Mr. Mallet's positive assertion that the "convex surface of a fracture (*i.e.* joint) *always* points in the same direction as that in which the cooling proceeded." That this mis-statement of the fact is not a casual error is shown by further passages, in which (page 183) it is asserted that if the cooling commences from the top surface of the bed, the "convex surfaces of the cross joints *all point downwards;*" whereas if the mass cooled from the bottom, the "convex surfaces of the joints of the lower prisms *point upwards.*" Mr. Mallet's theory, therefore, rests, unfortunately for him, upon a false assumption, which he might easily have ascertained for himself without stirring from London.

Mr. Mallet, however, may perhaps reply that his theory is correct, whether the assumption on which it rests be true or not, since I observe from an article in the latest number of the Proceedings of the Royal Society (162, vol. xxiii. page 444), that he still adheres to his preposterous notion of a Geyser underlying the volcanic vent of Stromboli,—even though it has been demonstrated to him that the steam and water tube required on this supposition must be at least 2000 feet in depth! He takes no notice, moreover, of the many arguments employed by me in the paper to which he refers,[1] against his theory, besides the height of the crater-floor[2] above the sea-level —any one of which is alone sufficiently conclusive as to its untenability.

NOTICES OF MEMOIRS.

Diatomaceæ in the Carboniferous Period.[3]

By Signor, Count, Abbot, Francesco Castracane.

(Translated by Miss L. H. Littledale, Dublin.)

So great is the importance of Coal, which constitutes the chief wealth of some favoured countries, and is the principal lever of England's power, that no one will wonder that its nature, its mineralogical properties, and the history of its formation, have claimed the attention of scientific men. This valuable substance, in which Nature has preserved to the feverish activity of our century the principal aliment of the metallurgic industry, of arts and commerce, has been the subject of the learned researches of many highly distinguished naturalists and geologists. They have examined the impressions of the many vegetable and animal remains which

[1] Geol. Mag. Dec. 1874.

[2] Bye-the-bye, why will Mr. Mallet persist in calling the bottom of the crater its "*fundus*"? *Fondo* is, no doubt, the word in use for it among Italian writers. But our own language possesses more than one synonym for the thing intended, any one of which would better express the idea to English ears. So, too, in the article on columnar basalt, the French word "couche" is always used by Mr. Mallet in lieu of our native synonyms of "layer," "zone," or "film," all equally expressive of his idea. Other writers, likewise, on volcanic subjects, still continue following the bad example set by Dr. Daubeny, in speaking of a "coulée" of lava, when they mean a "stream" or "current," words equally expressive of a once fluid or flowing mass.

[3] "Le Diatomace nella Eta del Carbone." Extracted from the Atti dell' Accademia Pontificia de' Nuovi Lincei," Rome, 27th year, 3rd session, February 22, 1874.

it contains, and have determined their genera and species; while, by cutting very thin slices of the coal itself, they have been enabled to study, with the aid of the microscope, its texture and minutest ingredients.

These researches did not, however, reveal the presence of some tiny little Diatoms which chanced to be there; thus it has been affirmed that Diatoms were not contemporaneous with coal; a distinguished German naturalist and micrographer having absolutely denied it to the author last summer, placing rather the first appearance of Diatoms at an infinitely more recent period. The only mention which came under my notice of the existence of Diatoms in coal was a quotation from *Acadian Geology* by the distinguished American naturalist, Dr. Dawson, referred to by Professor Huxley in a lecture given by him *On the Formation of Coal.* To prove the assertion that coal is not a subaqueous, but simply a sub-aerial formation, Dawson, amongst other arguments, says that "with the exception perhaps of some *Pinnulariæ* and *Asterophyllites*, there is a remarkable absence from the Coal-measures of any form of properly so-called aquatic vegetation."

On reading that quotation my curiosity was aroused in the highest degree; because, whilst ardently pursuing the study of Diatomaceæ, a strong conviction of their remote antiquity had fixed itself in my mind.

My wishes upon this subject were not influenced by any vain sentiment, but I felt the importance of such an argument in establishing a principle set forth by me on several occasions. Having discovered that in salt, fresh, and brackish waters the Diatomaceæ (together with sea-weeds and vegetables of a higher order) decompose the carbonic acid under the action of the sun's rays, and, assimilating the carbon, set free the oxygen which is the chief and indispensable element in animal respiration; and having experimentally found out that Diatoms, far from sustaining injury from the presence of animal substances in a state of decomposition, rather derive benefit from them—restoring, in short, the water itself to its original state of purity; I deduced from this the inference that in nature the first appearance of Diatomaceæ must have coincided with, if not preceded, the first moments of the existence of the primitive animal inhabitants of the water. The last time I expressed this opinion I added that sooner or later some rocks of Palæozoic age would, without fail, be met with to furnish indubitable proof of the presence of Diatomaceæ contemporaneous with the first animals that lived in the waters. But I was very far from thinking that only a few days after I had uttered this prognostic it would be actually verified. In a small residue collected from the incineration of a fragment of coal (given me as coming from Liverpool), carefully handled and placed for microscopic inspection, my satisfaction may easily be imagined when several Diatoms, perfectly distinguishable, presented themselves in the field of the microscope. In this way I was enabled to prove with all certainty what I had premised, viz. that Diatoms vegetated in the Carboniferous period, that is to say, with the earlier forms of animal life in the *Palæozoic ages.*

