from the underground channels being stopped by deposits.*

I have myself observed the complete cessation of a mineral spring. About twelve years since, there flowed, close by the Laacher-See, near the old abbey, a pretty abundant spring, which, judging from its enclosure, was used in former times by the inhabitants of the abbey. I visited this spring several times, as it excited my curiosity, being the only one of all the numerous springs in the neighbourhood of the Laacher-See, which shewed not even a trace of iron. It was a pure *seltzer*, containing, principally, bicarbonate of lime and magnesia. On going to see this spring, some years later, I found it stopped. There are also, very frequently, to be found in this neighbourhood, even considerable beds of *iron-ochre*, which indubitably have been deposited from irony springs, although such no longer occur in these localities. Such beds are often met with at the higher levels; and, in the lower levels, springs containing iron, which still deposit iron-ochre. It is very probable, that changes in the locality of the discharge of the springs have resulted from the obstruction of their channels. Yet not only such obstructions, but also considerable accumulations of iron-ochre, at the issue of the spring itself, have, here and there, induced the disappearance of the springs. Thus, in one place, where there was a three feet thick bed of ochre, I caused a sinking to be made, and discovered underneath a very abundant ferruginous spring.

In this neighbourhood there are, here and there, appearances from which we may conclude that there has been a change in the *nature* of the spring's *deposit.* In the immediate vicinity of the iron springs, more or less considerable deposits of *calcsinter* present themselves, whilst the actual or present sediments consist of iron-ochre, with a slight admixture of lime. It is very probable that these are the very springs which formerly deposited calcsinter, and which, at the present day, deposit only iron-ochre. If such a change in the nature of the spring's deposit be in harmony with the not unfrequent change in the constituents of the spring, we have in this an indication of the various deposits which occur in vein clefts—viz. in metalliferous veins. I believe, in fact, to have acquired conviction, and hope to shew proofs, that the most of the vein stuffs in metalliferous veins, if not all, have been introduced in the wet way.

Evidence for the variety of deposits in metalliferous veins are presented, amongst others, by the veins of the Erzgebirge. Thus, v. Weissenbach found, in the silver veins of *Brand*, in the Freyberg district, the arrangement of the component parts of the vein from the older towards the younger members—that is, from *the wall* to *the centre*, to be always as follows :—

1. Quartz predominating.
2. Manganese-spar—Brown-spar.
3. Sparry iron, fluorspar, barytes, equal with each other.
4. Calcspar.

He never found the above-named sparry minerals in any other than this series, and it appears, as far as he had opportunity of observing, to occur pretty much the same throughout the whole Saxon vein formation. It is important in reference to this mode of formation of the vein mass in metalliferous veins, remarks v. Weissenbach, that, should the above observation obtain generally, it would result that not the ores, but much more the kinds of spar, would, to a certain degree, characterize the epochs of formation.*

* Just as I was about to send off this paper, I have received, through the kindness of the Berghauptmann Freiesleben, his most recent interesting work, "Die Sächsische Erzgänge," &c., &c. Freyberg, 1843.

We there find under the title, "Arrangement of the Vein stuffs," the following: "It is peculiar to many formations, as has been long

Just as in the deposits of those springs at the earth's surface, to which we formerly alluded, an *alternation* appeared,

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known, that some of their veins display a regular ribbon-like structure, in as much as their minerals form parallel layers variously alternating with each other. (*Zonen, Streifen, Bänder oder Glieder.*) However, according to my notions, there has been more regularity discovered in this, than is consistent with direct observation. There has also been fixed for many formations a distinct epochal series of their members. It has been assumed, for example, that quartz forms the outer member next the walls of the vein; the spars, on the other hand, the inner or middle members. Even Werner's theory of veins (amongst others § 31) contains very distinct remarks on this. But more recently persons have gone further, and have raised up a theory of the development of veins upon it. It has been further assumed, that, as the depth increases, either the inner newer members disappeared, and the outer became more predominant, or, *vice versa*; from which the enrichment and impoverishing of a vein according to the depth have been explained. This may be the case in certain veins; but it does not appear to me to be founded on a pervading or completely established law," &c.

"Even a regular memberment of the vein stuffs is not a predominating circumstance. In many cases there exists no trace of it. Still seldomer, however, is there a constant epochal series in the individual members. For one example, in which the one or the other may be proved, there are many others in which this is not the case; where, rather, the different kinds of ore and matrices lie intermixed irregularly, as if poured together in one cast; or where the epochal series of the individual members does not remain the same. Isolated regularly membered veins have ever attracted more especial attention, because they are more interesting than others. Hence the great number of opposing appearances seem to have been less observed. I have therefore directed especial attention to this point for some considerable time; and when I have adduced more particularly the results of my observations for each particular formation, in a future complete exposition of the foregoing sketch, it will be seen that the general legitimate deductions which can be made from these, are only few. There are only a few minerals which prove themselves to be the newest formations, alike in druses and as the innermost members of the vein—for example, native silver, sulphuret of silver, (silver glance,) ruby silver, calcspar; others occur again and again alternately, next the walls and in the middle—for example, quartz, pyrites, brownspar, barytes," &c.

It is indeed difficult to decide between two men such as Freiesleben and v. Weissenbach, both practised in observation, and both, by their long calling as practical miners, in a position to study the most various relations of veins. Although the latter is inclined to assume a determinate epochal series of the members of veins, he by no means ignores the though only *one*, we find also in metalliferous veins a more frequently repeated alternation of vein stuffs. If these surface deposits shew, incontestibly, that the same spring may change the nature of its deposit in the course of time, we can, from this, conclude as to the *possibility*, at least, that also the alternating members of the vein, in metalliferous veins, may have had the same origin.

If we recur to the question of how the silica in quartz veins may have been precipitated from watery solutions, we cannot consentaneously suppose that this deposit has been a consequence of a decrease of temperature of the dissolving medium, or of its vaporization during the circulation of the water through the clefts; and as the assumption that organic remains in the adjacent rock have played a part, is only admissible for quartz veins in Neptunian formations, there remain still certain difficulties to solve. These decrease very much, however, if we take into consideration a

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fact that the regularity appears very frequently disturbed, and even adduces many examples of this.

The question is, whether order is the rule and confusion the exception, or whether the former is only fortuitous? As the formation of veins is a process occupying a great space of time, and as, after it had already begun, the fissures again widened out and the new fissure took, here parts of the adjacent rock, there parts of the vein stuff, according to the state of adhesion and cohesion between the rock and the vein stuff already formed, and of this latter with itself; it must have happened that the more recent vein stuffs now gained the interior,—now were deposited on the walls and on the fragments torn from the adjacent rock. To this has to be added, that there not unfrequently took place an exchange between the older and newer members of the vein, by the former being taken up by the solvent medium, and the latter being deposited and taking the place of the former. It might thus also so happen, that (if we suppose the introduction of the vein matrices in the wet way,) the same fluid, containing several vein-stuffs in solution, according as in one part it came in contact with the adjacent rock, and in another with older members of the vein, deposited by exchange one substance here, another there, just as a fluid would do if we added first one and then another re-agent. All these causes might produce the most various disturbances in the formation of the vein-stuffs, so that regularity only appears in those instances in which these disturbing causes have not acted. I have enlarged upon these circumstances in the sequel.

circumstance which is perfectly grounded in the laws of chemical affinity, and whose effect can be proved in the case of springs likewise. It is the mutual exchange, or the expulsion of one substance dissolved in water by another, with which the water comes in contact. Just as, for example, the bicarbonates of lime, magnesia, oxide of iron, and oxide of manganese, are precipitated by alkalies; so the same precipitation would follow, if water containing these bicarbonates were to come in contact with minerals having alkalies as constituent parts; for, although the latter are combined with silica, still these silicates would be decomposed by the half-combined carbonic acid of the bicarbonate. I have observed such a mutual exchange in a very palpable manner. The mineral spring formerly mentioned as having flowed from *under* a bed of iron-ochre, had channelled a passage for itself in *trass*, which was decomposed into a rich clay all around, and upon this channel there was an incrustation of carbonate of the protoxide of iron (*sphærosiderite*).

In this case, undoubtedly, the free and half-united carbonic acid of the mineral spring had extracted the alkalies from the silicates of the trass, whereby the bicarbonate of the protoxide of iron lost its dissolving medium, and deposited itself as carbonate of the protoxide of iron, as contact with the air was excluded. It is very probable that the carbonate of soda, which is so frequent a constituent of the mineral springs rising in the crystalline formations, has this origin in many cases,—that, viz., water, loaded with bicarbonates of lime, magnesia, protoxide of iron, and manganese, came in contact with formations containing silicates of soda.

In this manner, we can easily perceive how manganese spar, brown or pearl spar, sparry iron, and calc-spar, which so frequently occur as the matrix, may have been precipitated from waters that contained these minerals as bicarbonates, so far as there were silicates of the alkalies present in the adjacent rock. This is, however, exactly the case in the metalliferous veins running through the gneiss of the Erzgebirge, and in other crystalline formations. Such exchanges (*Austauschungen*) might be repeated more than once, if the composition of the water circulating in the vein-cleft changed.

Thus, Dr Speyer of Hanau, found, near Dietesheim, encasing pseudomorphous crystals of sparry iron, of the form of calc-spar.* They occur in the druses of Anamesite, in which, too, sphærosiderite is not unfrequently met with. It is not to be doubted that waters, which at an earlier period had deposited calc-spar, as they changed their nature and became charged with acid carbonate of the protoxide of iron, have effected the exchange between calc-spar and sparry iron. We do not require to ask whether that portion of carbonic acid which changes the neutral carbonate into bicarbonate, has a greater affinity for carbonate of lime than for carbonate of the protoxide of iron, or inversely; for there are many examples in chemistry of an inversion of affinities, under different circumstances, namely, when unequal masses operate. Water, charged with the bicarbonate of the protoxide of iron, may, if it flows uninterruptedly over calc-spar, part with the half-combined carbonic acid to this latter, and so dissolve it and carry it off, and, on the other hand, deposit the carbonate of the protoxide of iron thus become insoluble. But just as well might the reverse case occur, and the half-combined carbonic acid in a water charged with acid carbonate of lime be given off to sparry iron, and so the former be deposited, and the latter dissolved. In the first case, the greater mass of the half-combined carbonic acid in the bicarbonate of iron is effective; in the latter, on the other hand, that of the half-combined carbonic acid in the bicarbonate of lime; for, in the one case, new portions of the iron compound, in the other new portions of the lime compound, are uninterruptedly brought to bear by the water in circulation. Besides, the *possibility* of calc-spar occurring in the form of sparry iron cannot be doubted, although no such case is known.

That these pseudomorphous crystals of sparry iron, in the form of calc-spar, are produced in the wet way, no one will doubt. The crystals of sparry iron are partly hollow in the interior, partly more or less filled with calc-spar; the inner

* Die Pseudomorphosen des Mineralreichs, von Blum.—Stuttgart 1843; S. 304.

planes are uneven and somewhat granular. Where there is still calc-spar, plates of sparry iron may be seen between its foliated layers, by which regular cells are formed. These pseudomorphous crystals are partly upon calc-spar, partly united immediately with anamesite.

These circumstances shew that the conversion or exchange goes on slowly; so slow a process can only be conceived to operate in the wet way, and any idea of an effect by heat must be excluded.

The encasing pseudomorphous forms of bitter-spar, which the sparry iron in the quartz veins in greywacke near Rheinbreitbach assumes, have certainly been produced in a similar manner. If the fluids which had earlier deposited bitter-spar in these veins changed their nature—did they become irony —then the half-combined carbonic acid of the bicarbonate of iron took up the bitter-spar, and deposited in its place, as sparry iron, the salt of iron changed into neutral carbonate of the protoxide of iron.

Little difficulty as there is in understanding the deposit of the frequently named carbonates in the veins, and the expulsion of the one by the other; it is, however, more difficult to explain the deposit of quartz by exchange. Quartz, it is true, presents itself in the forms of calc-spar, bitter-spar, sparry iron, carbonate of lead, gypsum, barytes, fluor-spar, and barytocalcite. It is therefore supposable, that if calc-spar, for example, were deposited from a solution at one period, and at a later period were brought into contact with a solution of silicic acid, the former would be dissolved and the latter deposited.

In this manner, however, the deposit of quartz in quartz-veins and in the metalliferous-veins of the Erzgebirge, could not well be explained, as this would assume that the one or the other of these minerals had existed in the veins before the deposit of the quartz. This would, however, contradict the epoch series of the vein matrices of metalliferous-veins of the Erzgebirge. It is, besides, scarcely to be imagined, that the predominating quartz, the oldest member of the matrices of these metalliferous veins, could have been deposited by such an exchange.

(*To be Concluded in next Number.*)

*Proceedings of the Royal Society of Edinburgh.*

(Continued from Vol. XXXVI., p. 198.)

*Monday, 4th December* 1843.

Sir THOMAS BRISBANE, President, in the Chair.

The following Communication was read :—

On the Influence of various Circumstances in Vegetation upon the activity of Plants. Part II. The Umbelliferous Narcotics. By Dr Christison.

In the First Part of this inquiry, the author gave an account, in 1840, of some observations made by him, as to the influence of season on the activity of the acrid plants of the natural family *Ranunculaceæ*, and of the narcotics belonging to the family *Drupaceæ*.* In the Second Part now laid before the Society, he proceeded to relate a series of experiments instituted by him with the view of determining the influence of season on the activity of the poisonous narcotic plants of the family *Umbelliferæ*.

The plants belonging to this family are for the most part aromatic and stimulant, and destitute of poisonous properties. In four species only have narcotic properties been unequivocally recognised, viz., *Conium maculatum*, *Œnanthe crocata*, *Cicuta virosa*, and *Æthusa cynapium ;* but these are universally held to be highly energetic.

1. *Conium maculatum*, Common Hemlock.—No accurate information is yet possessed as to the influence of season on the activity of this species : for all investigations on the subject are vitiated by the uncertain strength of its preparations, and the ignorance which prevailed till very lately as to the conditions required for securing their uniformity. The author has found by experiment, as Professor Geiger had already been led to conclude, that every part of the plant is poisonous, both the root, the leaves, and the fruit ; and that the root is least active, the leaves much more so, but the fruit the most active of all. The root is commonly held to be most active in midsummer, when the plant is in full vegetation and coming into flower ; but this belief is founded only on a single, and not altogether conclusive, experiment made by *Professor Orfila.* This author found this part of the plant to be so feeble at all times, that its respective energy at different seasons could not be satisfactorily settled. The expressed juice of twelve ounces of roots had no appreciable effect on a small dog in the end of October or towards the

* See the Society's Proceedings, 1840-41.

close of June; but an alcoholic extract of six ounces in the beginning of May killed a rabbit in thirty-seven minutes, when introduced into the cellular tissue. The leaves are commonly thought to be most energetic when the plant is coming into flower in midsummer, and to be very feeble while it is young. The author finds it to be probable, that the leaves are very active in midsummer; but he has likewise observed, that they are eminently energetic in the young plant, both in the beginning of November, and in the month of March before vegetation starts on the approach of genial weather. Thirty-three grains of a carefully prepared alcoholic extract, representing one ounce and a third of fresh leaves, killed a rabbit in nine minutes, when introduced into the cellular tissue. The fruit is most active when it is full grown, but still green and juicy. It then yields much more of the active principle conia than afterwards when it is ripe and dry. The author added, as a fact contrary to general belief, that he had found the ripe seeds of hemlock, and an alcoholic extract of the leaves, to sustain no diminution in energy by keeping, at all events for eight years.

