FOREIGN CORRESPONDENCE.

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Novel Production of Artificial Coal and Anthracite (continued)—Metamorphism—Action of Lava and Trap-rocks on Calcareous Strata—Production of Minerals by Metamorphic Action—Metamorphosed Gypsum—Red-hot Lava two years and a half old—Cotunnite and Kerasine—Origin of Crystallized Sulphur in Sicily—Formation of Prairies—Their Relation to Peat-bogs.

M. Cagniard de la Tour formerly submitted woody matter in closed vessels to the action of great heat, with a view of obtaining coal; but his experiments, like those of Hutton, failed—the only result was bitumen. M. Barouilier, repeating the experiments of Hutton and Cagniard de la Tour, introduced three important modifications, which have contributed to the success of the operation. Firstly, he interposes a stratum of woody matter between layers of clay; in the next place, the vessel is not completely closed, but so arranged that the steam, and disengaged carburets of hydrogen, remain a certain time in contact with the mixture of ligneous matter and clay; and, finally, the temperature to which his apparatus was submitted never exceeded 300 degrees (Centigrade). The consequence was, that the products obtained resembled coal in every respect; and, as we said before, their appearance varies according to the nature of the wood employed in the experiment. They vary, also, a little with the temperature.

In a former paper we alluded to some very ingenious experiments made by M. Daubrée, the eminent geologist of the Faculty of Sciences at Strasburg,* by which he produced, artificially, a number of well-known minerals, by the sole action of water at a high temperature, sustained for long periods of time. In a Memoir lately published,† the same author states that, by submitting pieces of pine-wood to this remarkable action of hot water or steam, in a closed tube, he has obtained *Anthracite.* This is another new and curious fact to be added to his former interesting discoveries concerning the origin of minerals.

In a previous article‡ we have alluded to some interesting observations of M. Delesse on the metamorphism of rocks, and have

* See the Geologist for Feb., 1858.

† *Sur le Metamorphisme, &c., par* M. Daubrée. *Paris, Victor Dalmont,* 1858.

‡ The Geologist for March, 1858.

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made known the results of his researches on the alteration of combustibles—such as lignite, coal, anthracite, &c.—by the action of eruptive or plutonic rocks. We are happy to say that this distinguished geologist perseveres in the study of metamorphism, upon the phenomena of which he has already thrown so much light. In one of his recent memoirs, he has reviewed the action produced by lava and trap-rocks on the different limestone strata with which they have come in contact.

In the case of lava, either ancient or modern, the metamorphism produced seems to be entirely the result of great heat. By contact with lava, limestone has become crystalline, and has taken a saccharoid appearance. A great number of minerals are also formed in limestone strata by the metamorphic action of lava. M. Delesse has remarked, in particular, garnets, idocrase, epidote, pyroxene, and mica, all of which are observed at Vesuvius in the limestone of La Somma. Many stratified rocks with which lava has come in contact have been split or fissured, and have taken a reddish tint, which they had not before. This coloration, which is pretty general, appears to us to be due to the action of the atmosphere upon the protoxide of iron contained in the rocks at the time of their contact. This protoxide generally produces green or black-coloured silicates in volcanic and other plutonic rocks; but, if these are violently heated in the air, a certain quantity of the protoxides contained in their silicates of iron is transformed into peroxide, which is red.

When the heat produced during the eruption of the lava has been very great, the rocky strata upon which it has acted have become partially or wholly vitrified. It has been remarked, however, that rocks, sandstones, &c., are *not* changed into transparent quartz by the metamorphic action of lava; on the contrary, their silica combines with the different oxides furnished by the latter, and thus are produced certain silicates which have a vitreous appearance, thereby resembling quartz of a cellular structure.

