FOREIGN CORRESPONDENCE.

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

Daubree's researches on recently-formed Minerals—Action of Mineral Waters upon old Roman Cement—Daily production of Zeolites, Fluor-Spar, Arragonite, &c.—Plombierite—Time an important element in Geological Experiments—Delesse on the Metamorphism of Argillaceous and Siliceous Rocks—Earthquakes at the Cape of Good Hope—Apparition of different kinds of Fish after violent Earthquakes.

Professor Daubrée, of Strasburg, has obliged us with a copy of his interesting "Memoir on the Mineral Deposits of the Thermal Springs of Plombières." We hasten to make known to our readers the important results contained in this new work.

The investigations already made concerning the natural beds of those minerals, which have been classed in the family of Zeolites,* have led mineralogists to believe that water has been active in their formation. We have already shown† how M. Daubrée has reproduced in his laboratory a certain number of Silicates, and how he discovered that they had been formed in certain springs at Plombières since the time of the Romans. The present Memoir completes our knowledge of these interesting phenomena—and what can be more interesting than the formation of a stone before our eyes! It appears, moreover, that Zeolites have rarely or ever been artificially produced, and their origin has always been more or less enveloped in mystery.

In order to augment the volume of water in the warm springs of Plombières, the author has been constructing a deep aquaduct, for which it was necessary to cut through a crust of cement which the Romans formerly spread over the valley where the springs rise. This cement is composed of fragments of bricks, variegated sandstone, and lime. It has been powerfully acted upon by the mineral waters which come in contact with it at a temperature ranging from 50 to 60 degrees (centigrade). The lime and the bricks themselves have been thus transformed into new combinations, which have crystallised in their cavities. Among the products of this transformation, the most frequent are certain Zeolites, and especially *Chabasite* and *Apophyllite*. The former, which is a silicate of alumina and lime, is generally found in the spilites of certain basalt formations, in the Tyrol, Bohemia, the Hebrides, &c.; the latter, a silicate of lime and potash, is seen also in the cavities of spilite rocks and in the beds of magnetic ironstone in Norway, Sweden, &c. The samples taken from the warm springs of Plombières were in perfect, well-defined crystals, and in every respect similar to the minerals from the above-named countries.

Besides these, many other Zeolites are formed at Plombières, but their exact species has not yet been accurately ascertained. M. Daubrée names, therefore, with uncertainty *Scolezite*, *Harmotome*, and *Gismondine*. He mentions, also, the presence of a probably new species of hydrated

* Hydrated Silicates, partly soluble in strong acids.—T. L. P.

† *Vide* the Geologist for Feb., 1858.

carbonate of magnesia, which crystallizes in rhomboid laminæ of a pearly lustre.

The cavities of the Roman masonry contain *Hyalite* and other varieties of *Opal*. *Arragonite* is also found in these cavities; the samples are bipyramidal crystals, very acute, resembling those found in the iron-beds of Framont and certain basalt formations. *Calcareous-spar* is seen mixed with the crystals of Chabasite before mentioned, and in the same cavities are observed small crystals of *Fluor-spar*, which have, in some places, their usual and beautiful violet tints. We must add that Professor Nickles, of Nancy, has very recently discovered fluorine in the mineral waters of Plombières. Does the presence of this fluorine (contained in the water in shape of fluorides) explain that of Daubrée's crystals of fluor-spar, or do the latter account for the discovery made by Nickles? There can be hardly any doubt that it is the presence of certain fluorides in the waters of Plombières that has given rise to the formation of the Blue-John or fluor-spar seen by M. Daubrée,* by their action upon the lime of the Roman cement.

In certain cavities and fissures where the Roman cement is exposed to a direct stream of warm water, a gelatinous substance is precipitated, which, by contact with the air, hardens, becomes quite opaque, and as white as snow. This substance analysed by M. Daubrée, turns out to be a new mineral, a silicate of lime, to which he attributes the composition

$$CaO\ Si\ O^2 + 2\ HO$$

Silicate of lime + water.