In spite, however, of this successful result, obtained by the most scrupulous attention and caution, to avoid the smallest possibility of mistake, I confess that (from perhaps excessive timidity) I hesitated to submit it to public opinion. I therefore resolved to await the result of a contra-proof which I should be able to have by trying again a small remaining piece of the same coal, not omitting to employ on each occasion a perfectly clean test-tube that had never been used before. I need not say what was my gratification at seeing some Diatoms again in the field of the microscope; thus confirming the correctness of my previous experiment. And as a final argument I will add that the forms I recognized and ascertained in the second experiment were either more or less identical with those of the first, so that there could not remain the least doubt of the presence of the Diatoms in *that* coal. Hence it stood proved upon evidence that they must have existed contemporaneously with the plants, the remains of which serve as fuel in furnaces, and give life and motion to the countless steam-engines which make distances vanish and promote commerce. The Diatoms that I met with in this coal chiefly belong to fresh-water genera and species, if we except perhaps a *Grammatophora*, a little *Coscinodiscus*, and perhaps an *Amphipleura*, which appeared to me to be the *A. Danica*. Amongst fresh-water Diatoms I have distinguished the following :—

Fragilaria Harrisonii, Sm. = *Dontidium Harrisonii*.
Ephithemia gibba, Ehrbg., Prz.
Sphenella glacialis, Prz.
Gomphonema capitatum, Ehrbg.
Nitzschia curvula, Prz.
Cymbella scortica, Sm.
Synedra vitrea, Prz.
Diatoma vulgare, Bory.

The influence of the sea, which is shown in the different shapes of salt-water Diatoms (although only single specimens presented themselves among the many fresh-water ones in the residue of the Liverpool coal), offers us an indubitable proof that the waters of the sea must have penetrated amidst the remains of that ancient vegetation.

To account for the presence of those few little marine forms among fresh-water Diatoms, I do not think we can admit the hypothesis that they were merely adventitious, as if carried thither by the wind. Although there can be no reluctance to acknowledge that such a transportation *could* take place, yet I do not find it possible to persuade myself that some valves of marine Diatoms which have been now and then detected in the atmospheric dust, may be precisely encountered amongst a small number of fresh-water Diatoms. It is to be added, moreover, that I do not remember ever having met with a notice of marine Diatoms being found in the atmospheric dust, whereas fresh-water forms are often spoken of.

It is truly an easy thing to understand how at the drying up of a pond the wind may sweep away from the surface the minute siliceous skeletons of Diatoms which have been growing there for generations; but one could not so readily understand how the same could happen to those of the sea. However, the fact that at the very remote period

of the coal formation Diatoms lived and formed a part of its flora, offers us, it appears to me, a most valuable opportunity of making an observation of much greater import.

However little any one may be accustomed to the contemplation of nature, it is easy to recognize how the various organic types can to a certain extent be modified by the influence of climate and other circumstances under which they are living. Nevertheless, the effect of such influences is so much less perceptible, and the consequent modification so much slighter in proportion as the type occupies a more elevated position in the organic scale. Now, although, when disserting last year upon the structure of the Diatoms, and the various parts and substances which compose them, as well as the marvellous ornamentation to be admired in their valves, I allowed myself to be carried away by enthusiasm for these wondrous organisms, so far as to say [1] that "the Diatoms, far from being such humble little plants as to deserve banishment among the lowest organizations of the Vegetable Kingdom, have a far better right to be looked upon as forms as noble in their structure and perfect arrangement as they are marvellous for their minuteness," it is nevertheless true that, *organically* considered, they must be acknowledged simpler than and therefore inferior to the humblest mosses and vascular plants. Nevertheless, who could have expected (on the supposition that Diatoms have been growing from the time of the first dawn of life upon the earth, in such enormously long evolutions of centuries, and in the succession of ever new states of temperature and climate) that they would not at least have been greatly changed? All the forms I have been able to observe amongst the few ashes of the before-mentioned coal present such an appearance that the most practised and sharpest eye could not detect the slightest difference between them and actually living Diatoms. In outline, structure, shape and number of the flutings,—in short, in all the peculiarities which characterize the species that we meet with in a state of actual vegetation,—the Diatoms of the Carboniferous and Palæozoic periods agree exactly. In such immeasurable succession of centuries, organic life under this most simple and primitive form since its appearance upon the globe (notwithstanding the tremendous catastrophes which have altered the condition of its surface) has not experienced the slightest change, and remains unaltered up to our day: so true is it that upon each organic type Nature has imposed an immutable law which restrains it within its own limits.