The metamorphic action of trap-rocks—among which M. Delesse mentions basalt, dolerite, hyperite, euphotide, diorite, and ordinary trap—is observed to have been more marked on calcareous strata in those parts where the erupted mass has been greatest. The change undergone by the limestone-rock rarely extends, however, to more than

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a couple of yards from the sides of the erupted trap-rock. In general, this change has been greatest where basalt and dolerite have been ejected. The metamorphism undergone by limestone, in these circumstances, includes a change of structure and the formation of certain minerals. Some calcareous strata have become hard and compact in those parts which have been pushed up by trap-rocks ; others have taken a fragmentary, or even a prismatic structure—but only when they are argillaceous or siliceous. The prisms thus formed in limestones are not so well defined as those we observe in other varieties of rocks ; for instance, in sandstones, &c. The limestone of the Pyrenees has become cavernous or cellular by the metamorphic action of diorite. "Limestone," says M. Delesse, "generally becomes crystalline by metamorphism ; its colour becomes paler, and often exceedingly white." This reminds us that, some time ago, we found that certain limestones, which were remarkable for their whiteness, and which had been modified in structure by metamorphism, contained a notable quantity of magnesia, which must perhaps be attributed to the contact of the eruptive rock. The analysis, made at the same time, of a greenish-yellow compact dolomite gave me protoxide of iron and magnesia, besides lime, in such proportion that a certain quantity of protoxide of iron seems to have been substituted for an equivalent quantity of magnesia.

When a trap-rock has exercised metamorphic action upon a stratum of limestone, M. Delesse observes that the density of the latter has augmented considerably ; and in the vicinity of the eruptive rock are found mineral species produced by its influence, amongst others, oxide of iron, oxide of manganese, magnetic pyrites, brucite, dolomite, calcareous spar, chlorite, pyroxene, garnet, idocrase, gehlenite, &c. We find, also, in veins, injected, as it were, through the limestone, barytine, celestine, oligiste, pyrites, galena, blende, copper-pyrites, and some others.

M. Delesse has observed, also, that gypsum has been acted upon by metamorphism much in the same way as limestone ; thus, it has been observed in some cases to have become crystalline, and to contain oligiste and even iron-glance (carbonate of iron). We will reserve for a future paper M. Delesse's remarks on the metamorphism of sandstones and argillaceous rocks.

Professor Scacchi, of Naples, has lately addressed a letter to the

French geologist, M. Ch. St. Claire Deville, of which we reproduce the following extract:—"I don't know whether you are already aware that the lava of Vesuvius, which ran into the *Fosso della Vetrana* in 1855, was still, here and there, in an incandescent state as late as last autumn, and also that this lava has produced, by sublimation, a notable quantity (*non piccola quantita*) of *Cotunnite* (chloride of lead), of which I send you some samples, as this substance has been very rare here since 1822."

M. Deville remarks that these few lines are well worthy of notice, for it is certainly a curious fact that the lava which accumulated thickly in *la Vetrana* should preserve, two years and a-half after its emission, enough heat to present, here and there, portions in an incandescent state. But the presence of *cotunnite*, as a production of this lava, is not less remarkable. Our readers must not confound this rare mineral species with the chloride of lead called *Kerasine*, formerly discovered in the Mendip Hills of Somersetshire, and analysed by Berzelius, who found it contained one atom of chloride, and two atoms of oxide, of lead. According to M. Ch. Deville, *cotunnite* has only been seen at Vesuvius on three different occasions, and each time shortly after some great eruption or marked activity of the volcano. It was first observed in 1822, shortly after the great eruption of that period, and described by Monticelli and Covelli as a new mineral species; it was discovered in the higher crater of the volcano. It was next seen in 1840, a short time after the great eruption of 1839, when Signor Scacchi also discovered this same mineral in the upper crater of Vesuvius, near the *Punta del Mauro*. Finally, in 1857, the last-named geologist remarked the presence of *cotunnite* in the lava emitted a few months before the time of his observation.

We have received lately from Sicily a fine sample of crystallized sulphur, from the secondary strata of that island. We were astonished, on examining this sulphur, to find with what certainty we are able to arrive at its geological origin by reasoning from established chemical facts. Some months ago, M. Berthelot, one of the most distinguished chemists in Paris, showed that the metalloid of which we speak manifests two distinct forms: 1st, electro-negative sulphur, soluble in many dissolvents, but principally in sulphide of carbon, and crystallising in octahedrons; he has also called this variety "Octahedral sulphur." 2nd, electro-positive, or amorphous sulphur, insoluble in sulphate of carbon, and non-crystalline. The sulphur of the first category is that extracted from combinations in which sulphur enters as the electro-negative element, as in sulphuretted hydrogen and the different metallic sulphides. That of the second category is extracted from combinations in which it forms, on the contrary, the electro-positive element, as in sulphureous acid, sulphuric acid, and their salts, &c.