2. *Œnanthe crocata*, Dead-tongue.—This species is universally considered to be the most deadly of all the narcotic *Umbelliferæ*. Many instances of fatal poisoning with its roots have been published during the last two centuries, in the various periodicals of Europe. It has repeatedly proved fatal in two hours; and a portion no bigger than a walnut has been thought adequate to occasion death. Fatal accidents have occurred from it in England, France, Holland, Spain, and Corsica. The root would seem from these cases to be the most active part; but few observations are on reecod as to the effects of the leaves, and none as to the fruit. The root appears from these cases to be very active in all seasons, at least in the beginning of January, the end of March, the middle of April, the middle of June, and the middle of August.

The author proceeded to inquire carefully into the effects of season upon this species as it grows wild in the neighbourhood of Edinburgh, but was surprised to find that every part of the plant in this locality is destitute of narcotic properties at all seasons. The juice of a whole pound of the tubers, the part which has proved so deadly elsewhere, had no effect when secured in the stomach of a small dog, either in the end of October when the tubers are plump and perfect, but the plant not above ground, or in the month of June when it was coming into flower; and an alcoholic extract of the leaves, and that prepared from the ripe fruit, had no effect whatever when introduced into the cellular tissue of a rabbit, under the same conditions in which the Common Hemlock acts so energetically. By a comparative experiment he ascertained that tubers, collected near Liverpool, where one of the accidents alluded to above happened in 1782, act with considerable violence on the dog; and he briefly noticed some experiments, made at his request by *Dr Pereira*, with the Œnanthe of Woolwich, shewing that there also it is a powerful poison to the lower animals. Climate seemed to the author to furnish the only adequate explanation of these extraordinary differences; yet the plant grows in all parts of Scotland with great luxuriance.

3. *Cicuta virosa*, Water-hemlock.—This species has been also held to be a deadly poison ever since an express treatise on its effects was published by Wepfer in 1716; and repeated instances of its fatal action have been observed since, and some of these very recently, in Germany. The root is the only part which has given occasion to accidents; it has proved fatal in two hours and a half. Nevertheless, this plant too seems innocuous in Scotland, or nearly so, although, like the last species, it grows with great luxuriance. The juice of a pound of the roots collected in the end of July, while the plant was in full flower, produced no narcotic symptoms; and the only effects observed, namely, efforts to vomit, might have arisen from the operation which is necessary to secure the juice in the stomach. An alcoholic extract of the leaves collected at the same time, and a similar preparation made with two ounces of the full-grown seeds, while still green and juicy, had no effect whatever when introduced into the cellular tissue of a rabbit, except that inflammation was excited where the extract was applied.

4. The author has not yet had an opportunity of trying the effects of the fourth species, *Æthusa cynapium*, or fool's-parsley.

*Monday 18th December* 1843.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Communications were read:

1. A description of Congenital Malformation of the Auricle and External Meatus of both sides in three persons, with Experiments on the state of Hearing in them, and Remarks on the mode of Hearing by Conduction through the hard parts of the Head in general. By Professor Allen Thomson.
2. On the Luminousness of the Sea. By Dr Traill.

*Tuesday, 2d January* 1844.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Communications were read:—

1. On the Fossil Vegetables of the Sandstone of Ayrshire, illustrative of a series of them, as a Donation for the Society's Museum. By J. Shedden Patrick, F.R.S.E., F.R.S.S.A., &c

2. On a new Self-Registering Barometer. By Robert Bryson, F.R.S.

*Monday, 15th January* 1844.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Communications were read :—

1. On the Vibrations of an Interrupted Medium. By Professor Kelland.
2. On certain Laws of the Resistance of Fluids. By John Scott Russell, Esq.
3. Chemical Examination of the Tagua-Nut, or Vegetable Ivory. By Professor Connell.

*Monday, 5th February* 1844.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read :—

1. On the Tides of the Firth of Forth, and the East Coast of Scotland. By J. S. Russell, Esq.
2. Additional Observations as to the Poisonous Properties of Œnanthe crocata. By Dr Christison.

In this paper the Author added a few supplementary observations to those made on the alleged poisonous properties of the *Œnanthe crocata,* in his paper on the poisonous *Umbelliferæ,* read on the 4th December last.

He stated that he had met with other cases of poisoning with this plant, recorded by Continental authors, shewing that death may take place in an hour,—that so small a quantity as a single tuber, no bigger than the finger, has proved fatal,—that the roots are poisonous in some countries, from the beginning of January till the middle of October at all events, and probably throughout the whole year ; and that Spain may be added to the countries formerly mentioned, where fatal effects have been produced by the plant.

He next added, that he had recently tried on a dog the effects of the juice of a pound of tubers, collected by Dr Pereira on the 16th December from the locality of Woolwich ; and that no effect, or an exceeding slight one only, was produced.

It was farther observed, that, according to an analysis executed in 1830 by MM. Pihan-Dufeilay and Cormerais, the activity of the roots in French plants depends upon a resin. On proceeding to try upon a rabbit the effects of the resin, obtained by their process from the Woolwich plants, the author found that, when the resin from eight ounces avoirdupois, amounting to 24 grains, was introduced in the state of emulsion into the cellular tissue, the animal died in 78 minutes, after being affected with a remarkable combination of tetanic spasm and convulsions: but that no effect whatever was produced by the resinous extract from the same quantity of roots obtained about the same season of the year (midwinter) from the Dalmeny œnanthe, near Edinburgh.

He concluded this notice with an account of some experiments on the chemical analysis of œnanthe, observing that he had failed to obtain any principle from the Dalmeny seeds or root, by a process analogous to that by which conia is obtained from hemlock; and that the alcoholic extract of the Woolwich plants, distilled with solution of potash, yielded, like hemlock, a little oleaginous-like fluid, which was too minute in quantity for him to ascertain its properties accurately, but which, on the whole, seemed a volatile oil, and not an alkaloid.

*Monday, 19th February* 1844.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Communications were read:—

1. On the cellular Fibre and the Incrusting Matters of Plants. By Mr P. F. H. Fromberg. Communicated by Professor Johnston.

2. On a remarkable Oscillation of the Sea observed at various places on the coasts of Great Britain, in the first week of July 1843. By David Milne, Esq.

This phenomenon was observed on the 5th July and three following days. It did not occur on all parts of the coast of Great Britain. In England, it was observed only on the south shores of Cornwall and Devonshire. In Scotland, it was observed on the east coast; and there it was seen at a great many places, between Eyemouth in Berwickshire and the Shetland Islands.

It was only on the 5th of July that the oscillation occurred on the Cornish and Devonshire coasts. It prevailed on the Scottish coast, however, from the 5th to the 7th July inclusive.

The phenomenon consisted of a flux and reflux of the sea, beyond what could be accounted for by ordinary tides, or any wind prevailing at the time. The water suddenly rose up and sunk down from 2 to 5 feet in perpendicular height, producing effects more or less striking, according to the shelving character of the shore.

In regard to the cause of the phenomenon, various had been the surmises; though the general impression seemed to be, that it was produced by distant submarine earthquakes.

The author stated that he could not acquiesce in this view, and gave his reasons for saying so.

In order to obtain a wider field of induction, he referred to former instances of oceanic oscillations, and shewed that they were almost always accompanied with considerable atmospheric disturbances.

He then proceeded to give an account of a remarkable storm of wind accompanied by thunder, lightning, and hail, which had traversed the British Islands on the 5th of July, appearing first in the SW. of England, and passing through the midland counties, traversing the south-east parts of Scotland, and going off about the Aberdeenshire coast.

By the lightning and large hail-stones accompanying this storm, much damage to property, as well as loss of life, had occurred. At Sheffield, the barometer was, during the passage of the storm, observed to sink suddenly about an inch.

The storm appeared to have rotated, and in the usual way,—viz. in a direction contrary to that of the hands of a watch,—of which proofs were given.

The author then suggested, that the oscillations in question were probably produced by this storm. The parts of the coast where they were observed, coincided with the direction in which the storm moved. The fact that the oscillations on the Cornish and Devonshire coasts commenced before the storm arrived there, so far from being hostile to, supported this view; for if waves were created by the storm, as it approached Great Britain, these waves would advance more rapidly than the storm, which appeared to move northwards at the rate of from 70 to 80 miles per hour,—whereas the similar waves produced by the two Lisbon earthquakes had moved forward at a rate of from 120 to 130 miles per hour.

As to the way in which waves could be produced on the surface of the ocean, sufficient to produce the fluxes and refluxes in question, it was observed—

(1.) That the wind, by its mere mechanical pressure, was capable of heaping up, over a large expanse, a considerable body of water. By the force of the south or south-west blasts in the storm, the sea would be elevated, and waves would thereby be formed, which would move forward before the storm towards the south coast of England.

(2.) That the level of the ocean rises in proportion to the fall of the barometer; so that if, as there was every reason to suppose, this storm was accompanied in its track by a diminution of atmospherical weight, waves almost commensurate in extent with the diameter of the storm would be formed.

In either or in both of these ways, the sea may have been, and probably was, so affected on the 5th, 6th, and 7th July 1843, as to produce the ebbing and flowing which was observed on certain parts of the coasts of Great Britain.

*Monday, 4th March* 1844.

Sir T. M. BRISBANE, President, Bart., in the Chair.

The following Communication was read :—

## On the Human Races in Britain, enumerated by Tacitus. By Dr Hibbert Ware.

This memoir had been undertaken as preliminary to an ethnological inquiry which the author had proposed to institute into the aborigines of the British Islands. It was premised, that in this endeavour to seek for ancient races in those which were modern, great caution is required.

It has been asked, if, at the present day, we can as readily distinguish an Iberian type from one that is Gaulish or Caledonian, as was done more than seventeen hundred years ago in the time of Tacitus? It is answered, that, by a conservative principle in our nature, directed to the persistency of types, the influences of Time, Climate, and Civilization, are rendered of little avail. And, even in a mixture or crossing of races, there is an interposition of preserving laws made in favour of mutually approximating types, such as those of Europe. For instance, when two or more races are mingled together in different proportions, it is expected that the type of the minority will eventually become merged in that of the majority. But whether, in accelerating or postponing such a result, it will be found that, among all animals, nature exercises a sort of discretionary power under three varied circumstances: 1*st*, When races widely differ from each other; 2*d*, When races are in a less degree remote; and, 3*d*, When races, like those of Britain, or Europe in general, approximate closely to each other. These three circumstances the author discussed in succession.

1*st*, When races widely differ from each other, as in the crossing of the horse and the ass. In this case, nature has ever declared, that a debased or intermediate breed shall not be perpetuated.

2*d*, When races are in a less degree remote. In this example nature acts with uniformity, as in the crossing of the spaniel with the greyhound, &c.; and, among the human species, in the mixture of European and black races. In any one of these instances, there is no incapacity in the progeny to perpetuate its breed; but it will be found that the principle directed to the persistence of races gradually restores, in the course of a few generations, the purity of any one of the types which may have been contaminated by mixture, while the other type, in the mean time, is doomed to extinction.

3*d*, When races approximate closely to each other, as when spaniels (of which there are divers breeds) are crossed among themselves, and the same of white and grey mice, the result shews that, in the progeny, the types of a paternal or maternal stock are less liable to occur in an intermediate, than in a perfectly distinct form; or, in other words, that there is a less tendency to a fusion than to a separation of types. For instance, in the Western Highlands of Scotland, which were peopled in succession by the dark-haired Gael, and the flaxen-haired Scandinavian, there is, in the descendants, less a mixture than a separation of the types; the progeny of many families of the peasantry illustrating the distinctness with which Gaelic and Scandinavian characters are reproduced in cases where the paternal and maternal types differ from each other.

In bringing forward these illustrations, it was far from being argued that a progeny did not often exhibit an intermediate character, derived from the two races of a paternal and maternal stock; it was simply urged that a separation of types is equally, if not more common; and that, when a sort of intermediate character is actually derived from two European races, it is not necessarily perpetuated to a future progeny. On the contrary, a pure and distinct type, even though rendered, for a generation or two, intermediate and obscure, is often revived, with all its primitive decision of character.

The author, lastly, availed himself of the occasion to state, that the laws which appertained to the characters of races, hold good also with *individual* distinctions; and that nature seemed far more intent upon perpetuating through successive generations, what might be named the type of the *individual* or *person*, than upon producing intermediate likenesses, referred (often fancifully) to two types, paternal and maternal.

From all these observations, it was concluded, that, although in every society of mixed races the type of the minority had a tendency to become merged, or to disappear in that of the majority, yet that, by the interposition of relaxed laws, made in favour of the mixture of two or more approximating races, such a result (in the absence of exterminating wars, famine, or pestilence), may be postponed to an incalculable period of time; and, as an ultimate consequence, that the discovery of ancient European races in those which are modern, is a reasonable expectation not likely to be frustrated.

After these observations, the author proceeded to the chief object of the Memoir, which was to explain, on ethnological principles, the ancient British races enumerated by Tacitus. These were, 1*st*, the Caledonians—" the red hair of those who inhabit Caledonia, and their large limbs, bespeak a German origin;" 2*d*, the Gauls—" those who are nearest to the Gauls are also similar to them;" and, 3*d*, the Iberians, indicated by their swarthy features and their curled hair.

The following exhibits a classification of the modern British races, with which the author compared those enumerated by Tacitus; but the description of them does not admit of abridgment.

(A.) Races referrible to the Light-haired German Stock.

Under the common title *German*, it was supposed that three races, and possibly a fourth, might be included.

(*a*) *The Teutonic race.*—To this race the description given of the Germans by Tacitus was supposed to apply exclusively. This type the author stated to be found in Scotland and the north of England.

(*b*) *The Scandinavian race.*—This type was described by the author as it occurs in Orkney and Shetland, in the North and West Highlands of Scotland, and in Ireland.

(*c*) *The Anglo-Frisian race.*—The type prevails in the south and midland districts of England, but diminishes in the northern counties and in Scotland.

(*d*) *The Pictish race.*—The author has not yet had leisure to verify his suspicion, that there exists, in certain Scottish districts, another German race, to which, possibly, the description given of the Picts by Adamnan and various early writers, may apply.

(B.) The Dark-Haired Races of Europe.

Between the light-haired and dark-haired races of Europe constitutional differences exist; the former shewing the sanguine, and the latter the melancholic temperament. In the female constitution the diversity is still more apparent. Under the dark-haired races are included (*a*) the Cymric; (*b*) the Gaulish; (*c*) the Iberian. Tacitus merely distinguishes the two latter; but, under the term Galli of the ancients, two distinct races are included; and when the Romans alluded to the gigantic stature of the Gauls, the description could only apply to the Cymric race, variously named Cimmerii, Cimbri, and Ombri, who were contemporary with the Gauls.

(*a*) *The Cymric race.*—This was the type of the ancient Britons in the time of Tacitus, as well as of the Belgæ and Armorici in Gaul. It was also that of the Fir-bolgs (Viri Bolgæ) of Ireland.

(*b*) *The Gaulish or Gallic race;* also named Celtic,—a name which M. Thierry has proved to be merely a local one applied to an armed confederation of Gauls. The type was that of a third part of Gaul; and, in the time of Tacitus, it distinguished the population of Ireland, part of Wales, and perhaps a few limited districts of Caledonia.

