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(*To be continued.*)

FOREIGN CORRESPONDENCE.

By Dr. T. L. Phipson, of Paris.

Origin of the mud in these volcanos—Rarity of Sulphate of Potash in nature—Abundance of sulphate of soda—Beds of this salt in Spain.

We have stated that the mud discharged in these eruptions derives its origin from the materials of the mountains themselves. It replaces the lava of ordinary volcanos, as we observe to be the case with other mud-erupting craters which emit little or no lava—for instance, those of South America. We also observe that vitreous volcanic formations, such as obsidian, pearl-stone, pumice, &c., are entirely wanting in some volcanos, where compact or porous lava is the common product. Volcanic productions are, indeed, extremely variable, and differ according to the particular volcano to which they owe their birth. Humboldt informs us that the mineral composition of lava differs according to the nature of the crystalline rock of which the volcano is formed, the height of the point where the eruption occurs, and the temperature of the interior of the mountain. If we consider the marvellous production of minerals by the sole influence of water heated to 400° Centigrade, as related in one of our former papers—if we

consider that steam (which in volcanos is frequently acid) may be heated to an enormous extent—we shall readily conceive the production of some varieties of lava by the agency of hot water, acid vapour, and gases, and that of the mud in the Javanese and South American volcanos. Let us add, in conclusion, that the eruptions of mud-volcanos are accompanied or preceded, as in lava-producing mountains, by earthquakes, subterranean thunder, smoke, cinders, &c.

Sulphate of potash, as a mineral species, is extremely rare; it is known to the French mineralogists as Aphthalose; in Italy it goes under the name of *Aftalosio*, and is occasionally found in small white crystals on the lava of Vesuvius, or as a dry powder in the cavities of the lava. Some time ago Signori Corvelli and Monticelli remarked that the Aftalosio of Vesuvius is generally very impure, being frequently mixed with salts of copper or iron, but principally with common salt (chlorides of sodium). Signor Barresi, who is at present attached to the faculty of natural history in the University of Palermo, has just discovered, in Sicily, the mineral species of which we speak, in beautifully regular crystals, and perfectly pure. The samples he has collected are looked upon by naturalists with deep curiosity, and the learned professor has written upon his discovery a long paper, which we have not yet had the good fortune to receive.

If sulphate of potash be excessively rare in nature, the same cannot be said of sulphate of soda, which salt, though quite as soluble in water as the former, exists in enormous quantities near Lodosa, in Spain. Lodosa is a dirty little town on the confines of Navarre, and the province of Old Castille. The salt is also met with in the mountains of San Adrian and Alcanadre. M. de Lajonkaire has lately made extensive investigations concerning these important deposits.* The following is, for the two mountains just named, the general disposition of the strata where the sulphate of soda exists:—

1, Vegetable earth; 2, six to twelve feet of alluvial sand and clay, almost white; 3, a bed, seventy feet thick, of rolled stones, which are sometimes firmly cemented together by an argillaceous limestone; 4, about 165 feet of a green argillaceous marl, with beds of crystallized gypsum; 5, twelve to fourteen feet of wine-coloured

* They are far less important now, however, than formerly. The artificial sulphate of soda manufactured in large quantities from common salt for the use of the glass makers, the artificial production of carbonate of soda, &c., have greatly diminished in value the natural deposits.—T. L. P.

gypsum in marl of a like colour; 6, seventy-five feet of fine-grained variegated sandstone; 7, a bed of sulphate of soda, from a few inches to eight or nine feet thick; 8, seventy feet of blue schistose marl, with veins of gypsum; 9, another bed of sulphate of soda, varying in thickness from a few inches to forty or fifty feet; 10, about seventy-five feet of blue clay and gypsum; 11, thirty to forty feet of a fine-grained argillaceous sandstone, red and green; 12, a thin layer of common sea-salt mixed with clay; 13, fifty feet of green and red sandy marls; 14, twenty-five to one hundred feet of a red argillaceous sandstone alternating with pudding-stones of a similar colour.

These strata, which are frequently dislocated, uplifted, irregular, and partially destroyed by water, furnish us with a tolerable idea of a triassic formation.