He calls it *Plombierite*.

In spite of the extreme hardness of the Roman masonry, it gives, nevertheless, access to the mineral water, which not only penetrates it in all directions, but actually passes through it. This passage is very slow, but continuous, and permits the chemical reactions which take place to multiply slowly for an immense space of time—an experimental element which modern chemists are in the habit of neglecting, but which the old alchymists knew well how to take into consideration.† That time plays an important part in those essays by which we endeavour to imitate natural productions, is seen by those beautiful experiments of M. Daubrée's, to which we have before referred, and in

* M. Jutier has just discovered at Plombières a large vein of Fluor-spar in the granite, which is traversed by the mineral waters, and whence doubtless these waters derive their soluble fluorides, which coming in contact with the lime of the masonry are transformed anew into fluor-spar.—T. L. P.

† Hortulanus, in the sixteenth century, says that to procure the Philosopher's Stone, "On fait digérer pendant douze jours des suer de mercuriale, de pourpier," &c. The celebrated alchymist Geber says, "I have seen mines of copper from which particles of this metal were carried away by a current of water. This water having dried up, the atoms of copper remained three years in the dry sand. I discovered that at the end of this time they had been cooked and digested by the heat of the sun and changed into laminæ of pure gold. By imitating nature we produce the same transformation." Hoeffer, in his "History of Chemistry," say that experiments begun by certain alchymists of the middle ages were often transmitted from father to son as an inheritance; and that the son, not having lived long enough to terminate them, left them by will to his children.—T. L. P.

which *one month* was not deemed too long a period for *one experiment*. The mineral water of Plombières acts upon the masonry by the alkaline silicates it contains, and forms Zeolites in abundance. These crystallize at a temperature which is inferior to 60 degs. (centigrade), consequently under the simple pressure of the atmosphere, and almost at the surface of the soil. The crystals of Chabasite are always found in the bricks, the Apophyllite exclusively in the lime, which circumstance is in perfect accordance with the natural composition of each, and shows that their elements have not been totally brought by the water, but partly furnished by the cement. Hence the conclusion, that "the same dissolution, acting upon masses of different nature, developes in each distinct combinations," arrived at by M. Daubrée. This geological formation, which at Plombières is taking place under our eyes to a certain limited extent, has doubtless been accomplished in bygone ages to an immense extent. It is evident that many eruptive rocks must have been penetrated by water during the period of their cooling, and on a far larger scale, at a higher temperature, and under a much greater pressure than at the miniature laboratory, which Nature seems to have opened for the benefit of her pupils, at Plombières.

We have collected together the most important facts contained in M. Delesse's new Memoir on Metamorphism, for the purpose of relating them here, as it will be seen, if we mistake not, in the following lines, to what an extent water seems to have been active in the metamorphic transformations so perseveringly studied by this geologist. We have already mentioned the latter author's observations on the metamorphism of *carboniferous rocks* of every description, and also the results of his researches on the transformations of *limestone rocks and strata*, under the influence of eruptive or plutonic rocks.* In the work of which we speak here, *argillaceous* and *sandstone rocks* are studied from the same point of view. The latter, under the modifying influence of eruptive trap-basalt, dolerite, &c., present many phenomena well worthy of being recorded. Let us consider, first, the siliceous rocks :—

We find that their metamorphism, like that of limestone, is characterised either by the formation of certain minerals, or by peculiar modifications in their structure. Amongst the minerals thus formed are hydrated oxides of iron and of manganese, and certain carbonates, principally carbonate of lime, dolomite, also carbonates of magnesia and iron, sometimes silica. Among hydrosilicates ferruginous clay, and especially Zeolites, are formed. Green-earth is seen penetrating sandstones, to which it gives its colour, but their quartz remains as transparent as before, and comparatively unchanged. This metamorphism has been particularly favourable to the formation of Zeolites, which are seen to have been thus formed in the most compact of sandstones, and are even met with in common flint.† In most cases the Zeolites form a sort of white cement, filling up the small cavities between the grains of quartz in different sandstones. At other times they are seen as microscopic nodules, and often in perfect crystals, lining the cavities of the siliceous rocks.