The sulphur we received from Sicily is in large transparent crystals belonging to the third crystalline system, having for type the prism with a rectangular basis, or, as the French crystallographers term it, *le système prismatique rectangulaire droit.* It therefore is identical with M. Berthelot's octahedral or electro-negative sulphur; and, to assure myself of this, I treated it with sulphide of carbon, and found that it was completely soluble in this liquid, leaving not the slightest residuum. These natural crystals are, moreover, very beautiful, being of a transparent yellow colour, and showing, here and there, in their superficies or in their interior, the colours of the rainbow.

It appears evident enough, from what we have just stated, 1st, that this Sicilian sulphur has been crystallized in nature from a solution and not by fusion—for sulphur, when crystallized by fusion, takes the form of long prismatic needles belonging to another (the 5th) crystalline system (*système prismatique oblique*); its origin cannot, therefore, be immediately attributed to volcanic eruption. 2ndly, that if this sulphur be owing to the decomposition of any soluble combinations in which this element enters, it must evidently have come from such as contain it as an electro-negative element. For instance, from sulphuretted hydrogen, or certain metallic sulphides, and not from sulphurous acid, from sulphuric acid, or their salts.

M. Lesquéreux has read before the *Sociéte de Neufchatel* a paper on the formation of prairies in America, which concerns at once botanical geography and geology. The problem which the author has just endeavoured to solve, namely, the cause of the formation of these vast American prairies, is as interesting to the geologist as to the botanist, and, on this account, we will expose here the facts contained in M. Lesquéreux's memoir, which we consider most worthy of notice.

In nature, forests and prairies are not often met with simultaneously or intermingled one with the other, even on large portions of territory; on the contrary, they are seen to stretch *separately* over vast tracts of land. It has been remarked that the shade of trees prevents the growth of plants belonging to the family of the grasses, whilst the latter, in their turn, hinder the developement of the seeds of trees, and leave the young shoots exposed to a variety of accidents. But why and how have these vast tracts of country become forests and prairies at some very ancient period—probably when the waters retired from the surface of the soil which they cover, and vegetation first sprang up there? M. Lesquéreux asked himself this question whilst rambling over the plains of North America, and he endeavoured to answer it by direct observation.

On the banks of the Mississippi and the Minnesota M. Lesquéreux has actually seen prairies in process of formation. According to his observations, this is what takes place:—Mud is constantly deposited at each side of the river, but when the latter swells in the rainy seasons, the water passes over its banks, and forms immense marshes or swamps, where it becomes stagnant and putrid, and where the sand and mud which it has washed along in its course are deposited. Nothing is less favourable or contrary to arborescent vegetation; the roots are deprived of air by a stratum of water, which is never renewed; trees, if they have already begun to grow in these situations, perish when such inundation occurs, and when the heat of a summer's sun has evaporated the water, grass, rushes, and a few other plants of like structure, can alone resist and accomplish their developement under such circumstances.

In Germany, and many other parts of Europe, marshes are rarely, if ever, dried up in this way—the heat of the summer's sun is not sufficient in this climate to effect a complete evaporation before the equinoctial rains begin—they persist as swamps, and, in course of time, by the accumulation of *Sphagnum* and *Conferva*, peat-bogs are formed. Ancient marshes or swamps become either prairies or peat-beds, according to circumstances, but more especially according as inundation has been followed by a longer or shorter period of dryness. As regards America, M. Lequéreux brings forward a great number of examples, mostly taken from the banks of the great lakes Erie and Michigan, or the neighbouring rivers, to prove that prairies formed at different periods owe their existence to the causes above-named; whilst forests appear to have been formed solely on hills, or in parts remote from the influences of periodical inundation.

(*To be continued.*)

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