Brussels Tertiary and Fossils—Grœnendael—Laeken—Fossil palm-nuts and wood, pierced by the Teredo—Fossils having the odour of the Primeval Seas—Italian Earthquakes—Singular relation existing between magnetic observations and Earthquakes—Startling hypothesis proposed to explain Geological phenomena—Terrestrial magnetism—Earthquakes again—Novel production of artificial Coal and Anthracite.

DURING the five or six years I was occupied in scientific pursuits at the University of Brussels, I employed various means to make the acquaintance of, and to be on good terms with, the workmen employed in clearing away the sandy strata which surrounds the town; and especially with those occupied in levelling a great part of the *Faubourg de Schaerbeek*. Brussels, like Rome, is built upon seven hills, so that the works of which I speak often attained a considerable depth, affording many an opportunity of noting the exact disposition of the strata and the fossils they contain. By sundry promises of *faro* and cigars, I prevailed upon several workmen to bring to me everything "curious-looking" that they happened to meet with in their work of excavation, or to send for me immediately if the treasures they dug up were too large or too heavy to be transported to my abode.

In this manner I got hold of a good deal of rubbish, such as curiously shaped stones, clotted sand, differently coloured flints, &c.; but I soon found myself in possession of some very rare and curious specimens, which even the Professors of the University looked upon with

wonder, and which have more than once excited the curiosity and admiration of the illustrious and much regretted Dumont, who sometimes honoured me with a visit.

Brussels, I should also inform my readers, stands upon the lower or more ancient of the tertiary strata. D'Omalius d'Halloy classes its strata in the *middle Eocene* formation; the town and its environs are built upon an immense bed of sand, often calcareous, and presenting frequently blocks of calcareous sandstone, which gradually blend into a sort of shining quartzite, known as *grès luisant* by the Belgian and French geologists, and blocks or strata of white or yellowish limestone. These are all employed, to a certain extent, for building and paving, but the stones they furnish are not large enough to be very valuable. This deposit is tolerably rich in fossils, most of which are also found in the lower strata of the Paris tertiaries, which are of the same age.*

At Grœnendael—a lovely spot to the south of Brussels, a small village,

> "Where greenwoods, lakes, and fragrant flowers,
> Mossy banks and sweet-scented bowers,
> Chase from our thoughts toil, care, and strife,
> Recal bright summer-days of life,"

and which affords a far better harvest to the botanist than to the "brother of the hammer"—the sand and blocks of sandstone are impregnated with a great quantity of yellow oxide of iron (*limonite*), which, when found in crystalline blocks of a darker colour, is extracted for working, as it forms a tolerable iron-ore. At Laeken, the favourite residence of king Leopold, we have another and more recent stratum of sand, belonging, perhaps, to the *upper Eocene*; but geologists are divided in opinion as regards its relative age.

Among other fossils brought to me from the middle Eocene sand of Schaerbeek were some magnificent specimens of a sort of cocoa-nut.† Once upon a time these "cocoa-nuts" (*Nipadites*) grew and flourished at Brussels; now-a-days it is as much as we can do to keep the hardy date-palm alive in this climate. In the same strata with the "cocoa-

* Our readers should refer to Sir C. Lyell's "Memoir on the Tertiary Formations of Belgium," in the Journ. Geol. Soc., vol viii, for details of the structure and paleontology of that country, and for references to other authors and geologists who have treated of the same subject.—Ed. Geologist.

† See Lyell's Memoirs, *op cit.* p. 344 and pl. 19, for an account and figures of these palm-nuts, allied to those of the *Nipa*.—Ed. Geologist.

nuts" (which are always completely petrified) are found petrified stems of palm-trees, bamboos, and poplar-trees.

These palm-nuts, bamboos, and poplar-like trees are sometimes found pierced in all directions by a species of *Teredo*, which has left its worm-shaped shells in the petrified wood. Sometimes large clusters of the calcareous tubes of this mollusc are found covering, or buried in, the stem of a poplar or palm-tree; sometimes again they show themselves in compact masses, where only a slight vestige of a tree-stem remains discernable; in this case the wood has been so thoroughly tunnelled, that hardly any of it remains.