* The GEOLOGIST for February and June, 1858.

† Flint is undoubtedly of aqueous origin.—T. L. P.

The structure of the latter is observed to have become prismatic, lithoid, cellular, vitreous, or even marbled. When a sandstone has been thus modified, it has lost its red colour, which is replaced by white, grey, green, or black tints; the rock has become sonorous, and, under the hammer, breaks into splinters. When of a friable nature, the grains of quartz in the siliceous rocks have been cemented together by metamorphism, and even in the sandstones which present the most compact appearance the arenaceous structure is easily rendered evident by the action of an acid. When a prismatic structure has been taken by sandstones, the prisms are well-defined and perpendicular to the surface of contact with the trap-rock; their section is small, but their length attains sometimes as much as two yards and more. Sandstone which has become prismatic by the contact of basalt, contains a certain quantity of water, and when the former rock has taken a vitreous or cellular structure at the same time, it has undergone violent metamorphism, but still contains water, and its density has been diminished.

"The metamorphism experienced by argillaceous rocks from contact with traps," says M. Delesse, "is very difficult to define, as the former contain almost all the elements that are found in the eruptive rock that has modified them. The proportions of these elements, then, alone can vary, hence chemical analysis can only show us the modifications these proportions have undergone. Moreover, as these rocks are very compact, minerals can only be formed in their cavities and fissures; and it is easy to see that the latter do not differ from those formed in limestones and siliceous rocks under the same influence."

The structure of argillaceous rocks, however, has undergone, by metamorphism, very great transformation, in a thousand different ways. An argillaceous rock may, however, sometimes be seen in immediate contact with traps, without having undergone the slightest change. On the other hand, the structure of the former is often observed to have become polyhedral, pseudo-regular, spheroidal, or even prismatic —the prisms being formed of hard clay, which has shrunk, but which contains as much water as the original unaltered clay. Generally speaking, argillaceous rocks that have been modified by upheaving traps, &c., have become hard and lithoid, or stony, and have lost their water and the carbonates they contained originally. By contact with trap-rocks in which zeolites are abundant these clay strata have often been changed to *Pelagonite*, being penetrated at the same time by different species of zeolites, carbonate of lime, silica, and the minerals peculiar to the Amygdaloidal rocks. They have likewise become cellular and transformed into spilite, especially if they be calcareous, in which case they lose, by metamorphism, the greater part of their carbonates. In these cavities are seen, also, the minerals peculiar to Amygdaloids.

Argillaceous rocks have often been changed into *jasper* by the metamorphic action of certain traps. In this case they preserve, more or less, the marks of their original stratification, which are represented by parallel bands or veins. They have thus become hard, compact, and of bright and varied colours.

Porcelanite-jasper is observed in contact with basalt-rocks, its cha-

racters denote that it bears a great resemblance to Pelagonite. The metamorphism of argillaceous rocks into jasper is very frequent, and must not be regarded as a *silicatization*, for analysis shows that the jasper thus produced contains, in most cases, less silica than the rock from which it has been formed. The presence of alkalies in an argillaceous rock seems to have facilitated its metamorphic transformation. Hence *argilolite* has been more easily transformed than *clay*.

The minerals formed by metamorphism, added to the changes produced by artificial heat on clay rocks, show that during metamorphic action the temperature was tolerably moderate, and that water must have played as great a part as the contact of the eruptive rock.

We promised, in our last paper, to refer again to M. Castelnau's observations on the earthquakes of the Cape of Good Hope.

On the 14th of August, 1857, at half-past eleven at night, Cape-town experienced a violent shock, which was followed by two others of ten seconds' duration each. The whole phenomenon lasted about forty minutes, or rather longer, especially near the Table Mountain. The usual subterranean thunder was heard at the same time. Domestic animals appeared as frightened as the men.* Luckily, at the Observatory none of the instruments were disturbed.