(*c*) *The Iberian race.*—This type is still to be studied in the ancient Silurian district of Tacitus, particularly in the counties of Monmouth and Brecon. Hitherto the characters of this race have not been defined; which blank in ethnology it was one of the leading objects of the present memoir to supply;—while another, yet an ultimate one, was to shew, that the Iberian tribes are to be considered as the aborigines of the British Islands, as well as of Spain, Ireland, Gaul, and Italy.

*Monday, 18th March* 1844.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Communications were read :—

1. On the Existence of an Osseous Structure in the Vertebral Column of Cartilaginous Fishes. By James Stark, M.D., F.R.S.E.
2. Farther Observations on Glaciers, by Professor Forbes.

*Monday, 1st April* 1844.

Sir T. M. BRISBANE, President, Bart., in the Chair.

The following communications were read :—

1. On the Development, Structure, and Economy of the Acephalocysts of Authors ; with an Account of the Natural Analogies of the Entozoa in general. By Harry D. S. Goodsir, Conservator of the Museum of the Royal Coll. Surg. Edin. Communicated by John Goodsir, Esq.
2. Account of a Repetition of Dr Samuel Brown's Processes for the Conversion of Carbon into Silicon. By George Wilson, M.D., Lecturer on Chemistry; and John Crombie Brown, Esq. Communicated by the Secretary.
3. On Dr Mathew Stewart's General Theorems. By T. S. Davies, Esq., F.R.S.E.

*Monday, 15th March* 1844.

Very Rev. Principal LEE, Vice-President, in the Chair.

The following Communications were read :—

1. Inquiry into the Aborigines of the British Islands. Part 2. On the claims of the Cymric and Gaelic races to be thus considered. By Dr S. Hibbert Ware.

In the first part of the present memoir, it was shewn that Cæsar divided Gaul into three parts, of which one was inhabited by the Belgæ, another by those who, in their own language, were called Celtæ, but who, by the Romans, were named Gauls, and a third by the Aquitani. These three nations, according to the Roman historian, differed from each other in language, customs, and laws; but it was remarked by the author, that they also differed from each other in physical characters,—the Belgæ possessing what is named a Cymric type, the Gauls proper a Gaulish type, and the Aquitani an Iberian type. All these three races were to be distinguished from the zanthous, light-haired, Germanic tribes of the West of Europe, not only by the dark colour of the hair and eyes, but by other particulars, as the form of the head, &c.

The present memoir was confined to (1*st*), the Cymric race, and (2*dly*), the Gaelic race.

(1*st*), *The Cymric race.*—The physiological distinction of Cymric and Gaelic races was first established by the late Dr W. F. Edwards, in his memoir "Des Caractères Physiologiques des Races d'Humain." The Cymric head is long, and often failing in width. The forehead is large and high ; the nose curved, with the extremity depressed, and the nasal ailes raised or turned up ; the chin strongly marked and prominent, and the stature tall. It was also explained by the author that these physical characters were associated with a distinct moral type.

It was argued, in the present memoir, that the Cymri had no real pretensions whatever to consider themselves (as in the ancient British triads) a primitive race in Britain. In tracing their progress from their oriental sojourning place to the remote west, they appear to have taken possession of no ground in any part of Europe which had not been preoccupied by other races. The author, in the course of arriving at this conclusion, gave the following historical account of the Cymri.

Sogdiana and Bactriana appear to have been the cradle of this race. At the present day, the Cymric type may be identified among the wandering tribes of Beloochistan, of which the author had evidence in some very accurate drawings, executed for him by his late son, during the expedition of Lord Keane.

The course of Cymric migration from east to west, was inferred by the occasional light which history affords of the physical characters of this early race, aided also by philological tests. The Cymric type is to be detected among some of the tribes anciently dwelling between the Caspian and Euxine seas, and in certain Eygptian sculptures, as figured by Rosellini, of the *Feccaro* (named by Wilkinson, *Tokkari*) dwelling, in the time of Rameses the Third, not far from the eastern shores of the Mediterranean. Various kinds of evidence also demonstrate, that the Cymri are to be traced, during their westerly migration, in Persia, along the shores of the Black Sea, in Greece, in Italy, and in the tracts watered by the Danube and the Rhine. They again appear as confederated tribes, known by the appellation of Boii, and Belgæ. Under the name of Fir-bolgs (Viri Bolgæ), they peopled Ireland, and, in occupying England and Scotland, they were lastly driven, by Saxon inroads, to the mountainous recesses of Wales. Various details of the greater or less prevalence of the Cymric type, as it is to be traced in these different countries, were supplied by the author.

(*2dly*), *The Gaulish, or Gaelic races.*—According to Dr Edwards, the head is round, so as to approach in a manner to a spherical form ; the forehead is moderate, a little swelled out, and retreating towards the temples ; the eyes are large and open ; the nose, in tracing it from the depression at its origin, is nearly straight, or without any marked curvature, and rounded at the extremity ; the chin is also rounded. Lastly, the height is moderate ; which, as Thierry, in his Histoire des Gaulois, first shewed, is an important historical distinction : for whenever the Romans spoke of the gigantic height of the Gauls, they meant their Cymric, and not their Gaelic foes. It was also explained that the moral type of the Gauls differed much from that of the Cymric race.

In considering the claims of the Gaelic race to be ranked as aboriginal in Britain, the author entered upon two questions, (*a*) their original sojourning place, and (*b*) their course of migration.

(*a*) The *Asiatic* cradle of the Gaelic race.—The author, after noticing the suspicion of Baron Larrey, that Arabia was to be thus considered, as well as the various opinions on this subject, advanced by Vallancey, Dr O'Conor, Sir William Betham, and others, was inclined to believe that the primitive Gauls were a polished and civilized people, originally dwelling on the eastern coast of the Mediterranean, who, as maritime adventurers, visited the west of Europe on objects of traffic, particularly for the sake of the precious metals. He did not consider it as necessary to this opinion, that they should be identified with the Phœnicians, or any other nation equally maritime ; but left this question to be determined by more satisfactory evidence than has hitherto been adduced, resulting from a comparison of physical characters. It was also observed, that the leading physical characters of the Gael, namely, the form of the head and features, appear in the figures of certain sculptured monuments of the very early period of Rameses the Third, which, from a discordancy in other respects, have greatly puzzled both Champollion, and Rosellini. These figures of a civilized people, richly attired, are referred to inhabitants of Canaan or its confines.

(*b*) The course of Gaelic migration to the West—The author was disposed to consider, that evidence of the westerly course of Gaelic migration might probably be found in the commercial settlements which early maritime tribes may have formed on the Mediterranean coasts and islands. He, accordingly, adverted to the remark of Baron Larrey, relative to the identity of the western Arabs with Gaulish races,—to the assertion of Gesenius, that the Numidian language was a pure, or very nearly pure, Hebrew, such as was spoken by the ancient Canaanites or Phœnicians,—and to various Clyclopean structures in Malta, on the African coast, and elsewhere, similar to those which characterise the westerly countries of the

Gael. But the author dwelt most upon the account of the Turditani of Spain, as given by Pliny, to whom on early introduction of letters was ascribed, together with the use of valuable works of art wrought in the precious metals, resembling such as are constantly discovered in Ireland, which indicate the very early state of civilization in this country. The author then entered into a detailed description, from personal observation, of the greater or less frequency of the Gaelic type in France, Ireland, Scotland, and Wales; and of the causes to which its disappearance in many extensive districts might have been attributable.

After these explanations, the general question was considered,—What race ought to be regarded as aboriginal in the British islands? Llwyd had long since shewn, from the language of topography, that the Gauls had preceded the Cymri in the occupation of Britain. But it was asked,—if there might not have been a still earlier race existing in this country than the maritime and commercial Gauls?

To this question an answer was given in the affirmative. Tacitus, in his enumeration of British races, has suggested, that an ancient Iberian stock, remarkable for a swarthy complexion and curled hair, might have passed over and occupied the seat of the Silures (in South Wales);—a British tribe, with whom he was disposed to identify this primitive race of Spain.

It was then stated, that the author had collected abundant evidence which leads to the conclusion, that an Iberian, or Aquitanian race, was an older one in Britain than either of the two whose pretensions he had discussed; but that it would be in vain to establish their aboriginal claims, unless the history of the Cymri and the Gael, in reference not only to their Asiatic sojourning place, but also to their westerly course of migration, was well understood. He, lastly, expressed his hope, that, if the aboriginal claim of the Iberian race meet with confirmation, some light would be thrown upon the fossil bones of the human species which are found in caves, or buried deep in strata of peat, occasionally associated with the remains of animals now extinct, which have had an existence prior even to the records of history.

2. On the Knowledge of Distance given by Binocular Visions. By Sir David Brewster, K.H.

*Monday, 6th May* 1844.

Dr ABERCROMBIE, V.P., in the Chair.

The following Communications were read :—

1. On the Conversion of Relief by Inverted Vision. By Sir David Brewster, K.H.

2. On the Geology of Cockburn-Law and its Neighbourhood.

By William Stevenson, Dunse. Communicated by David Milne, Esq.

The author, in the first part of his paper, described the nature of the formations, and in the last part offered his views in explanation of the appearances.

In describing the formations, he enumerated, first, those of *aqueous*, and last those of *igneous* origin.

I. The former consist of the greywacke, the old red sandstone, and the coal formation.

(1.) The *greywacke* strata form the summit of Cockburn-Law, having a strike about NE. and SW. nearly vertical. There appears to be no decided evidence of any organic remains in these strata ;—there are curious markings which are most probably only concretionary. At Hoardwheel, situated to the eastward of Cockburn-Law, two varieties of copper ore are found in the greywacke, the green and the grey, the former of which is the most plentiful, and imparts a beautiful hue to some of the rocks. The oxide of manganese is also widely diffused.

(2.) The *old red sandstone* strata lie over the vertical strata of the greywacke. At a distance from the hills they are generally horizontal, or dip away at a gentle angle ;—but at the sides of the hills they are highly inclined. These old red sandstones are extensively developed in Preston Haugh. The lowest bed consists of both angular and roundish greywacke and porphyritic portions. The colour of this formation is, especially towards its base, of a red colour.

It is in this formation, that the bones, teeth, scales, and spines of the *Holoptichius nobilissimus*, a large ganoid fish, are found. These interesting relics are very abundant in the strata opposite to Cockburn Mill, and also about half a mile below it, on the right bank of the Whitadder.

(3.) The strata of the *coal-formation* lie above the old red sandstone rocks in a conformable position. They are to be seen in the Whitadder, below Preston Bridge, and consist of the ordinary sandstones, shales, and strata of ironstone. The only fossils prevailing in them are those of terrestrial vegetables.

II. The *Igneous* rocks were divided by the author into two classes —one of which he described as the Felspathic, the other as the Augitic.

(1.) The *Felspathic* rocks comprehend all those igneous rocks associated with the greywacke strata, consisting of the granites, and syenites, and old porphyries of Cockburn-Law, the Staneshiel, the Knock Hill, Blackerstone Hill, &c.

(2.) The *Augitic* trap-rocks exist almost entirely among the more recent aqueous rocks, viz., the old red sandstones and coal-measures. They are seldom or never seen within the range of the greywacke formation, at least in this neighbourhood.

These augitic traps exist both in the form of narrow dykes, and in that of great masses constituting hills. Of the former, the Cumledge trap-dyke is a good example. It is seen in the bed of Oxendean Burn at Cumledge House, and there forms an amygdaloidal greenstone, abounding in veins of zeolite, steatite, and other minerals. The width of the dyke at this place is about ten yards. The average direction of the dyke is NNW. and SSE. It has had the effect, as usual, of hardening the strata on each side of it. This dyke has been traced by the author for a considerable distance, running through both the old red sandstone and coal formations. It appears also to reach into the granite of the Staneshiel and Cockburn-Law.

An amygdaloidal trap is to be seen on the left bank of the Whitadder, below Cockburn Mill, forming a bed of about four feet thick, and lying above the old red sandstone strata. There are large accumulations of greenstone at Borthwick and Castle Mains. Dunse-law is also composed of basalt.

In the *second* part of his paper, the author shewed that the granite and other felspathic rocks were formed before the deposition of the old red sandstones, and the trap-rocks after the deposition of the coal-measures.

Mr Stevenson's paper was illustrated by a geognostical map, as well as by numerous sections.

3. Notice regarding the Indian Grass Oil, or Oil of Andropogon Calamus-aromaticus. By Thomas G. Tilley, Phil. D. Communicated by Dr Christison.

*Monday, 2d December* 1844.

SIR T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read :—

1. Account of the late Earthquake at Demerara. By W. H. Campbell, Esq. Communicated by M. Ponton, Esq.
2. On the Existence of an Electrical Apparatus in the Flapper Skate and other Rays. By James Stark, M.D., Fellow of the Royal College of Physicians, Edinburgh.
3. Observations on the Comet, visible now or lately in the Constellation of the Whale. By C. Rumker, Esq. Communicated by Sir T. M. Brisbane, Bart.

*Monday, 16th December* 1844.

SIR GEO. MACKENZIE, Bart., in the Chair.

The following Communications were read :—

1. On a Possible Explanation of the Adaptation of the Eye to Distinct Vision at Different Distances. By Professor Forbes.
2. Notice of an Ancient Beach near Stirling. By Charles Maclaren, Esq.

*Monday, 6th January* 1845.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read:—

1. Farther Remarks on the Electrical Organs of the Rays. By Dr Stark.
2. Observations on the same subject. By John Goodsir, Esq.
3. On the Cause which has produced the Present Form and Condition of the Earth's Surface. By Sir George Mackenzie, Bart.

*Monday, 20th January* 1845.

The Right Reverend Bishop TERROT, V. P., in the Chair.

The following Communications were read:—

1. Some Account of the Magnetic Observatory at Makerstoun, and of the Observations made there. By J. A. Broun, Esq. Communicated by Sir T. M. Brisbane, Bart.
2. Description of a Sliding Scale for Facilitating the Use of the Moist-bulb Hygrometer. By James Dalmahoy, Esq.
3. Account of Experiments to Measure the Direct Force of the Waves of the Atlantic and German Oceans. By Thomas Stevenson. Communicated by David Stevenson, Esq.
4. A Verbal Communication in regard to Chevalier's Experiments on the Decomposition of certain Salts of Lead by Charcoal. By Dr Traill.

*Monday, 3d February* 1845.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read:—

1. On a Peculiar Modification of the Doubly Refracting Structure of Topaz. By Sir D. Brewster, K.H.

While examining, in polarised light, some of the crystals which he had discovered in Topaz, the author observed certain optical phenomena, depending on a peculiarity of structure. This peculiarity is manifested either in the depolarisation of light, when it gives rise to four quadrants of light, separated by the radii of a black rectangular cross similar to the central portion, or the tints of the first order in the uniaxal system of polarised rings, or in the unequal refraction of common light, which gives rise to the mirage of a luminous point, in the form of concentric circles surrounding the centre of force. In every case there was found a quadrangular cavity in the centre of the intersection of the cross, generally dark and opaque, but in one case having a luminous spot in the centre. These cavities are from the $\frac{1}{3000}$ to the $\frac{1}{4000}$ of an inch in diameter.

These cavities are quite distinct from all those formerly described by the author; and from the phenomena above described, he concludes that the contents of each cavity have exerted an elastic force on the surrounding mineral while in a plastic state. In some cases fissures are seen proceeding from the central cavities, but these are supposed to have been produced after the mineral had become indurated, and had already been subjected, in the plastic state, to the pressure or force above indicated.

These cavities never accompany the cavities with two fluids, but occur in specimens containing numerous embedded crystals, differing little from Topaz in refracting power.