The fossil* of which I speak belongs to that tribe of worm-shaped mollusca so much dreaded by shipowners before the copper-sheathing of vessels was imagined. The animals of this genus lay their eggs upon the surface of submerged wood; the young *Teredo*, as soon as it is excluded, begins to work its way inward, and continues to proceed to a greater depth as it grows larger. Its mode of operating, both curious and wonderful, is described in works on Zoology; its tunnelling apparatus exceeds everything man's genius has yet brought to bear in making *his* tunnels. The particular species to which I allude as being found in the fossil-trees of the Schaerbeek sand, is the *Teredo corniformis* of Lamack.† The existing Teredo makes the same havoc amongst the cocoa-nuts and palm-stems which float at the present time in the tropical seas, that its predecessors made thousands of centuries ago, when flourishing amidst the waters that deposited the middle Eocene beds of Brussels.

Our readers have doubtlessly heard of the marvellous property possessed by musk of retaining its odour for a long period of time—months, nay, years, may elapse, and the musk is as odoriferous as ever. But can any odour be retained for 100,000 years or more? My fossil Teredos answer this question in the affirmative! When these fossils are fresh from the strata in which they lie, they have a strong smell of the sea; so strong, indeed, in some specimens that I could hardly believe it possible. The odour of the sea is, however, very characteristic, and not easily mistaken or forgotten; it has been remarked in very early

* See Forbes' and Hanley's "British Molluscs" for a good account of the Teredo.—Ed. Geologist.

† In the Province of Brabant, we have two or three other fossil species of the same genus.—T.L.P.

historical periods. If I remember rightly, Quintius Curtius Rufus, in one of the ten books which he wrote to convey to posterity the "History of the Reign of Alexander the Great," says that the pilots recognised the sea by its odour, "agnoscere se auram maris." However, to assure myself that the odour of the tertiary sea was not an illusion, I immediately had the fact certified by a considerable number of persons, among whom I could name some very eminent and popular men. All, without exception, were delighted at the idea of their olfactory organs thus launching them into the byegone ages of geological periods, and marvelled at the prodigious number of years the fossils I have described had retained their smell. I then made known this discovery to the Paris Academy of Sciences.

I have said that the fossils here alluded to were taken from the *middle Eocene* of Brussels; they have, therefore, retained their odour for thousands of centuries!

M. Prost, who inhabits Nice, has furnished us with many observations on the earthquakes of Italy, and on the oscillation of the ground along the coasts of the Mediterranean. Very frequent, and even violent, in the year 1855, these terrible commotions became milder in 1856; but took a new degree of intensity in the year 1857, when, on the 20th and 21st of August, a strong shock was felt on the Italian and African coasts. Here are, however, some curious observations recently communicated to the Academy of Sciences at Brussels by the learned Secretary, M. Quetelet, Director of the Brussels Observatory, and which tend to show that there exists a certain relation between the magnetic forces of our planet and the phenomena of earthquakes. "In the forenoon of the 17th of last December," says M. Quetelet, "a violent magnetic perturbation was observed by my son in the Brussels Observatory." At noon the perturbation increased considerably; the proximity of an Aurora borealis was presumed to be the cause of this phenomenon, and shortly afterwards the local papers spoke of the apparition of an Aurora borealis, which had been seen at Brussels between five and six o'clock on the morning of the 17th. The customs-officers stationed at the gates *Porte Joseph II.* and *Porte de la Loi*, near the Rue Montoyer, were the first to remark it; they thought it was the effect of a tremendous fire in some part of the town. The luminosity spread from north to south across the heavens, preserving its brilliancy throughout, and detaching itself gloriously from a background of cloudless sky glittering with stars.