This earthquake was felt 200 miles to the north, and 400 miles to the east of the Cape. The direction of the undulations seems to have been that of the meridian. The ships stationed in Table-bay all felt the effects of the shock, and the "Solertia," a vessel commanded by Captain Boisse, which, at the time of the earthquake, was one hundred miles south of Cape-point, was launched out of its course to the eastward.

The same observer informs us that these phenomena have been comparatively rare at the Cape of Good Hope. Since the commencement of the present century, we have only the following on record:—In the year 1809, a succession of shocks lasted from the 4th of December to the 24th of the same month. In 1811, an earthquake, felt on the 2nd of June, was described by Burchell, who says that a shock was also experienced in the preceding year. In 1843 a very slight motion of the earth's crust was observed. The most formidable of these, and

* See THE GEOLOGIST for July, 1858, p. 300. In reference to Boussingault's observations, recorded in this number, we will quote here Alexander von Humboldt's words on the same subject:—"To man," says this illustrious author, "the earthquake conveys an idea of some universal and unlimited danger . . . . We are accustomed from early childhood to draw a contrast between the mobility of water and the immobility of the soil on which we tread; and this feeling is confirmed by the evidence of the senses. When, therefore, we suddenly feel the ground move beneath us, a mysterious and natural force, with which we are previously unacquainted, is revealed to us as an active disturbance of stability. A moment destroys the illusion of a whole life; our deceptive faith in the repose of nature vanishes, and we feel transported, as it were, into a realm of unknown destructive forces. Every sound, the faintest motion in the air, arrests our attention, and we no longer trust the ground on which we stand. Animals, and especially dogs and swine, participate in the same anxious disquietude; and even the crocodiles of the Orinoco, which at other times are as dumb as our little lizards, leave the trembling bed of the river, and run with loud cries into the adjacent forests."—T. L. P.

perhaps the worst that the Cape ever experienced, was that of the 4th December, 1809. Among the curious effects produced by it, we will mention the following:—In Table-bay is now seen a fish belonging to the genus *Gadus*, and probably identical with that which Linnæus named *Merlucius*. It seems satisfactorily proved that the appearance of this species at the Cape immediately followed the formidable earthquake of which we speak; it was never seen or heard of in these latitudes before the 4th of December, 1809. Dr. Andrew Smith, in his *Illustrations of the Zoology of South Africa*, speaks of a similarly curious coincidence as regards another fish—the *King's Fish* (*Xiphiurus Capensis*), which, according to this author, "appeared in the precincts of the Cape after an earthquake; it is not mentioned which, but at all events it must have been a considerable time back, as the traveller, Barrow speaks of the *King's Fish* as being found near the Cape in 1797."

We read in an old Spanish proverb, that "things which are very singular are apt to become wonderful." But here are instances of like phenomena from another source:—At the destruction of Riobamba, in the year 1797, recorded by Humboldt, when the shocks were not attended by any outbreak of the neighbouring volcanos, "a singular mass called *Moya*," he says, "was uplifted from the earth in numerous continous, conical elevations; the whole being composed of carbon, crystals of Augite, and the siliceous shells of Infusoria." The same celebrated writer, speaking of the volcanos of the Andes, says, "Cavities, which are either on the declivity or at the foot of the mountain, are gradually converted into subterranean reservoirs of water, which communicate by numerous openings with mountain springs, as we see exemplified in the highlands of Quito. The fishes of these rivulets multiply, especially in the obscurity of the hollows; and when the shocks of earthquakes, which precede all eruptions in the Andes, have violently shaken the whole mass of the volcano, these subterranean caverns are suddenly opened, and water, fishes, and tuffaceous mud are all ejected together. It is through this singular phenomenon that the inhabitants of the highlands of Quito became acquainted with the existence of the little Cyclopic fishes (*Pimelodes Cyclopum*) termed by them prenadilla."

It has not yet been well ascertained whence come the numerous dead insects that Palmieri has often spoken of as filling up the mouths of *fumerolla* on Vesuvius, about the month of May or June, and which were observed again, as usual, last year.