Since the mineral must have been plastic when it yielded to the pressure here noticed, it cannot have been formed by the aggregation of molecules having the primary form of the crystal.

These considerations, along with others connected with the crystals, which occur in the cavities of Topaz, have led the author to adopt the idea of a new and peculiar kind of crystallization, to which he will soon direct attention.

## 2. Extracts from Letters to the General Secretary, on the Analogy of the Structure of some Volcanic Rocks with that of Glaciers. By C. Darwin, Esq., F.R.S. Specimens were exhibited. With Observations on the same subject, made by Professor Forbes.

" I take the liberty of addressing you, knowing how much you are interested on the subject of your discovery of the veined structure of glacier ice. I have a specimen (from Mr Stokes's collection) of Mexican obsidian, which, judging from your description, must resemble, to a considerable degree, the zoned ice. It is zoned with quite straight parallel lines, like an agate; and these zones, as far as I can see under the microscope, appear entirely due to the greater or lesser number of excessively minute, flattened air cavities. I cannot avoid suspecting that in this case, and in many others, in which lava of the trachytic series (generally of very imperfect fluidity) are laminated, that the structure is due to the stretching of the mass or stream during its movement, as in the ice-streams of glaciers. * * *

"If the subject of the lamination of *volcanic* rocks should interest you, I would venture to ask you to refer to p. 65–72 of my small volume of 'Geological Observations on Volcanic Islands.'* I there

* The laminated, volcanic rocks of Ascension, consist, as described by Mr Darwin, of excessively thin, quite parallel layers of minute crystals of quartz (determined by Professor Miller) and diopside; of atoms of an oxide of iron, and of an amorphous, black augitic mineral; and, lastly, of a more or less pure felspathic stone, with perfect crystals of felspar placed lengthways. The following is a portion of the passage referred to:—"Several causes appear capable of producing zones of different tension in masses semiliquified by heat. In a fragment of devitrified glass I have observed layers of sphærulites, which appeared, from the manner in which they were abruptly bent, to have been produced by the simple contraction of the mass in the vessel in which it cooled. In certain dykes on Mount Ætna, described by M. Elie de Beaumont, as bordered by alternating bands of scoriaceous and compact rock, one is led to suppose that the stretching movement of the surrounding strata, which originally produced the fissures, continued, whilst the injected rock remained fluid. Guided, however, by Professor Forbes's clear description of the zoned structure of glacier ice, far the most probable explanation of the laminated structure of these felspathic rocks appears to be, that they have been stretched, whilst slowly flowing onwards in a pasty condition, in precisely the same manner, as Professor Forbes believes, that the ice of moving glaciers is stretched and fissured. In both cases, the zones may be compared to those in the finest agates; in both, they extend in the direction in which the mass has flowed, and those exposed on the surface are generally vertical. In the ice, the porous laminæ are rendered distinct by the subsequent congelation of infiltrated water; in the stony felspathic lavas by subsequent crystalline and concretionary action. The fragment of glassy obsidian in Mr Stokes's collection, which is zoned with minute air-cells, must strikingly resemble, judging from Professor Forbes's description, a fragment of the zoned ice; and if the rates of cooling and the nature of the mass had been favourable to its crystallization, or to concretionary action, we should here have had the finest parallel zones of different composition and texture. In glaciers, the lines of porous ice and of minute crevices seem to be due to an incipient stretching, caused by the central parts of the frozen stream moving faster than the sides and bottom, which are retarded by friction. Hence, in glaciers of certain form, and towards the lower end of most glaciers, the zones become horizontal. May we venture to suppose that, in the felspathic lavas with horizontal laminæ, we see an analogous case? All geologists who have examined trachytic regions have come to the conclusion, that the lavas of this series have possessed an exceedingly imperfect fluidity; and as it is evident that only matter thus characterized would be subject to become fissured, and to be formed into zones of different tensions, in the manner here supposed, we probably see the reason why augitic lavas, which appear, generally, to have possessed a higher degree of fluidity, are not, like the felspathic lavas, divided into laminæ of different composition and texture. Moreover, in the augitic series, there never appears to be any tendency to that kind of concretionary action, which, we have seen, plays an important part in the lamination of rocks of the trachytic series, or, at least, in rendering that structure apparent."

throw out the idea, that the structure in question may perhaps be explained by your views on the zoned structure of glacier ice, the layers of less tension being, in the case of the Ascension obsidian rocks, rendered apparent, chiefly by the crystalline and concretionary action superinduced in them, instead of, as in zoned ice, by the congelation of water. * * *

"How singular it at first appears, that your discoveries in the structure of glacier ice should explain the structure, as I fully believe they will, of many volcanic masses. I, for one, have for years been quite confounded whenever I thought of the lamination of rocks which have flowed in a liquified state. Will your views throw any light on the primary laminated rocks? The laminæ certainly seem very generally parallel to the lines of disturbance and movement. Believe me, &c. C. DARWIN."

To Professor FORBES.

Professor Forbes confirmed the previous remarks by others, made by himself on the specimens transmitted to him by Mr Darwin, and on specimens from Lipari and Iceland in the collection of the Royal Society, as well as by direct observations made by himself on the lava streams of Ætna.

### 3. Professor Forbes then read the following Letter from Professor Gordon, of Glasgow, also on the subject of the Viscous Theory of Glaciers.

GLASGOW, *January* 31. 1845.

* * * When you requested me to give you a memorandum of what appeared to me to be the *very glacier-like motion* and appearance of Stockholm pitch flowing from a barrel, I considered my observation to have been too casual to be worth writing, and having foreseen that I could arrange an experiment at Gateshead in the beginning of the year, I delayed giving you the memorandum you wished. I had hoped to have been able to inspect and report on my experiment about this time; but I cannot go to Gateshead for some time to come, nor have I had any report of the progress of my pitch glacier since the 6th January, when I was informed it had not moved since the day after I left it, on the 28th December. Your note of yesterday induces me to offer you the following still perfectly vivid impressions of the analogy between *ice* and *Stockholm pitch*.

Allow me, in the first place, to mention that I read your travels in the Alps, in May last; and that on the 24th of June I spent almost 20 hours on the glaciers of the Grindelwald. I went up by the lower glacier, prepared with poles to prove the motion, and actually observed a progress of about 12 inches in the course of 13 hours, from 6 A.M. to 7 P.M. I traced the "dirt bands" on the surface.

I was let down into several crevasses, one of them to a depth of 30 feet, and could trace the *slaty structure* of the ice, the alternate clear blue thin veins, and the transition to opaque grey or even white. I descended from the glacier with a much better appreciation of the theory of glaciers than I had had, and a strong conviction that the facts I had observed, could not be otherwise accounted for than by the mechanical theory you have given. In passing through Gateshead in August, a broken headed barrel of Stockholm pitch at the Wire Rope Factory, attracted my attention. Its general appearance is represented in Fig. 1.*

A mass of Stockholm pitch *broken* from a barrel in August (at the time of the observations I am about to mention) presented a dark-brown colour, a glassy lustre, translucent edges. The substance is fragile, fracture conchoidal, and very uniform. A mass, Fig. 4., which was brought to me by the workman having charge of this department, and which he had broken from the end of such a *stream* as I have represented coming from the barrel, presented generally the same appearance as a mass broken from an entire barrel,† but had this remarkable peculiarity, that there were lines —structural lines, *a a a a*—whose texture and colour were different from the general colour of the mass recognisable on such points as *b b b*, between any two such structural lines.

Fig 2. is an elevation of the stream of pitch, shewing pretty nearly the dimensions and outward appearance of the stream. The striated *slaty* structure appears here on the outside, as is more distinctly (intended to be) shewn in Fig. 3. There were certain well-defined lines, and on either side of these for some little distance, other small lines or cracks (but not *open* cracks or fissures), and then a space of smooth glassy-looking pitch.

I am strongly impressed with the idea, that the structural lines are a *result of the motion*, and that they correspond with the *veins* of glaciers. The lines incline most when the surface is steepest, as at *h*, Fig. 3., and are very faint and nearly horizontal at *i*, where the surface of the stream is nearly so too. I left Gateshead without having an opportunity of getting a sectional view of this stream. I can get no real Stockholm pitch in Glasgow, else I should have made the experiment you have incited me to attempt here. I am, &c.

LEWIS GORDON.

To Professor FORBES.

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* The numbers refer to drawings sent by Professor Gordon to Professor Forbes.

† The pitch is *fragile* at the same time that it *flows*.—L.G.

*Proceedings of the Wernerian Natural History Society.*

On 23d Nov. 1844 this Society commenced its thirty-eighth session, and appointed office-bearers for 1845. Professor Jameson was re-elected president; Professor Traill, Dr Greville, and Dr Brunton, were elected vice-presidents; Dr C. Anderson, W. Copland, Esq., Harry D. S. Goodsir, Esq., and Dr Coldstream, were chosen of the Council; Dr Neill, and T. J. Torrie, Esq., joint-secretaries; and the other office-bearers, were re-elected.

Jan. 25.—Professor Jameson, P., in the Chair. A communication from Dr John Davy on the Nature and Qualities of Guano was read; and also a paper by Mr Rhind on the Transport of Erratic Blocks. Numerous donations to the Society's library were announced.

Feb. 8.—Professor Jameson, P., in the Chair. Dr Traill read the first part of a paper on the Characters and Classification of Serpents. At the same meeting Mr John Goodsir gave a particular descriptive account of a minute entozoon infesting the spinal nerves of the Gadidæ; and which he exhibited in a recent specimen of haddock. As the cells of this parasite had long ago been figured by Dr Monro secundus, in his great work on the Nervous System, Mr Goodsir proposed to name the animal Neuronoia Monroii.

Feb. 22.—Dr C. Anderson in the chair. Dr Traill communicated the second part of his paper on Serpents, illustrating the families, genera, and species, by an extensive series of well preserved specimens.

Mar. 15.—Dr W. Macdonald in the chair. Professor Jameson read a paper on the Supposed Stratification of Primitive Rocks and their alleged Mechanical Origin. Dr Neill, secretary, then read (1.) a communication from William Baker, Esq., endeavouring to establish the identity of the Salmon with the Common Trout; (2.) An account by M. Guerin of Geneva, of the Rock-nose of Whalers, being either a marked variety of the Balæna mysticetus or a distinct species; (3.) Notes made during a visit to Ichaboe, and the adjoining coast of Africa, in 1844, by Mr P. Gillespie, commander of the barque Drummore of Leith, with his meteorological journal; (4.) Notice regarding a specimen of the Frog-shaped South American Lizard, called Phrynosoma cornuta, which had been kept alive for some months in a hothouse at Canonmills.

Long. 3° 12' W., Lat. 55° 13' N. Height above the Sea, 180 feet; Distance from the Sea, 10 miles. Height of the Rain-Gauge from the Ground, 5 feet.
The observations taken at 9 A.M. and 9 P.M.

## BAROMETER.

| 1844. Months. | Atmospheric Pressure, Morning. | Atmospheric Pressure, Evening. | Mean of Morning and Evening. | Reduced to 32° Fahr., and corrected to sea-level. | Mean Daily Range. | Mean Nightly Range. | Mean Range in 24 hours. | Monthly Extremes. Highest. | Lowest. | Greatest Range in 24 hours. | Least Range in 24 hours. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 29.81 | 29.84 | 29.82 | 29.97 | 0.100 | 0.116 | 0.216 | 30.36 | 29.02 | 0.47 | 0.07 |
| February | 29.43 | 29 45 | 29.44 | 29.58 | 0 173 | 0.146 | 0.319 | 29.94 | 28.66 | 0.70 | 0.02 |
| March | 29.62 | 29.67 | 29.65 | 29.76 | 0.158 | 0.145 | 0.303 | 30.40 | 28.85 | 0.64 | 0.03 |
| April | 29.95 | 29.96 | 29.95 | 30.06 | 0.098 | 0.080 | 0.178 | 30.32 | 29.46 | 0.52 | 0.01 |
| May | 30.10 | 30.11 | 30.10 | 30.20 | 0.060 | 0.052 | 0.112 | 30.40 | 29.75 | 0.28 | 0.01 |
| June | 29.79 | 29.44 | 29.62 | 29.72 | 0.064 | 0.070 | 0.134 | 30.08 | 29.40 | 0.48 | 0.04 |
| July | 29.78 | 29.76 | 29.77 | 29.85 | 0.091 | 0.067 | 0.158 | 30.11 | 29.17 | 0.55 | 0.01 |
| August | 29.62 | 29.63 | 29.63 | 29.73 | 0.090 | 0.092 | 0.182 | 30.21 | 29.00 | 0.46 | 0.01 |
| September | 29.91 | 29 93 | 29.92 | 30.02 | 0.060 | 0.069 | 0.129 | 30.26 | 29.52 | 0.31 | 0.01 |
| October | 29.52 | 29.49 | 29.50 | 29.61 | 0.117 | 0.122 | 0 239 | 30.24 | 28.80 | 0.60 | 0.02 |
| November | 29.96 | 29.66 | 29.81 | 29.93 | 0.094 | 0.096 | 0.190 | 30.20 | 28.87 | 0.60 | 0.03 |
| December | 29.94 | 29.94 | 29.94 | 30.10 | 0.053 | 0.076 | 0.129 | 30.35 | 29.30 | 0.34 | 0.01 |
| Means | 29.78 | 29.74 | 29.76 | 29.87 | 0.096 | 0.094 | 0.190 | | | | |
| 1843 | 29.75 | 29.71 | 29.72 | 29.85 | 0.105 | 0.104 | 0.209 | | | | |

## THERMOMETER.

| Months. | Mean of greatest Heat. | Mean of greatest Cold. | Mean Temp. of Morning. | Mean Temp. of Evening. | Mean of Extremes. | Mean of Morning and Evening. | Mean of both. | Mean Range of 24 hours. | Monthly Extremes. Highest. | Lowest. | Greatest Range in 24 hours. | Least Range in 24 hours. | Temp. of Spring-water. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 44.5 | 33.4 | 37.4 | 38.4 | 38.9 | 37.9 | 38.4 | 8.0 | 51.0 | 13.5 | 25.0 | 4.5 | 42.5 |
| February | 38.5 | 28.0 | 31.8 | 33 6 | 33.2 | 32.7 | 32.9 | 10.9 | 48.0 | 13.0 | 28.0 | 4.0 | 41.7 |
| March | 45.3 | 32.3 | 38.7 | 38.9 | 38.8 | 38.8 | 38.8 | 13.0 | 59.0 | 19.0 | 23.5 | 0.0 | 45.0 |
| April | 54.6 | 39.5 | 47.6 | 47.1 | 47.0 | 47.3 | 47.2 | 15.2 | 66.0 | 31.0 | 33.0 | 6.0 | 50.5 |
| May | 62.1 | 42.1 | 53.7 | 51.4 | 52.1 | 52.5 | 52.3 | 20.7 | 70.0 | 31.5 | 33.0 | 12.5 | 48.1 |
| June | 62.0 | 48.4 | 55.5 | 54.6 | 55.2 | 55.0 | 55.1 | 13.9 | 71.5 | 41.0 | 23.0 | 4.5 | 51.6 |
| July | 64.8 | 47.9 | 57.9 | 57.2 | 56.3 | 57.5 | 56.9 | 15.4 | 76.0 | 41.5 | 26.5 | 6.0 | 53.0 |
| August | 61.5 | 47.2 | 55.1 | 54.8 | 54.3 | 54.9 | 54.6 | 14.1 | 70.0 | 39.0 | 26 0 | 5.0 | 52.5 |
| September | 61.7 | 46.4 | 54.0 | 54.2 | 54.0 | 54 1 | 54.0 | 14.5 | 75.5 | 34.0 | 29.5 | 5.0 | 50.3 |
| October | 54.0 | 41.4 | 46.0 | 47.6 | 47.7 | 46.8 | 47.2 | 12.5 | 69.0 | 29.0 | 21.0 | 4.0 | 48.6 |
| November | 48.2 | 39.6 | 42.6 | 44.3 | 43.9 | 43.4 | 43.6 | 8.6 | 54.5 | 30.0 | 15.5 | 4.0 | 47.0 |
| December | 37.9 | 30.4 | 32.4 | 34.7 | 34.1 | 33.5 | 38.8 | 7.4 | 43.5 | 20.0 | 13.5 | 2.0 | 43.6 |
| Means | 52.9 | 39.7 | 46.0 | 46.4 | 46.2 | 46.0 | 46.2 | 12.8 | | | | | |
| 1843 | 54.1 | 40.7 | 46.6 | 47.4 | 47.4 | 47.0 | 47.2 | 13.2 | | | | | |