It was learnt shortly afterwards that a most violent earthquake had ravaged, on the night which separated the 16th and 17th of December, the greater portion of the two Sicilies, especially the town of Salerno, Potenza, and Pola. Many thousands of the population perished in the Basilicata and neighbouring provinces, where the phenomena appear to have been concentrated. Naples itself experienced three violent shocks, which, however, were fortunately unattended by loss of life. Other convulsive movements of the earth were felt in Naples on the 19th, 20th, and 23rd of the same month. The inhabitants, much terrified, hoped and prayed for an eruption of Vesuvius. The earthquake of the 17th December produced a certain effect on the south parts of Germany. Bavaria and Wurtemburg likewise experienced its influence; and on the 20th December, at half-past five o'clock in the morning, violent shocks were felt at Agram, in Crotia. The undulations of the ground took a direction from the south-east to the north-west, and the shaking of the earth lasted about three hours and a half.

During the early days of last January, the amplitude of oscillation in the magnetic needle of the Brussels Observatory evinced considerable irregularity, especially on the 5th, 6th, and 7th of that month. But on the 9th the needle was, moreover, suddenly displaced at each oscillation. The papers made known shortly afterwards that an earthquake had taken place on the 8th and 9th of January, at Varna.

These data evidently tend to prove that a certain relation exists between the phenomenon of earthquakes and terrestrial magnetism.* But this relation of which we speak, to what extent is it established? Can we admit, with Mr. Evan Hopkins, that terrestrial magnetism is the great and sole agent of nature by which all geological changes have been, or are, accomplished? Certainly not. This author's hypothesis is, however, extremely curious. We are indebted for an abstract of it to an accomplished geologist, Miss Catherine J. B. Taylor, and we are thus enabled to let our readers judge for themselves. Mr. E. Hopkins endeavours to demonstrate that "the slow operation of that power which we call terrestrial magnetism accounts for all the changes observed on the surface of the earth, in the structure, combinations, and relations of

* Whilst writing the above, the following passage of Humbolt's is irresistibly called to mind:—"When the needle, by a sudden disturbance in its horary course, indicates the presence of a magnetic storm, we are still unfortunately ignorant whether the seat of the disturbing cause is to be sought in the earth itself or in the upper regions of the atmosphere." (*Cosmos, vol. I.*)—T. L. P.

the crystalline and sedimentary rocks, individually and collectively." This is certainly somewhat startling. "Mr. E. Hopkins endeavours to prove his theorem," says a writer of the present day, "by the general principles of the polarity of matter, the ascertained meridional structure of the crystalline rocks, the distribution of metalliferous deposits, &c. . . The fact of the general meridional structure of crystalline rocks is pretty clearly established; and Mr. Hopkins adds, from his own observations, additional proofs of the extent to which this formation prevails over the surface of the globe."

But the most surprising part of the hypothesis is that in which it is affirmed that the solid parts of the earth's surface are, by the same influence (terrestrial magnetism), perpetually, though slowly, moving from the south to the north, this being represented as affording the only solution to certain obscure problems which have long puzzled geologists and astronomers. The rate of the meridional progression is estimated as high as one minute (one-sixtieth of a degree) in three years, or one degree in 180 years; so that in 2,700 years the northern parts of Australia will be right under "the line," and in 3,600 years the Orkney and Shetland Isles will be nearly on a level with the north pole! "Supposing this rate of movement to be constant," says the writer quoted above, "the spot on which London stands must have been in the equator some 9,180 years ago, and the whole of England will be within the arctic circle in about 2,800 years hence. Thus may be explained the phenomena of organic remains of plants, which must have lived and died on the spot where they are found, though the climate now around them is utterly unfit for their existence. Thus also may be explained the position of the stars since the altered period of the earliest authentic records of astronomy. Instead of the *precession of the equinoxes*, or the bodily oscillation of the globe, Mr. E. Hopkins maintains that a slow but steady movement of the crystalline surface of the earth, from pole to pole, would account for all the phenomena."

Where will imagination carry us—or, rather, future generations, when they find themselves all safely lodged at the north pole? Magnetism, after all, is but one of the many physical forces which have acted, and still continue to act, upon our globe; and why should *that one* be regarded as the origin of all the others, any more than heat, electricity, or motion?* Mr. E. Hopkins must answer this question before his hypothesis can be submitted to serious consideration.