But the successful result I obtained from the examination of the Liverpool coal, and the discovery of Diatoms contemporary with its formation (thus conclusively proving the existence of Diatoms in the Palæozoic epoch), revived my desire to institute a similar research through coal from other sources. Otherwise it might be questioned by some whether the Diatoms found in the chip of Liverpool coal had not simply adhered to it by accident, without being contemporary with its formation: as it might happen that Diatoms should

[1] See my note "On the Structure of Diatoms," Atti dell' Accad. Pont. dei Lincei, Anno 26, 19 Gennaro, 1873.

accidentally be discovered upon the surface of granite, or any other older rock, without any one assuming that they grew in the period of the granite's formation.

Such objections did actually occur to my mind; they lost all force, however, by the reflection that the scrap of coal upon which my examination had been made came out of the solid mass of that mineral, and not from off the surface; besides, the piece from which it was detached is preserved in the Mineralogical Cabinet of the "Sapienza" in Rome, and thus the discovery made by me may be controverted by other people at any time.

These examinations are rendered easy to me from the special arrangement of my microscope, which is such that it enables me to be sure of having examined in turn each point of the entire substance, giving me, besides, leisure to mark the position of the smallest form whatsoever, in order to be able to find it again at any moment. After having fully determined the fact of the presence of Diatoms in the Liverpool coal, I resolved to ascertain whether the same could be detected in coal from other sources. With this intention I have up to the present time made analogous investigations upon three other samples obtained from the before-mentioned Mineralogical Cabinet. One is from the mines of St.-Etienne, another came from Newcastle, and the third was a fragment of the so-called "cannel-coal" of Scotland. Not a single one of these different substances failed to reveal Diatoms in greater or less numbers. Of these I did not remark any that were not fresh-water; nevertheless the species varied in each. The forms I found did not give me occasion to note any novelty whatsoever, while there was not one among them of which I would have hesitated in declaring that it was a living form. Thus the presence of Diatoms (which seemed to me such a great fact to have been able to prove in the Liverpool coal) showed itself persistently in the three other different kinds, so that I begin to suspect that *perhaps* Diatoms accompany every stratum of coal.

From the presence of Diatoms in coals not only does the principle established by me of the necessity of Diatoms in water to maintain animal life stand confirmed, but we have a new subject of study in recognizing the highly important part which Diatoms and microscopic life have ever played upon the earth.

From all this arises the necessity of the geologist directing the greatest attention to whatever traces remain to us of these minute beings which had so much share in the history of the globe.

I am encouraged to hope that these observations of mine, or at least the fact proved by me of the presence of Diatoms in coal, will not be regarded as undeserving attention by some geologist or micrographer. It will be most gratifying to me if my remarks and experiments, under the direction of some more competent person, prove any advantage to science. In that case, in order to facilitate the task still more to any one less expert who may wish to undertake such an examination, I shall add a hint as to the process followed by me in conducting these researches. The course to pursue is decided by the flinty nature of the Diatom-valves, and in order

to separate them from the mixture of calcareous or organic matter with which they are found united, it is usual to put the whole into a glass test-tube with hydrochloric acid, adding caustic potash from time to time, keeping all slowly dissolving by heat, in order to isolate the silex, destroying the remainder. But in unburnt coal it is too difficult to dislodge the carbon, and the acids have little effect upon it. I must, however, refer to the calcination I effected by grinding up the substance, and then, collecting it in a china vessel, placed upon a stove in a glass tube, subjecting the whole to the action of the heat, while, at the same time, a slight current of oxygen crossing the tube combined with the carbon in creating carbonic acid.

Experience has taught me, however, the necessity of conducting this operation at a lower temperature, in order to prevent the alkaline or earthy bases and metallic oxides, which may be amongst the ashes, from forming vitreous silicates by melting and mixing with the valves of the Diatomaceæ. It is also well to leave the glass tube, in which the fusing is going on, uncovered, in order to watch its progress. The small residue obtained through this process is to be put into a clean test-tube, adding nitric acid and hydrochloric acid, and caustic potash, assisted by the heat of a lamp to eliminate any alkaline or earthy base, and every trace of metallic oxides. The last operation over it only remains to wash repeatedly with distilled water the very light dust which is left behind, letting it stand for some hours each time to settle, in order to be sure of not losing the smallest particle of it in pouring off the water.

Those who follow this method exactly cannot fail to succeed. The object may then be mounted with Canada Balsam, or in any other suitable medium: and steadily and closely watching it under the microscope, they will not be long before they see some valves of Diatoms, entire or broken.

If any investigator wish for fuller information, I shall have great pleasure in gratifying him, and will consider myself honoured by his applying to me.

REVIEWS.

I.—An Abstract of the Geology of India. By Prof. P. M Duncan, F.R.S. (London, 1875.)

THIS Abstract is a useful addition to geological literature. Without any pretension to a general treatise on the subject, and consisting merely of geological facts, with no sections or illustrations, it is intended as a text-book for the students of the Indian Civil Engineering College, where Geology is fortunately recognized as a necessary part of their education, and as an advantage to their future career. The late Mr. Greenough had collected a vast amount of material, which he used in preparing his large geological map of India in 1854, a reduced copy of which, with notes, appeared in 'Petermann's Geogr. Mittheilungen' for 1855. But this knowledge has been considerably increased by the subsequent labours of Carter, Drew,