# Dr DUNBAR'S *Meteorological Observations for* 1844.—(Continued).

WINDS—THEIR DIRECTION AND FORCE, AND WEATHER, STATED IN THE NUMBER OF DAYS IN WHICH EACH PREVAILED.

| MONTHS. | N. | NE. | E. | SE. | S. | SW. | W. | NW. | Calm. | Moderate. | Brisk. | Strong Breeze. | Stormy. | Sun shone out. | Rain fell. | Snow and Hail. | Frost. | Thunder. | Rain in Inches. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, | 2 | 4 | 1 | 1 | 1 | 7½ | 7½ | 7 | 14 | 9 | 1 | 5 | 2 | 29 | 12 | 4 | 14 | ... | 2.60 |
| February, | 2 | 7 | 4 | 2 | ... | 4½ | 6 | 3½ | 6½ | 8 | 2 | 12½ | ... | 24 | 7 | 14 | 18 | ... | 2.03 |
| March, | 2 | 3 | 1 | 2 | ... | 14 | 4 | 5½ | 6 | 5 | 7 | 10 | 3 | 28 | 11 | 8 | 12 | ... | 2.32 |
| April, | ... | 1 | 2 | 2 | 7 | 7 | 7 | 4 | 12 | 7 | 8 | 3 | ... | 27 | 13 | ... | 4 | ... | 0.94 |
| May, | 2 | 16 | ... | 1½ | 4 | 3½ | 1 | 3 | 9 | 5 | 8 | 9 | ... | 31 | 3 | ... | 2 | ... | 0.28 |
| June, | 1 | 4 | 1 | 3½ | 7 | 10½ | ... | 3 | 10 | 8 | 4 | 8 | ... | 24 | 13 | ... | ... | 1 | 3.43 |
| July, | ... | 2 | ... | 8½ | 5½ | 9 | 4½ | 1½ | 17 | 10 | 2 | 2 | ... | 28 | 21 | ... | ... | 4 | 3.97 |
| August, | ½ | 1 | 2 | 1 | 1 | 9 | 7½ | 9 | 12 | 7 | 5 | 7 | ... | 30 | 16 | ... | ... | 1 | 2.18 |
| September, | ½ | 11½ | 5 | 1 | 2 | 7 | 1 | 2 | 10 | 12 | 7 | 1 | .. | 27 | 10 | ... | ... | 2 | 3.69 |
| October, | ... | 5 | 4 | 6 | ... | 7 | 3 | 3 | 7 | 10 | 9 | 3 | 2 | 29 | 14 | 2 | 5 | 2 | 2.47 |
| November, | 3 | 6½ | 2 | 8½ | 1 | 7 | ... | 2 | 11 | 8 | 2 | 7 | 2 | 20 | 12 | ... | 5 | ... | 1.58 |
| December, | ... | 9 | 12 | 9 | 1 | ... | ... | ... | 18 | 10 | ... | 3 | ... | 21 | 3 | 1 | 25 | ... | 0.15 |
| Total, | 13 | 70 | 34 | 46 | 29½ | 86 | 41½ | 43½ | 132½ | 99 | 55 | 70½ | 9 | 318 | 135 | 29 | 85 | 10 | 25.64 |
| 1843, | 14½ | 39½ | 39 | 34½ | 47½ | 93 | 54 | 43 | 132½ | 105 | 35½ | 79 | 13 | 302 | 164 | 14 | 55 | 12 | 32.69 |

## REMARKS.

The maximum of *Atmospherical Pressure* was on the 29th of March and 2d of May, when the Mercury stood at 30.400. The minimum on the 28th of February, 28.600. Range, 1.740.

The maximum of *Temperature* was on the 23d and 24th of July, viz., 76°; in 1843 it was 79°. The minimum, February 27, viz. 13°; in 1843 it was 17°. The mean of extremes exceeds the mean of morning and evening only by 2–10ths of a degree. The mean temperature of the year is lower than that of 1843 by 1 degree, but exactly equal to the mean temperature of the last 20 years. A great change is observable in the temperature of December 1844. In 1842 and 1843, it exceeded the temperature of the same month during the last 20 years by 10 degrees; while in 1844, it was 13 degrees below the same month in the two years above specified, and 3 degrees below the 20 years' mean. The weather during the month was remarkably agreeable and mild; it was uniformly frosty, and thus kept the mercury low; but the frost was never severe, and the atmosphere, for a mid-winter month, so pleasant to the feelings, as will cause the December of 1844 to be long held in agreeable remembrance.

The quantity of *Rain* fallen in this locality during 1844 was only 25.64 inches, less than that of 1843 by 7 inches, and less than has fallen here in the twelvemonth for the last 18 years, ever since the memorable dry year of 1826; and no more than the average of that on the east coast of Scotland, which is a third less than with us on the west. The number of days on which rain fell is less by 12 than in 1843. The driest month was December, and the wettest, as usual, July.

Of *Snow*, we have had double the number of days to that of the preceding year, chiefly in the spring months.

We have had more easterly *wind* than usual. Throughout the whole of December, the wind blew, with the exception of one day, from easterly points, but generally moderate.

N.B.—Under the heading NE. are ranged all the days from which the wind blew from any intermediate point between N. and E.:—the same of SE., SW., and NW.

*Mean State of the Barometer and Thermometer at Canaan Cottage, near Edinburgh.* By A. ADIE, Esq. 1844.

Lat. 55° 57′. Height above the mean level of the Sea, 246 feet.

| MONTHS. | Thermometer observed at 10 A.M. and 10 P.M. Mean. | Registering Thermometer. Means of Minimum. | Registering Thermometer. Means of Maximum. | Barometer. Morning. | Barometer. Evening. | Rain. |
|---|---|---|---|---|---|---|
| January | 38.48 | 32.22 | 54.22 | 29.28 | 29.63 | 1.23 |
| February | 34.52 | 22.43 | 46.51 | 29.25 | 29.26 | 1.72 |
| March | 35.29 | 39.35 | 52.59 | 29.16 | 29.45 | 2.43 |
| April | 51.17 | 48.33 | 58.50 | 29.76 | 29.73 | 0.40 |
| May | 58.75 | 39·23 | 58.42 | 29.99 | 30.10 | 0.15 |
| June | 58.14 | 46.66 | 64.26 | 29.65 | 29.65 | 2.71 |
| July | 57.79 | 48.39 | 65.39 | 29.62 | 29.65 | 2.39 |
| August | 56.09 | 46.93 | 64.68 | 29.19 | 29.54 | 2.11 |
| September | 53.18 | 48.00 | 60.29 | 29.82 | 29.81 | 2.40 |
| October | 41.20 | 40.11 | 53.23 | 29.60 | 29.69 | 0.82 |
| November | 44.15 | 38.40 | 48.03 | 29.52 | 29.45 | 3.92 |
| December | 36.63 | 28.90 | 36.42 | 29.84 | 29.88 | 0.37 |
| Annual Mean | 47.12 | 39.32 | 55.77 | 29.55 | 29.65 | 20.65 |
| | | 47.55 | | 29.60 | | |

*The Meteorology of Whitehaven. Remarks on the Weather, &c., of* 1844. By J. F. MILLER, Esq. Communicated by the Author.

It must have been obvious even to the most casual observer of atmospheric changes, that the past year has been marked by several periods of extreme drought. Indeed, except in 1842, there is no year which at all approaches it in dryness, since the Journal was commenced in 1832. The quantity of rain taken by the gauge in 1844 is 36.723 inches, being 2.030 inches under the fall in 1842, and nearly 12 inches under the average.

The wet days exceed those of 1842 by 5, but are 32 under the average number, which is 204.

The principal periods of drought in 1844, are as follow :—From the 23d of April to the 5th June, rain fallen .262, or about a quarter of an inch: 25th June to 10th July, none: 23d August to 5th September, none; and there was but one wet day from the 17th of the same month till its close: from 19th November to 31st December (44 days), 0.405, or between a quarter and half an inch. The quantity of melted snow is above the average by 0.774, or more than three quarters of an inch, and the number of snowy days also exceed the average number by seven. The fall of rain at Cleator, four miles S. of Whitehaven, registered by T. Ainsworth, Esq., is 39.31 inches, and the wet days 152.

Last year we gave the results of some experiments with two gauges (the one placed at 6 inches, and the other at 6 feet above the ground) which were apparently at variance with what has been considered by most Meteorologists a well-established fact, "that where a gauge is merely removed to a higher position in the atmosphere, independent of locality, less rain is deposited in the instrument in proportion to its distance from the surface." But, however this may be at small distances above the ground, it is certain that at considerable elevations much less rain is deposited than at the surface. Thus, one of the gauges with which the experiments above alluded to were conducted, on being removed to the steeple of St James's Church (78 feet above the street*), received, in 1844, only 27.862 inches, about one-fourth less than the gauge at 6 feet. The gauge on the steeple was examined weekly, and I generally found it to contain from one-third to one-fourth less than the standard instrument at 6 feet. The difference, however, varied from one-half to only one-tenth less; on five occasions I found the quantity only one-half, mostly when the fall was moderate and attended with violent gales. Thrice the receipts of the two gauges were equal, or nearly so, when the rain descended in vast torrents during a calm, or with no particular high wind; and, upon one solitary occasion, the higher gauge *exceeded* the lower by nearly one-fourth, without any attendant circumstances apparently sufficient to account for the discrepancy. The rain fell chiefly on two nights, the upper current varying from two to three points west of the wind, which was strong at SW. and SSW.

Although the receipt of rain is greatest at or near the surface of the ground, and the fall is found to diminish as the gauge is removed to a higher position in the atmosphere; yet as we ascend into hilly and mountainous districts, the annual depth of rain rapidly increases. Thus the fall at Whitehaven during last year is only 36.723, whilst at Ennerdale Lake it amounts to 54.626, an excess of nearly one-half; and this is probably below the average proportion. The fall at Keswick, in 1844, is 40.629; at Ambleside, 58.828; at Grasmere, 65.632; and at Doncaster, in Yorkshire, only 18.18 inches. The writer has, for some time past, had a number of gauges dispersed through the Lake District of Cumberland, the results of which he intends to publish in the course of the ensuing summer. It may be remarked, that Ennerdale is far from being the wettest portion of the Lake District.

Barometer.—The mean of the barometer (29.743), so nearly corresponds with the average of preceding years, that the difference is unworthy of notice. An examination of the table will confirm the remark made in last year's report, relative to the atmospheric tide, or horary variation of the mercurial column. The mean at 9 A.M. is 29.743, at 2 P.M. 29.740, and at 9 P.M. 29.749. The atmospheric pressure arrives at the maximum between 9 and 11 o'clock in the evening; at 3 P.M. it is at the minimum, and at 9 A.M. at the mean for the 24 hours. The annual high extreme of the barometer (30.30) occurred with the wind at ENE., on the 2d of May, about a week after the commencement of the six weeks' drought. The lowest point which it reached was 28.58, with the wind at SE., on the 25th of February, amidst a continuance of very changeable weather—frequent falls of snow, alternating with keen frost, and a bright unclouded sky.

Thermometer.—The mean temperature of 1844 (48°.117), is about 1° under the average of this locality. The thermometer attained its maximum with the wind at SSE., on the 23d July, when it rose suddenly from 66°, on the previous day, to 79°.5, an elevation of 13° in 24 hours, and of of 18°.5 in 48 hours. On the 24th and following day it reached 79° and 78°; and on the 26th it as suddenly fell again to 66°, the maximum of the 22d. The lowest point to which it descended was 22°.5, on the

* St James's Church is about 30 yards distant, in a direct line, from the standard gauge at 6 feet.

13th and 22d of December, with the wind at ESE. At Carlisle, the minimum (9°) occurred on the night between the 5th and 6th of February, when the minimum at Whitehaven was 33°, a difference of temperature of 24° between two places, about 40 miles distant from each other. We have on former occasions alluded to the decided superiority which this town possesses over many others in the southern and south-eastern counties of England, in the greater warmth and less variable character of its climate, especially during the winter season. But it maintains this advantage over most, if not every other town in the same county, even those situated within a few miles of the sea. During the late frost, the thermometer at Wigton, 30 miles NE. of Whitehaven, was frequently 14°, 15°, and even 17° lower in the nights.

Dew-Point, &c.—The mean complement of the dew point, or the difference between the temperature of the air and that of the vapour which it holds in mechanical combination (5°.66), indicates a drier state of the atmosphere than in the previous year; but 1842 stands higher than either in point of hygroscopic dryness. Now the fall of rain is exactly in accordance with the indications of the hygrometer: last year 9.843 inches less rain fell than in 1843, and 1842 received 2.030 inches less than in 1844, and 11.513 inches less than in 1843. And as the rate of the production of vapour proceeds, *cæteris paribus*, in the inverse ratio to the quantity of moisture already suspended in the atmosphere, we find accordingly, that the mean evaporating force is, in 1842, 25.8 grains; in 1844, 20.8 grains; and in 1843, 20.36 grains per hour.

Evaporation Gauge.—It may appear somewhat anomalous, that whilst the quantity of water thrown off in the form of elastic vapour is 31.719 inches, an increase of 5.262 inches on the previous year, the mean evaporating force continues nearly the same. This discrepancy between estimation and absolute measurement, is chiefly occasioned by the increased action of the sun's rays in 1844 over 1843, which, it is obvious, cannot be taken in as an element in computing the evaporating force. Last year the fall of rain exceeds the evaporation only by five inches: in 1843, the excess of rain was nearly twenty inches. The greatest amount of evaporation occurs in May, and the least in December. It may be worthy of remark, that the evaporation in December 1844 (.800), with a mean temperature at the freezing point, is exactly the same as in the corresponding month of 1843, with a mean temperature 10° higher, but in conjunction with an excessively damp, foggy atmosphere. The evaporation exceeds the fall of rain in no less than four months of last year, viz., May, July, August, and December; and in three other months, viz., April, June, and November, the deposition and absorption are nearly equal. In this wet locality such a circumstance probably does not occur more than once in a quarter of a century.