* Consult on this question, Grove's "*Correlation of Physical Forces*."—Ed. Geol.

And now to return to the fearful Italian earthquakes. The volcanic disturbances in Naples do not appear to have entirely ceased. At Montemurro three shocks were felt immediately before dawn on the 26th of February; and afterwards, about daybreak, so violent an earthquake took place, that the inhabitants fled, with cries and tears, from their beds into the open country, and were still more alarmed when they learnt from some peasants that the ground had been seen to open and close again at each shock.

At the same time, a severe commotion was experienced in Viggiano, where some walls fell, without doing further injury. Belvano, also, on the 23rd, was shaken, but rather less severely; and, on the same day, towards night, the inhabitants of Saponara heard, at an interval of thirty seconds, two subterraneous noises, resembling the reports of a very large piece of cannon. At the trembling of the ground, the terrified inhabitants fled from their houses, and gathered together for prayers in a chapel. Other slight shocks have since been felt in many places of the Basilicata, not excepting Potenza, so fearfully shaken by the former commotions. We cannot resist noting down here two striking features of the human character, which the late earthquakes in Italy have enabled certain persons to observe. In spite of the apparent violence of the phenomenon in Naples, and the utter ignorance that prevailed as to what might be the dreadful and immediate consequences, bands of thieves entered the houses deserted by the frightened tenants, and ran off with everything they could lay their hands upon. Indeed, some of the Italian papers assure us, that greater loss was sustained in Naples by these robberies than by the earthquake itself. Does not this fact tempt us to exclaim, "Man's greatest enemy is man?" But the same papers report (and we notice it with pride and pleasure), that the promptest and most generous succour proffered to the unfortunate sufferers from the earthquake and its effects, came from the English residents at Naples, who immediately subscribed large sums of money, to be distributed among their distressed fellow-creatures.

We will now call attention to an ingenious method by which coal has lately been produced artificially, and, as far as we know, for the first time. The experiment to which we are about to refer formed the subject of a recent communication to the Academy of Sciences at Paris, on the part of the author, M. Barouilier, who has accomplished the mineralogical feat in question by means of an apparatus, extremely

simple, that enables him to submit vegetable matters previously enveloped in damp clay, to an elevation of temperature ranging between 200 and 300 degrees (Centigrade), and sustained for a long period of time. The apparatus is not perfectly or hermetically closed, but allows, though with difficulty, the vapour and the different gases to escape. In this manner, organised vegetable tissues are decomposed at a moderate temperature, and under a sufficient degree of pressure to prevent any serious disagregation of their parts. Saw-dust of different kinds of wood produces, in this experiment, *different varieties of coal;* and, moreover, stems and leaves print their forms on the clay in a thin bituminous, or coaly layer, which gives to the specimens produced the aspect of every description of coal-schist on which we observe, in nature, similar impressions.

We must here remark, however, that, long before the time of M. Barouilier, Hutton used, with many others, to look upon coal as the product of a species of dry distillation; and, to give to his ideas all necessary confirmation respecting this, he submitted pieces of wood to intense calcination in a hermetically closed iron vessel. He obtained in this manner a species of coal, or rather a melted mass of something very much resembling coal, but which showed no organic texture whatever. But, from the beautiful investigations of MM. Link, Ehrenberg, and many microscopists, it is next to impossible to find a piece of coal which does not evince ample proofs of its organic origin by the numerous, and oftentimes perfectly preserved, organised tissues it contains. The most important feature in M. Barouilier's experiment is, then, the production of coal, preserving, at the same time, its organic texture entire. Other experimental philosophers, amongst whom we should name Hutton, Petzholdt, Cagniard de la Tour, &c., have produced curious varieties of *carbon* or *bitumen*, in their experiments—M. Barouilier has formed *coal*.*

(*To be continued.*)

* In the second volume of the new edition of Mantell's "Wonders of Geology," just published, our readers will find an ample *résumé* of microscopical researches in the structure of coal, and a notice of the experiments by Goeppert and others, in illustration of the nature of coal.—Ed. Geologist.