Radiation.—The amount or effect of terrestrial radiation is determined by exposing a self-registering thermometer on the grass, under a clear or cloudless sky, and comparing its indications with those of a similar instrument, covered at the top, about four feet from the ground. The difference exhibits the depression of temperature produced in the superincumbent stratum of air, by the free radiation of heat from the earth's surface. From a series of observations carried on almost every night when the weather permitted, we give below the maximum or greatest amount of radiation in each month, premising that in the first four months of the year, the thermometer was exposed on the soil, and during the other eight months on the grass:—

Maximum of Terrestrial Radiation.—January 23d, 6°.5; Feb. 12th, 7°; March 21st and 28th, 8°; April 7th and 12th, 8°.5; May 26th, 12°; June 4th, 9°; July 15th and 23d, 11°.5; August 27th, 11°; September 20th, 9°.5; October 28th, 11°; November 21st, 10°.5; December 3d, 11°.

In 1843 the greatest amount of radiation was 9° in the month of February.

Winds.—Our rainy wind is the SW., and it is also the prevailing one. The last three years, however, have received much less than the average amount of rain; and, accordingly, in distributing the winds over that period, we find a deficiency of the SW., and an unusual prevalence of easterly and north-westerly winds. In 1844, the north-westerly and south-easterly classes are nearly equal in number, as will appear from the following summary:—

| Year. | N. | NE. | E. | SE. | S. | SW. | W. | NW. | Dead Calm. |
|---|---|---|---|---|---|---|---|---|---|
| 1844... | $36\frac{3}{4}$ | $37\frac{1}{4}$ | 47 | 55 | 49 | $44\frac{1}{4}$ | $37\frac{1}{4}$ | 58 | $1\frac{1}{2}$ |
| 1843... | $25\frac{3}{4}$ | $36\frac{1}{2}$ | $41\frac{1}{2}$ | $35\frac{1}{2}$ | $53\frac{1}{2}$ | $65\frac{3}{4}$ | $60\frac{1}{4}$ | $42\frac{1}{2}$ | 4 |
| 1842... | 16 | 40 | 31 | $62\frac{1}{2}$ | $71\frac{1}{4}$ | $59\frac{1}{4}$ | $48\frac{3}{4}$ | $36\frac{1}{2}$ | 0 |
| | $78\frac{1}{2}$ | $113\frac{3}{4}$ | $119\frac{1}{2}$ | $152\frac{3}{4}$ | $173\frac{3}{4}$ | $169\frac{1}{4}$ | $146\frac{1}{4}$ | 137 | $5\frac{1}{2}$ |

The total annual forces are as under.

| Year. | Calm. | Light Breeze. | Moderate Breeze. | Fresh Breeze. | Strong Wind. | Gales. |
|---|---|---|---|---|---|---|
| 1844......... | 49 | 119 | 103 | 41 | 24 | 30 |
| 1843......... | 35 | 79 | 117 | 54 | 43 | 37 |
| 1842......... | 26 | 78 | 149 | 58 | 31 | 23 |

It will be observed, we had in last year an unusual preponderance of calms and light winds, and fewer gales or high winds than usual. The latter chiefly occurred in March and October.

Weather.—The following table exhibits a summary of the state of the weather during the last three years:

| Year. | Clear throughout. | Cloudy without Rain. | Rain. | Sun shone out. | Snow. | Hail. | Frost. | Thunder and Lightning. |
|---|---|---|---|---|---|---|---|---|
| 1844...... | 30 | 164 | 172 | 292 | 19 | 12 | 53 | 15 |
| 1843...... | 31 | 124 | 210 | 233 | 12 | 22 | 48 | 17 |
| 1842...... | 43 | 155 | 167 | 253 | 6 | 15 | 25 | 9 |

The wet days are fewer by thirty-eight than in 1843; and we have had forty-one more days of sunshine, seven of snow, and five of frost.

We shall now conclude our report with a short remark on the character of each month of the bygone year.

*January.*—Fine and mild, with an unusual absence of frost, snow, or gales of wind. Large Lunar Halos on the 2d, 26th, and 28th. On the 17th a thrush's nest, containing two eggs, was found in this vicinity.

*February.*—Very changeable weather; frost and a clear sky alternating with rain, snow, and high winds. The snow, when melted, yielded 1.436 inches of water. Lunar Halos on the 1st, 2d, and 3d. That of the 2d continued for more than five hours, and was followed by snow immediately on its disappearance.

*March.*—Heavy gales prevailed during the first half of the month, when the weather became fine and mild, and so continued, with occasional frost, till its close. On the 3d, primroses gathered; 31st, first butterfly seen (*Vanessa urtica*).

*April.*—Beautifully fine and mild throughout. No frost, snow, or hail. On the 1st, the tortoise-shell butterfly (*Vanessa polychloros*), and on the 16th the Io began to appear. On the 14th the cuckoo, and on the 18th several swallows were observed in this vicinity. The cuckoo was not *heard* till the 21st or 22d, a week after it was first seen. On the afternoon of the 28th a magnificent Solar halo was visible for three hours.

*May.*—The weather throughout the whole of this month was of the most beautiful description. Slight showers fell on three days, but the whole barely exceeded a quarter of an inch. The atmosphere was in an exceedingly dry state, we may say almost destitute of moisture. The daily complement of the dew-point varied from 10° to 26°, and the mean of the dew-point for the month was 12°.06 under the temperature of the air. On some occasions the dew-point could not be obtained without the application of a freezing mixture to the instrument. This unusual capacity of the atmosphere for vapour, and the prevalence of strong easterly breezes, increased the daily amount of evaporation to an enormous extent, which, combined with the absence of two of the causes essential to the formation of dew, a calm and moist atmosphere, greatly augmented the severity of the drought. The evaporation exceeded the rain by more than six inches. The radiation of heat from the earth's surface during the nights was immense, frequently amounting to 11° and even 12°. The mean of the radiation for twenty-four days is 7°.5. 22d, an aurora. 31st, a total eclipse of the moon, seen under most favourable circumstances. An account of this occultation appeared in the Whitehaven Herald of May 5th.

*June.*—The fall of rain from the 23d of April to the 5th of June only measured .262, or about one-fourth of an inch. This is the longest period of drought I have recorded, except in 1836, when only two very slight showers (.083) fell, from the 27th of April till the 8th of June. Prior to the conclusion of the drought, the hay and grain crops had suffered severely. The springs and wells had ceased to yield their supplies; and the lakes, streams, and rivers, were lower than they had ever been known since the memorable 1826. A gentleman who made accurate measurements of the depth of Buttermere Lake both in 1826 and on the 4th instant, states, however, that the lake was 5½ inches lower in the former year. The atmospheric spring on the summit of Great Gavel mountain, said to contain water even in the most extreme droughts, was this month found empty. On the 14th we observed a patch of snow on the Scawfell Pikes, an evidence of the low temperature of these elevated regions. Severe as the drought was in the north, it was of much longer duration in other parts of the kingdom, and especially in the southern and eastern counties. At Edmonton, near London, the whole of the rain which fell from the 25th of March to the 24th of June, only amounted to 1.055 inches. At Doncaster, in Yorkshire, the drought was even more severe than in the vicinity of the metropolis, commencing the 15th of March, and ending the latter part of June: indeed, very little rain fell till the 14th of July. From the 15th March till the 15th June, the fall scarcely exceeded half an inch. Grass was in many places not worth cutting; and, in some instances, for want of pasture, the farmers were obliged to turn their cattle into fields destined for hay.

*July.*—There was no rain from the 25th of June till the 10th of July. The early part of the month was, consequently, highly favourable for securing the hay crops, which, in many instances were got under cover without a drop of rain. Seed grass proved a miserable crop, but ley and meadow hay turned out tolerably well; at all events, so much better than was looked for, that sellers, who expected to have realized 1s. per stone for their hay, were afterwards fain to accept of one-third of the anticipated price.

*August.*—Another remarkably dry and cold month, though it is usually the warmest and among the wettest of the twelve. The evaporation exceeded the rain (2 inches) by .521 ; yet the former is much less than usual, and nearly 2 inches under that of the preceding month. This deficiency was in part caused by the low mean temperature of the month, which is 2° under that of July, and 2°.5 and 5°.5 respectively, under the corresponding month in 1843 and 1842. On the 7th there occurred the most terrific gale of wind ever remembered at this season. In the Lake District it is described as a hurricane, and was attended by the most violent torrents of rain. At Gatesgarth there fell 5.15 inches, and at Buttermere 4.19 inches, in 48 hours. Our summer fruits, as gooseberries, pears, and apples, were this year produced in great abundance. After the violent storm above alluded to, which made sad havoc amongst the fruit trees, apples were selling in our market at 6d. per stone, the price of the better sort of potatoes. The grain harvest commenced in this neighbourhood about the 24th. Auroræ on the 1st and 9th. 27th, a Lunar halo.

*September.*—We had no rain from the 23d of August till the 5th of September, and there was only one wet day after the 17th of the month. Weather fine and mild, and, on the whole, dry; for although we had nearly six inches of rain, it all fell in eleven days. On the 13th and 14th, however, the rain descended in vast torrents, and in forty-eight hours I had measured 4.137 inches, the largest quantity which has fallen in any two consecutive days since I have kept a record. On the 13th and 14th, there fell at Gatesgarth 4.66 inches, and at Wastdale Head within a fraction of six inches; but even this large quantity is very much under the average proportion which exists between Whitehaven and some parts of the Lake District. It is rather remarkable, that on these two days, the fall at Grasmere did not reach three inches. We have again been blessed with a most abundant harvest, which has been secured in excellent condition. The wheat crop is pronounced better than it has been for the last twenty-five years; barley was full on the ground, and the yield is remarkably good; but oats are deficient both in quantity and quality. Except in very backward districts, the harvest was quite concluded in this part of the country by the 26th of the month.

*October* was chiefly remarkable for its high temperature. Swallows were seen in the Lake District as late as the 15th; but none were observed in this neighbourhood after the 22d of September, the usual time of their disappearance. The weather was favourable for the out-door operations of the farmer, and for taking up the potato crops, which were, generally speaking, abundant, except on wet clayey lands. The turnip crops were excellent. On the 24th, at noon, and for nearly three hours after, there was a large Solar halo, 42° in diameter. On the evening of the following day, there was also a Lunar halo.

*November*, we might observe, was unusually dry, if the same remark did not equally apply to almost every month of the past year. On the night of the 14th, there fell at Gatesgarth, in nine consecutive hours, more than three inches of rain, nearly twice the quantity deposited at Whitehaven during the whole of this month. We had no frost from the 21st of March till the night of the 22d of November; and this was the only one in the month on which the thermometer reached the freezing-point. A thermometer on the grass, however, fell to 24°, and in the previous month it descended to 6° below the freezing-point. Several flocks of wild geese were seen passing over the town during this month. On the

24th, there occurred another total eclipse of the moon, seen to great advantage. Rarely do two central eclipses take place in one year; and it is, perhaps, equally seldom that two consecutive occultations are seen under such favourable circumstances.

*December.*—This is both the coldest and the driest December which has come within the period of my observation. The mean temperature is 10°.369 under the average, and 13°.895, and 14°.169 respectively, under the temperature of the same month in 1842 and 1843. The evaporation exceeds the fall of rain by more than three-fold. The whole quantity of rain which fell from the 17th of November till the close of the year—44 days, only amounted to .405, or between a quarter and half an inch. 12th, Lunar halo.

Although we would decidedly discountenance the predictions of the so-called weather prophets, who profess to foretell atmospheric changes with a mathematical certainty; yet it seems obvious, from an examination of well-authenticated records kept over a long series of years, that wet and dry periods do succeed each other with tolerable regularity. The last three years have certainly exceeded the average in point of climate: and the experience of some of our oldest meteorologists would lead us to conclude, that this fine and dry period is not yet ended.

J. F. Miller.

Whitehaven, *January 20th*, 1845.

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# SCIENTIFIC INTELLIGENCE.

## GEOLOGY AND MINERALOGY.

1. *Geognostical Structure of Mageröe.*—In the second part of Professor Keilhau's *Gaea Norvegica* there is a very interesting account of the geognosy of the island of Mageröe in Finmark; and we extract the following few facts, chiefly for the purpose of indicating the geognostical constitution of *the two most northern promontories in Europe*. The largest portion of Mageröe is composed of gneiss and mica-slate. The tract of gneiss lying farthest to the NW. of the island presents a rock which is petrographically identical with the oldest gneiss in Norway. The gneiss of *Knivskjäl-Odden, the most northern promontory in Europe*, is granitic, while the rock composing the tract of gneiss at the Kamöefjord, on the east side of the island, is partly the usual primitive gneiss, and partly a porphyritic gneiss, containing large crystals of felspar. The portion of gneiss occurring at Mageröe Sound is of a less constant petrographical character; and Von Buch says, that the cliffs in the Bay of Finvigen are so exceedingly black, that the observer has difficulty in persuading himself that they consist of gneiss. The rock at that locality is a small granular mixture of mica and a little quartz, the plates of mica being so small, that they can with difficulty be recognised. At another place in the same small tract of gneiss, the rock is more a granite than a gneiss or a mica-slate, and is a pretty coarse granular compound of greyish-yellow felspar and grey quartz, with so little mica that the slaty structure is by no means distinct. The central portion of Mageröe is composed of mica-slate, and contains two beds of white and grey granular limestone. This mica-slate district includes the *North*

*Cape*, in which promontory the rock is fine-slaty, rich in quartz, and somewhat inclined to gneiss; some of the beds, as at Hornvigen, containing a little felspar. At the North Cape the dip is from 50° to 80° to the ESE. and SE. In the south and east of the island of Mageröe, the mica-slate becomes gradually changed into clay-slate, so that the south-eastern coast of the island is almost to be regarded as a clay-slate tract. To the north and especially to the north-east of Kjelvig (in the south-eastern portion of Mageröe) there is a district chiefly composed of granite; and to the west of Kjelvig, euphotide occurs in considerable quantity. The latter rock is met with on both sides of the Skibsfjord, and forms the principal mass of two small portions of country, of which the one is surrounded by the mica-slate of the island; and the other by mica-slate, and towards Kjelvig by the rock resembling clay-slate and by granite. The euphotide frequently consists of a hard greenish or brownish-black serpentinic basis, with imbedded bronzite; but sometimes consists of a greenstone mixed with smaragdite, which is fine granular, and exhibits traces of a slaty structure. The greenstone sometimes contains no smaragdite, but presents hornblende, which is so developed and arranged as to impart to the rock the slaty structure of hornblendic gneiss, and to admit of the direction and dip being determined. There are complete transitions of all the different varieties into one another; and the euphotide formation passes imperceptibly into the bounding granite. The relations of the euphotide to the mica-slate, described by Professor Keilhau, are very curious, but for an account of them we must refer to the original work.

2. *Geognosy of Nordkyn in Finmark.*—Professor Keilhau states that the Köllefjord and the Oxefjord penetrate an endless series of strata of mica-slate containing beds of quartz, and having a dip of from eighty to ninety degrees to the WNW. These strata and beds extend to Nordkyn, and there form *the extreme northern point of the mainland of Europe.* There the quartz predominates; it is generally coarse and splintery; and is sometimes mixed with mica, but at other times is pure. In part it assumes the appearance of sandstone; for, translucent, milk-white, distinctly separated grains of quartz, which are sometimes as large as peas, are more or less closely aggregated together in the coarse splintery mass. This is the first indication of a type which assumes a very great degree of importance in the series of rocks towards the east. The dip at Nordkyn is WNW., and is from seventy to eighty degrees. The violent surf renders it impossible to land at the extremity, which is separated by a fissure from Kinerodden, the high promontory of Nordkyn.

3. *Supposed Organic Remains of Kaafjord in Norway.*—Some very curious round concretions have been found in the hard green slate of Kaafjord, and have been regarded as petrifactions; but from the specimens sent to me, they are evidently not at all of organic origin. They are composed of compact greenstone arranged in concentric layers, and remind those who have sufficiently studied the mutual transitions of the greenstone and the green slate, of the globular diorite of Corsica. A rock resembling the Corsican would have been produced at the Kaafjord, if the transmutation of the green slate had proceeded a little farther. It is, no doubt, the concretions mentioned above which Russegger has de-

scribed as remains of trilobites.—*Keilhau's Gaea Norwegica;* Part II. p. 285.

4. *New Proof of the Cantal being a crater of Soulevement.*—The Cantal is almost entirely composed of trachyte, and its general aspect presents a vast cone, having in its centre a gigantic hollow of about five English miles in diameter. Deep valleys diverge from this centre on all sides, like the spokes of a wheel, and impart to the whole mountain mass a peculiar character, which, combined with various other phenomena, has induced Messrs Elie de Beaumont and Dufrénoy to consider it as a *crater of soulevement.* The trachyte of the Cantal generally occurs in the form of great *nappes,* which rise with a gentle slope in the direction of the central depression. Its ordinary appearance is that of a breccia, whose fragments and basis being of the same nature, cannot be distinguished from each other; but, notwithstanding this fragmentary appearance, all its component parts are contemporaneous. The name of trachytic tufa has been given to it,—an expression which conveys the idea, that the matter issuing from the interior of the earth in a pasty state, has given rise, in the volcanic opening itself, to fragments which were immediately united together by the flowing mass. The nature of the rock is displayed in all the escarpments; but it is exhibited with peculiar distinctness in the tunnel of nearly 4000 English feet in length, which has been pierced between the valleys of Aurillac and Murat, on the road from Paris to Montpellier, for the purpose of rendering the journey less dangerous in winter. This gallery has also afforded the means of studying the numerous veins which traverse the mass of trachytic tufa. The uniformity of the rock through which the tunnel of Lioran has been carried, is one of the most interesting facts revealed by this great work of art. We thus learn that it is one and the same *nappe* of trachyte which is traversed throughout the whole length of the tunnel,—a circumstance opposed to the supposition adopted by some geologists, that the whole mass of the Cantal has been produced by the accumulation of successive eruptions; for we have in this uniformity one of the most certain proofs of its formation by soulevement.*

5. *On the Cause of the Colours in Precious Opal. By Sir David Brewster.*—This gem is intersected in all directions with colorific planes, exhibiting the most brilliant colours of all kinds. The cause of these colours has never, we believe, been carefully studied. Mineralogists, indeed, have said that they are the colours of thin plates of air occupying fissures or cracks in the stone; but this is a mere assumption, disproved by the fact, that no such fissures have ever been found during the processes of cutting out, grinding, and polishing, which the opal undergoes in the hand of the lapidary. In submitting to a powerful microscope specimens of precious opal, and comparing the phenomena with those of hydrophanous opal, Sir David Brewster found that the colorific planes or patches consist of minute pores or vacuities arranged in parallel lines, aud that various such planes are placed close to each other, so as to occupy a space with three dimensions. These pores sometimes

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* From M. Dufrénoy's Report on a Memoir by M. Rozet on Auvergne.—*Comptes Rendus de l'Academie des Sciences*, vol. xviii. p. 133.

exhibit a crystalline arrangement, like the lines in sapphire, calcareous spar, and other bodies, and have doubtless been produced during the conversion of the quartz into opal by heat, under the peculiar circumstances of its formation. In some specimens of common opal, the structure is such as would be produced by kneading crystalline quartz when in a state of paste. The different colours produced by those pores arise from their different magnitudes or thickness; and the colours are generally arranged in parallel bands, and vary with the varying obliquities at which they are seen.—*Athenæum, Report of Brit. Assoc.*

6. *On Crystals in the cavities of Topaz, which are dissolved by heat, and re-crystallize on cooling. By Sir David Brewster.*—Sir David gave a brief notice to the British Association of the discovery which he had made, about twenty years ago, of two new fluids in the crystallized cavities of *topaz*, and other minerals. One of these fluids is very volatile, and so expansible, that it expands twenty times as much as water with the same increase of temperature. When the vacuities in the cavity which it occupies are large, it passes into vapour; and in these different states he had succeeded in determining its refractive power, by measuring the angles at five feet. Total reflection takes place at the common surface of the fluid of the topaz. The other fluid is of a denser kind, and occupies the angles and narrow necks of cavities. The cavities, however, in which the soluble crystals are contained, are of a different kind. They (viz. the cavities) are imperfectly crystallized, and thus they exist in specimens of topaz which contain the cavities with the two new fluids; they contain none of the volatile and expansible fluid, which is doubtless a condensed gas. The crystals which occupy them are flat and finely crystallized rhomboids, When heat is applied, they become rounded at their edges and angles; and soon disappear. After the topaz has cooled, they again appear, at first like a speck, and then re-crystallize gradually, sometimes in their original place, but often in other parts of the cavity,—their place being determined by the mode in which the cooling is applied.

## BOTANY AND ZOOLOGY.

7. *Distribution of Plants on Mount Canigou, Eastern Pyrenees.*—In reporting to the Academy of Sciences on a table of the limits of certain plants on the western slope of the Canigou, presented by M. Massot of Perpignan, M. Adolphe Brongniart made the following observations:—M. Massot's table gives the height above the level of the sea, of the upper and lower limits of many of the species constituting the remarkable vegetation of the Canigou, which forms the eastern extremity of the chain of the Pyrenees. The table is so much the more interesting for botanical geography, from containing the limits of many plants which had not generally attracted attention in this point of view, and which, although less striking to the eye than forest trees or cultivated species covering large surfaces, nevertheless contribute, by their combination, to impart to each zone its own particular aspect of vegetation. After enumerating forty-two species, which he had observed on the summit of the mountain, at a height of 9137 English feet, the author indicates the lower limits of some of these species, and the upper limits of other plants

which do not reach that height. Other species, again, are confined between lower and upper limits which are not far distant from each other; and these neither grow towards the base of the mountain nor at the summit. The table shews, in a striking manner, the unequal extent of the zones of the different species; for some of them only grow under conditions differing very little from one another, while others are suited to very various climates—an observation which accords with what is remarked in regard to differences of latitude. Among the plants which grow on the summit of the mountain, M. Massot mentions two, the *Potentilla nivalis*, and the *Saxifraga oppositifolia*, which cease to grow at 443 feet below it (that is to say, at 8694 feet above the level of the sea), whereas the *Gentiana verna*, and the *Luzula spicata*, which also grow on the summit, are met with on the slope of the mountain at much lower elevations; the former at 4337 feet, and the latter at 3238 feet above the level of the sea; the one thus inhabiting a zone of about 4800 feet, and the other a zone of about 5900 feet. It would be interesting to be able to extend this comparison to the greater part of the plants growing on this mountain, but in regard to many of them we are still in want of data for the purpose: thus, of forty-two species observed by M. Massot, on the summit of the Canigou, he only gives the lower limits of twelve. It is to be desired that the author should prepare as complete a catalogue as possible of the plants growing on the mountain, that he should determine the lower and upper limits of each of them, and that he should include in his researches the different slopes of the mountain, so as to ascertain the influence of the exposure on the limits of these different plants. The author ought also to be requested to extend his observations to the limit of the cultivation of the olive, and to add to his catalogue a list of the plants belonging to that region, in order that we may be able to ascertain what are the plants of the olive region which in that district penetrate into the region of vines, and what are the relations between the flora of that region of vines and the flora of the vine region of central and northern France. In M. Massot's table the limit of the oaks is not given; and it is very probable that, besides the evergreen oak and the cork tree, which must grow in the olive region, and whose upper limit it would be interesting to determine, oaks with deciduous leaves are to be met with higher up, regarding which it would be important to determine the upper and lower limits, and also to ascertain distinctly the species. It would also be desirable to ascertain, with accuracy, the limit of all the trees on the different slopes, and that those which generally grow in the Pyrenees, but which seem to be awanting on the Canigou, should be indicated in a special manner; because the limits of trees, being those which are most easily recognised, are most available in comparisons with different countries. In pointing out the deficiencies in M. Massot's investigations, my chief object has been to shew how interesting it would be for botanical geography to possess a complete account of the distribution of plants on a mountain so favourably placed as the Canigou, and which, by its isolation, its various exposures, and its height, might become one of the most important elements in the general examination of the geographical distribution of plants in Europe. I shall only add, that, in order that an investigation of this description should possess all desirable certainty, it would be necessary that the author should collect, and send to the Academy, specimens of all the species whose limits he may determine, and also specimens of all the species taken from the middle, and from the two limits of their region; because, such specimens would be necessary for the proper determination of species, and of the differences which may be presented by them in the different situations where they grow.

8. *On solid Vegetable Oils.—Linnæan Society, June* 18. The Bishop of Norwich in the chair.—A paper was read by Mr E. Solly on the solid vegetable oils. These oils were characterised by possessing stearine, the solid principle of all oils, in such quantity as to render them solid at the ordinary temperature of the atmosphere. They were of the consistence of animal fats, and in many instances were used as substitutes for butter, as articles of diet. There was some difficulty in distinguishing these oils from wax, but the latter was produced in much less quantities. The various plants yielding solid oils were pointed out, with the modes of obtaining the oils, and the uses to which they were subservient in the various parts of the world. Few or no British plants yield solid oils. The plants yielding butter, tallow, and solid oils, which were mentioned, are as follows:—*Theobroma Cacao,* chocolate-nut tree, yielding Cacao butter; *Vateria Indica,* producing a solid semicrystalline fat, used for various purposes in India, where the tree is called Tallow-tree; *Pentadesma butyracea,* the Butter or Tallow Tree of Sierra Leone. Several species of plants belonging to the natural order Lauraceæ, as *Laurus Nobilis, Tetranthera sebifera* or *Litsea sebifera, Laurus cinnamomum,* &c., yield solid oils, in addition to their volatile fluid oils. The *Myristica moschata,* the common Nutmeg, with the *M. sebifera,* both yield a solid oil, sometimes called nutmeg butter; *Bassia butyracea,* the Mahva or Madhuca-tree, gives out a kind of butter which is used in India. The Butter-tree of Mungo Park, found in Africa, is the *Bassia Parkii* of some writers, though others have doubted if the Butter-tree of Park is a Bassia at all. The butter is also called Shoa butter, and specimens were exhibited, procured by Dr Stanger during the late Niger expedition. Several palms yield solid oils; the principal of these are the *Cocos nucifera,* cocoa-nut tree, and the *Elæis Guineensis;* the former yields the cocoa-nut oil and butter, the latter the palm oil of commerce. All the fruits, however, of Palmaceæ are capable of yielding more or less solid oil, and many other species than those named yield the palm oil of commerce.

9. *On the Ibis.*—According to Pliny, the Ibis freed Egypt from serpents. Herodotus had previously expressed the same opinion; but doubts have been raised in modern times as to these birds possessing the power of destroying serpents. These doubts were founded on the organisation of the beak, the length and delicacy of which appeared but little adapted to enable the birds to contend with animals possessed of a certain degree of strength, however small they may be supposed to be.

The black Ibis, one of the two species the Egyptians possessed, is pretty widely spread in Southern Algeria, where the French troops have seen them flying in flocks like our crows. M. Guyon states, that having had occasion to examine an individual killed in the Ourancenis (a great mass of mountains in Algeria beyond Chelif), he found in its crop three kinds of insects quite entire, which formed three very distinct packets, one of locusts, another of Scolopendræ, the third of scorpions. He has been informed that other individuals of the Ibis, caught alive and domesticated by the officers, fed only on grasshoppers or locusts, which they chase, and which they will even take from the hand, if presented to them.

M. Guyon asks whether these locusts, so common in Egypt, may not be the winged serpents of which Herodotus speaks. This appears to him the more probable, because Herodotus, who gives the nomenclature of all the animals of Egypt, from the elephant down to the fly, makes no mention of locusts, which have always been the scourge of that country. M. Guyon adds, however, that M. Lefevre informs him that he has seen an Ibis seize and swallow lizards, as well as pretty large pieces of an adder which he amused himself by throwing to it. This may be readily conceived when we think of the manner in which the animal proceeds to swallow its prey. Having seized it with the extremity of the beak, the bird, by a rapid movement, throws it into the air, and soon takes it into its throat. If it is a living body which it seizes, it is always the head which enters first into the beak. M. Guyon has likewise learned from other persons, that the Ibis is very fond of the barbel, a fish which is found abundantly in the rivers of Algeria; that it swallows food cooked or raw, bread softened in water, boiled substances, &c.; that it easily becomes familiar with man, in so much that at Orleansville one of these birds, which lived there at liberty for six months, came every day at meal time to the tent of a captain, to receive the food he was accustomed to give it.*

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## NEW PUBLICATIONS RECEIVED.

1. Elements of the Comparative Anatomy of the Vertebrate Animals designed especially for the Use of Students. By Rudolph Wagner, M.D., Professor of Comparative Anatomy and Physiology in the University of Göttingen, &c. Edited from the German by Alfred Tulk, M.R.C.S., London. 8vo, pp. 264. Longmans and Co., 1845. *This valuable work will form a good Manual for Students of Comparative Anatomy.*

2. Contributions towards a Fauna and Flora of the County of Cork. By J. D. Humphreys (the Zoology), and Dr Power (the Botany). 8vo, pp. 160. J. Van Voorst, London; and George Purcell, Cork. 1845.

3. Elements of Physics. By G. F. Peschel, Principal of the Military College at Dresden, &c. Translated from the German by E. West. Illustrated with diagrams and woodcuts. Part 1, Ponderable Bodies. 12mo, pp. 307. Longmans and Co., London, 1845. *Not yet finished.*

4. A Discourse delivered upon the opening of the New Hall of the New York Lyceum of Natural History. By John W. Francis, M.D., 8vo, pp. 93. New York.

5. The Chemistry of Vegetable and Animal Physiology. By Dr G. J. Mulder, Professor of Chemistry in the University of Utrecht. Tran-

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* L'Institut, No. 540, p. 152.

slated from the Dutch by Dr Fromberg, with Notes, &c., by Professor Johnston. Part 1. 8vo, pp. 184. William Blackwood and Sons, Edinburgh and London. *Hitherto many valuable Dutch works on Science have remained concealed in the original language, and consequently unknown to the greater number of English readers. We rejoice, therefore, to find that the Messrs Blackwoods are about to supply this want. We think they have been particularly fortunate in their selection of the very valuable and interesting work of the celebrated Mulder, of which only the first part has been published. The remaining parts we hope will follow speedily.*

6. Philosophy of the Moving Powers of the Blood. By G. Calvert Holland, M.D., London, 8vo., pp. 308. John Churchill, London, 1844.

7. On the Atmospheric Changes which produce Rain, Wind, Storms, and the Fluctuations of the Barometer. By Thomas Hopkins. 8vo, pp. 98. Simpkin, Marshall, and Co., London; and Sims and Denham, Manchester. 1844.

8. Bibliothèque Universelle de Genève, up to No. 107. November 1844. Published 15th January 1845.

9. Calcutta Journal of Natural History, Nos. 13, 14, 15, 16—Geology and Zoology. By John M'Clelland, Bengal Medical Service. The Botany by W. Griffiths, F.L.S., Madras Medical Service.

10. Journal of the Asiatic Society of Bengal, Nos. 60 and 61. Also an extra Number, or Supplement to the Number for 1842. *It is entirely occupied with a Geological and Mineralogical Survey of the Himmalaya Mountains, by the late Captain J. D. Herbert. The Author, and also the Editor of this Memoir, appear to have had a glimpse of the views of Professor Jameson on the want of Stratification in Primitive and Transition Rocks, and of their Crystalline and Morpholitic characters, as given in his early writings, and in his Lectures on Natural History.*

11. American Journal of Science and Arts, by Messrs Silliman, has reached, up to January Number for 1845.

12. Quarterly Journal of the Geological Society.—No. I. *We shall be happy to learn that this periodical obtains wide circulation.*

13. The Natural History of Animals; being the substance of Three Courses of Lectures delivered before the Royal Institution of Great Britain. By Thomas Rymer Jones, F.R.S., F.L.S., Professor of Comparative Anatomy in King's College, London. Vol. I., 12mo, pp. 362. With 105 Illustrations. John Van Voorst, Paternoster Row, London. 1845. *We trust nothing will occur to prevent the speedy publication of the remaining volumes of this interesting and promising work.*

14. A Thermometric Table of the Scales of Fahrenheit, Centigrade, and Reaumur, &c. By Alfred T. Taylor, Lecturer on Chemistry, Guy's Hospital, London. Thomas and Richard Willads, Philosophical Instrument Makers, &c., Cheapside, London. 1845. *This Table, with the more extended Tables of the late Dr Atkin, published by Messrs Black and Company, ought to go together, and be in the hands of scientific readers.*

15. The Actual Process of Nutrition and Inflammation in the Living Structure, demonstrated by the Microscope. Part II. By William Addison, F.L.S.. &c. 8vo, pp. 114. With Plates. J. Churchill, London; and Deighton, Worcester. 1845.

16. An Essay on Tropical Agriculture, with some remarks on certain Barbadian Soils, &c. By G. Lovell Phillips, M.D., Oxon., F.R.C.P.L. 8vo, pp. 116. Hedderwick and Son, Glasgow. 1845.

17. Geology as a Branch of Education. By Professor Ansted. J. Van Voorst, London. 1845.

18. The Geologist's Text-Book. By Professor Ansted. J. Van Voorst, London. 1845. Pp. 143.

19. Practical Geology and Ancient Architecture of Ireland. By George Wilkinson, Architect, Member of the Royal Irish Academy, &c. &c. Illustrated with seventeen plates, and seventy-two woodcuts. 8vo, pp. 348. London, John Murray; William Curry jun. and Co., Dublin. 1845.

20. Gaea Norwegica, Von Mehreren Verfassern, Herausgegeben Von B. Mathias Keilhau, Professor der Mineralogie, Geognosie, und Bergbaukunde, an der Universität zu Christiania, Ritter des Königl. Nordstern ordens so wie, des Königl. Wasa-ordens. Ordentlichem Mitgl. der Königl. Gesellschaft der Wissenschaften zu Drontheim, der Königl. Academie der Wissenschaften zu Stockholm, Ehrenmitgliede der Wernerian Natural History Society of Edinburgh, &c. &c. Zweites Heft. Mit Zwei Tafeln. Folio. Christiania, Druck und Verlagvon Johann Dahl. 1844. The following are the contents of the present part of this important work:—IV. Determinations of the Heights of Mountains in Norway. By A. Vibe, Esq., Captain of Engineers. *A considerable portion of this article is transferred to the pages of this Number.*—V. On the Structure of the Rock Masses of Norway. By Professor Keilhau. *The introductory portion of this able article, forwarded by the Professor to us, appeared in former Numbers of the Philosophical Journal.*—VI. On the Norite, and of the Mineral Treasures of the Granite Veins that occur in that rock. By Dr and Lecturer Scheerer.

21. Dent on the Azimuth and Steering Compass. Published by the Author. London. 1844. 8vo.

22. On the Production of Soils and Manures by the Lower Orders of Plants. By R. D. Thomson, M.T., Lecturer on Practical Chemistry in the University of Glasgow. 8vo. 1845.

23. Annual Report of that pleasant Meeting, the Berwickshire Naturalists' Club. 8vo. 1844.

## *List of Patents granted for Scotland, from 24th December 1844, to 22d March 1845.*

1. To William Thomas of Cheapside, in the city of London, merchant, being a communication from abroad, "improvements in manufacturing stays, bandages, and other similar articles."—24th December 1844.

2. To William Higham of Notty Ash, near Liverpool, in the county of Lancaster, plumber, and David Bellhouse, also of Liverpool aforesaid, merchant, "improved constructions of boilers, for evaporating saline and other solutions for the purposes of crystallization, and also for the evaporation of fluids generally."—24th December 1844.

3. To Joseph Lockett of Manchester, in the county of Lancaster, engraver, "improvements in apparatus for preparing to be engraved or turned such copper or other metal cylinders or rollers as are to be used for printing, or embossing, or calendering calico or other fabrics."—26th December 1844.

4. To Robert Walker of Saint Helen's, in the county of Lancaster, colliery agent and manager, "improvements in apparatus for riddling coals at collieries."—26th December 1844.

5. To Christopher Phipps of River, near Dovor, in the county of Kent, paper-manufacturer, being partly a communication from abroad, and partly by his own invention, "an improvement or improvements in the manufacturing of paper, and in making writing and other papers, or in the machinery employed for those purposes."—26th December 1844.

6. To James Nield of Taunton, in the state of Massachusetts, in the United States of North America, machinist, "certain improvements in looms."—27th December 1844.

7. To Henry Charles Lacy of Kenyon House, near Manchester, in the county of Lancaster, Esquire, and George Watson Buck of Manchester, in the said county, civil-engineer, "a new manufacture for, and method of sustaining, the rails of railways."—28th December 1844.

8. To John Swindells of Manchester, in the county of Lancaster, manufacturing chemist, "several improvements in the preparation of various substances for the purpose of dyeing and producing color; also improvements in the application and use of several chemical compounds for the purpose of dyeing and producing color not hitherto made use of." —30th December 1844.

9. To Moses Poole of the Patent Office, London, gentleman, being a communication from abroad, "improvements in preparing or treating hemp flax and other textile plants."—30th December 1844.

10. To Benjamin Baillie of Henry Street, in the county of Middle-

sex, glazier and metal frame-maker, "improvements in regulating the ventilation of buildings."—31st December 1844.

11. To Robert Griffith of Smethwick, near Birmingham, in the county of Stafford, engineer, "improvements in the manufacture of bolts, railway pins, spikes, and rivets."—31st December 1844.

12. To Guy Carleton Coffin of Sandford, in the county of Wilts, Esquire, "certain improvements applicable to locomotive, marine, and stationary engines."—2d January 1845.

13. To John Ainslie, farmer, Redheugh, near Dalkeith, North Britain, "a certain improvement, or certain improvements, in the apparatus and arrangements for the manufacture of tiles, and similar articles, from clay and other plastic matter."—2d January 1845.

14. To George William Lenox, and John Jones of Billeter Square, in the city of London, merchants, "improvements in the manufacture of sheaves and shells for blocks, and of bolts, rings, or washers, for the purposes of shipwrights and engineers."—9th January 1845.

15. To Charles Louis Mathurin Fouquet of Jermyn Street, Haymarket, in the county of Middlesex, gentleman, "improvements in the preparation of an artificial vegetable gum, to be used as a substitute for gum-senegal."—9th January 1845.

16. To Joseph Woods of Bucklersbury, in the city of London, civil-engineer, being a communication from abroad, "improvements in producing and multiplying copies of designs and impressions of printed or written surfaces."—10th January 1845.

17. To Archibald Trail of Great Russell Street, Bloomsbury Square, in the county of Middlesex, gentleman, "an improvement in the manufacture of sails for ships and other vessels."—13th January 1845.

18. To Frank Fielder of Old Street, in the parish of Saint Luke, in the county of Middlesex, gentleman, being a communication from abroad, "certain improvements in wire-work for the manufacturing of paper and the application thereof to such purposes.—13th January 1845.

19. To Thomas Lever Rushton of Bolton-le-Moors, in the county of Lancaster, iron manufacturer, "certain improvements in the manufacture of iron."—14th January 1845.

20. To James Palmer Budd of Ystalyford, iron-works, Swansea, merchant, "improvements in the manufacture of iron."—17th January 1845.

21. To Ralph Knowles Waller of Manchester, in the county of Lancaster, candle-wick manufacturer, "improvements in the manufacture of platted wicks, and in the manufacture of candles."—17th January 1845.

22. To Stephen Hutchison of the London Gas-Works, Vauxhall, in the county of Surrey, engineer, "certain improvements in gas meters." 21st January 1845.

23. To Arthur Wall of Bisterne Place, Poplar, in the county of Middlesex, surgeon, "certain improvements in the manufacture of steel, copper, and other metals."—21st January 1845.

24. To William Betts of Smithfield Bars, in the city of London, distiller, and Alexander Southwood Stocker, of the same place, gentleman, "improvements in bottles, jars, pots, and other similar vessels, and in the mode of manufacturing, stoppering, and covering the same." —22d January 1845.

25. To Squire Diggle of Bury, in the county of Lancaster, machine-maker, "certain improvements in looms for weaving."—22d January 1845.

26. To Pierre Armand Le Comte de Fontainemoreau, of No. 7 Skinner Place, Size Lane, in the city of London, being a communication from abroad, "certain improvements in covering or coating metals and alloys of metals."—24th January 1845.

27. To Alexander Bain of Charlotte Street West, in the county of Middlesex, engineer, "improvements in apparatus for ascertaining and registering the progress and direction of ships and other vessels through water, and for ascertaining the temperature in the holds of ships and other vessels, for taking soundings at sea, and in apparatus used in lighthouses."—27th January 1845.

28. To George Brown of Glasgow, in Scotland, merchant, being a communication from abroad, "certain improvements in the manufacture of soda."—27th January 1845.

29. To John Reed Hill of No. 98 Chancery Lane, in the county of Middlesex, civil-engineer and patent agent, "improvements in a press or presses, machine or machines, for letterpress printing."—28th January 1845.

30. To John George Bodmer of Manchester, in the county of Lancaster, engineer, "certain improvements in locomotive steam-engines and carriages to be used upon railways, in marine engines and vessels, and in apparatus for propelling the same, and also in stationary engines, and in apparatus to be connected therewith."—29th January 1845.

31. To John James Russell and Thomas Henry Russell, both of Wednesbury, in the county of Stafford, tube-manufacturers, "improvements in the manufacture of welded iron tubes."—30th January 1845.

32. To John Rand of Howland Street, Fitzroy Square, in the county of Middlesex, artist, being a communication from abroad, "improvements in piano fortes."—30th January 1845.

33. To Christopher Dunkin Hays of Bermondsey, in the county of Surrey, master mariner, "certain improvements in machinery or apparatus for propelling vessels."—31st January 1845.

34. To William Edward Newton of the office for patents, 66 Chancery Lane, in the county of Middlesex, civil-engineer, being a communi-

cation from abroad, " certain improvements in apparatus for propelling vessels."—4th February 1845.

35. To Robert Gordon of Heaton Foundry, Stockport, mill-wright and engineer, " certain improvements in grinding wheat and other grain, and in dressing flour and meal, which improvements are also applicable to grinding cement and other substances."—5th February 1845.

36. To George Bell of Pembroke Road, in the city of Dublin, " improvements in drying malt, grain, and seeds."—5th February 1845.

37. To Peter Borrie of Princes Square, St George's in the East, in the county of Middlesex, engineer, " certain improvements in steam-engines, boilers, and propelling machinery."—13th February 1845.

38. To Arthur Varnham of the Strand, in the county of Middlesex, stationer, " improvements in the manufacture of paper, in order to prevent fraud, which he intends to call ' safety and protective paper.' "—13th February 1845.

39. To Francis Stanislas de Sussex of Bethnal Green, in the county of Middlesex, chemist, and Alexander Arrott of Gloucester Crescent, Regent's Park, in the same county, chemist, " improvements in the manufacture of oxides of manganese."—13th February 1845.

40. To Frank Hills, " certain improved means for producing or manufacturing artificial coal or fuel, and other useful products connected therewith."—17th February 1845.

41. To Joseph Thomas of No. 1 Finch Lane, Cornhill, in the city of London, publisher, being a communication from abroad, " a new and improved tube."—17th February 1845.

42. To William Edwards Staite of High Street, Mary-le-bone, in the county of Middlesex, gentleman, " certain improvements in the processes and apparatus for preparing extracts and essences of vegetable and animal substances."—19th February 1845.

43. To James Power of Threadneedle Street, in the city of London, merchant, being a communication from abroad, " improvements in the manufacture of candles and soap, and in treating a certain vegetable matter for such manufacture, and for other uses."—24th February 1845.

44. To Robert Oxland of Plymouth, in the county of Devon, chemist, " improvements in the manufacture of chlorine."—24th February 1845.

45. To Jean Albert Palmaert of Brussels, in the kingdom of Belgium, colonel of staff, being a communication from abroad, " improvements in the means of economizing and applying heat obtained from known processes."—25th February 1845.

46. To Richard Haworth of Bury, in the county of Lancaster, engineer, " certain improvements in steam engines."—26th February 1845.

47. To William Hannis Taylor of Piccadilly, in the county of

Middlesex, gentleman, and Thomas Bartlett Simpson of Great Russell Street, in the same county, gentleman, "certain improvements in propelling."—26th February 1845.

48. To William Kenworthy of Blackburn, in the county of Lancaster, manufacturer, "certain improvements in looms for weaving."—28th February 1845.

49. To Augustus William Gadesden of Woburn Square, in the county of Middlesex, gentleman, "improvements in the manufacture of sugar."—4th March 1845.

50. To John Blyth and Alfred Blyth of the parish of St Anne, in the county of Middlesex, engineers, and George Parker Hubbuck of Ponder's End, in the said county of Middlesex, engineer, "certain improvements in steam-engines, steam-boilers, and machinery for propelling vessels, which improvements in steam-engines and steam-boilers are for the most part applicable to the purposes of steam navigation, but are also applicable to other purposes for which steam-engines or steam-boilers are or may be used."—6th March 1845.

51. To Robert Fergusson, linen manufacturer in Dundee, in the county of Forfar, Scotland, "improvements in the machinery and apparatus for the manufacture of cloth by hand, steam, or other power."—13th March 1845.

52. To Louis Antoine Ritterbandt of Gerard Street, Soho, in the county of Middlesex, doctor of medicine, "certain improvements in preventing and removing incrustation in steam-boilers and steam-generators."—18th March 1845.

53. To John Fisher the younger, of Radford-Works, in the parish of Radford, in the county of Nottingham, gentleman, and James Gibbons of New Radford, in the said parish of Radford, machinist, "certain improvements in the manufacture of figured or ornamented lace or net and other fabrics."—19th March 1845.

54. To Alexander M'Dougall of Daisy Bank, in the parish of Manchester, in the county of Lancaster, gentleman, "certain improvements in the method of working atmospheric railways, which improvements are also applicable to canals and rivers."—19th March 1845.

55. To Octavius Henry Smith of Wimbledon, in the county of Surrey, Esquire, "certain improvements in steam-engines, boilers, and condensers."—20 March 1845.

56. To Wilton George Turner of Gateshead, in the county of Durham, doctor in philosophy, "improvements in the manufacture of caustic alkalies, soda, and potash, and their carbonates, and also in the manufacture of the ferro-cyanates of soda or potash."—20th March 1845.

# INDEX.

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