VI.—NOTE ON THE SYSTEMATIC POSITION OF GRAPTOLITES, AND ON THEIR SUPPOSED OVARIAN VESICLES.

By WM. CARRUTHERS, F.L.S.

ANY observations which can throw light on the systematic position of the *Graptolitiæ* are of great importance. That these anomalous fossils are Zoophytes, in the wide sense of the term, is almost universally conceded; the difficulty is in determining whether they are coelenterate or mollusoid. Those who have described the members of the family have almost invariably considered them to be hydrozoa, and it must be allowed that in general aspect they very much resemble *Plumularia* and *Sertularia*. But when their structure is examined it will be found that they widely differ from any known hydrozoon, and especially in that the entire polypidom is composed of the different polype-cells, without any distinct common canal. Sometimes the polypes rise from a common substance which extends along the whole of the celluliferous portion of the organism, but there is no constriction or septum at the base of the cells, cutting off this common substance from the individual polypes. This is the structure of *Graptolitus priodon*, Bronn. In other species the walls of each cell seem to be continued to the solid axis, as is the case most probably in *Graptolitus sagittarius*, L. and certainly in some of the species with a double series of cells, as *Diplograpsus folium*, His. *D. pristis*, His. and *D. cometa*, Gein. The mouths of the cells are frequently furnished with one or more long spines, as in some species of *Bastrites*, and in *Diplograpsus pristis*, His. In these characters the graptolites show a greater affinity with the polyzoa. Compare the genera *Scraparia* and *Bicellaria*. But there are some peculiarities which do not well agree with the living forms of either section of zoophytes. Among these may be mentioned first the prolongation of the solid axis in both the unilateral and bilateral forms beyond the celluliferous portion in the newer part of the polypidom, and then their free polypidoms, for neither the spines which terminate the older portion of some species of *Diplograpsus* nor the slender base of *Dendrograptus linearis*, Car., could be radicles, and the species of the genus *Graptolitus* have no indications of a hydrorhiza from the older extremity.

Any information as to the method of reproduction would greatly assist in forming an estimate of their affinities. In the November number of this journal (Vol. III. p. 488), Mr. H. A. Nicholson drew attention to some minute organisms from the graptolite shales of Moffat, which he supposes to be the ovarian vesicles of Graptolites. I have in my collection two or three distinct forms of these capsules, and I have considered (perhaps wrongly) the fossils figured by Mr. W. H. Baily in the explanation to sheet 133 of the Irish Survey, p. 12, as another form. Thinking they might be ovi-sacs, I have for many years been carefully looking out in my quarryings in the Moffat shales for any indication of the connection between the organisms and the graptolites. In shales where every fossil is almost always compressed to a mere film, and the remains are confusedly scattered

over the surface of the laminae, mere juxtaposition, without a traceable union, is of little importance. I believe the specimen figured by Mr. Nicholson, which was the only one he observed, is a case of mere juxtaposition. If we are to be guided in our interpretation of these organisms by the structure and relation of parts in recent forms, it will be difficult to find an ovarian vesicle attached by a large mouth to the polypidom, or having the relation to two cells which is shown in Plate XVII. Fig. 3 (l.c.), and we do not know any hydrozoon which has "corneous 'gonophores'" that become "free swimming 'zooids.'" Supposing the minute fossils to be ovarian vesicles, we would be inclined to consider the elongated mucro to be the pedicel. The broad end is always very faint, indicating that the wall of the capsule was thinner at this place. Indeed the fossil remarkably resembles the gonophore of *Sertularia operculata*, L. except in the great difference in size. If it belonged to the graptolite, we should expect a similar relation to the supporting organism. In *Sertularia* the ovi-sac has a very simple structure. In the allied genus *Plumularia* the sac is composed of the polype-calls of a branch specially altered for this purpose, as was shown by Edward Forbes. It consequently occupies the position of the branch, but in *Sertularia* the sac rises from the surface of the common canal and does not interfere with the symmetry of the parts. I have never been able to detect in any graptolite the suppression of a cell, far less of a series of them, that would indicate their possessing a vesicle having the structure of those of *Plumularia*, nor have I seen on the polypidom of the fossil any scars that could have been produced by the fall of the capsule. The organisms that Hall found on a species of *Diplograpsus* have a very different aspect from those found at Moffat. He believes that the contents of the ovi-sacs were minute graptolites like the parent. He figures a small specimen very near to the mouth of a sac, from which he considers it has just escaped. This also would be anomalous in hydrozoa. In the volume of the Proceedings of the Royal Physical Society of Edinburgh, published in 1858, I figured a young specimen of my *Diplograpsus tricornis*, which seems to be the same species as that subsequently figured by Hall under the name of *G. Whitfieldii*. I have traced its growth from the youngest condition where the three spines were at the proximal end, and the slender solid axis at the distal, and only a delicate membrane expanded between without indication of cells. As the organism grew the cells appeared, and gradually developed around the free portion of the axis. I have noticed a similar growth in *D. pristis*, His., and I believe also in *D. cometa*, Gein., a beautiful species not uncommon in the Moffat shales. It would be an important observation if anything like these younger forms could be detected in the interior of a capsule, but in the hundreds I have examined I have seen no indication of their contents; and in the innumerable specimens of double graptolites which my hammer has laid open, I have never seen anything like what Hall has figured.

The oval or rounded bodies which Mr. Nicholson figures are most

probably specimens of *Siphonotreta micula* which occur in these graptolitic shales. His description and figures, as far as they go, correspond with M'Coy's fossil, which I have found at Garple and elsewhere in Dumfriesshire.

NOTICES OF MEMOIRS.

I.—THE FOSSIL FISH OF MOUNT LEBANON.¹

THE fossil fishes of Mount Lebanon appear to have been first noticed in the time of the Crusaders, and subsequently by the travellers Korte, Lebrun, Volney, and mentioned by Scheuchzer, in 1708. They were first scientifically described by Blainville, who noticed two species, and afterwards by Agassiz, Sir Philip Egerton, Heckel, and Pictet. New researches on these fishes by MM. Humbert and Pictet have been published at Geneva, illustrated by 19 plates. By these authors the fishes are considered to belong to the Cretaceous period, from the great number of Teleostean fish and the absence of Ganoids,—from a certain number of genera or groups which exclusively characterize the Cretaceous period—from the great number of extinct genera which give a special physiognomy to these faunas, such as at Hakel, the *Pseudoberyx*, *Petalopteryx*, *Coccodus*, *Aspidopleurus*, and *Cyclobatis*, and at Sahel Alma, the *Pycnosterinx*, *Cheirothrix*, *Rhinellus*, and *Spaniodon*, and lastly, from the fact that the genera which have living representatives are the most abundant at Lebanon, such as the types of the *Beryx*, the *Clupea*, and *Chirocentrites*, which are more or less eminently Cretaceous, or have their commencement in that period.

From a general comparison of the fish fauna of Hakel with that of Comen in Istria,—of the fauna of Sahel Alma with that of the Westphalian Chalk, and both of them with the Cretaceous fauna of England, the authors consider that the fishes of Lebanon belong to the Middle Cretaceous period.

In reviewing this fauna palæontologically, or in relation to the previous Jurassic and subsequent Tertiary periods, some interesting facts appear. Taking the classification of fishes by J. Muller, but three of his sub-classes have fossil representatives, the Elasmobranchs, Ganoids, and Teleosteans. The latter being generally considered to have first appeared in the Cretaceous period, but the genera *Tharsis*, *Leptolepis*, etc., are now recognised as Teleosteans, and related to the *Halecoides*,—fishes which possess in a high degree the normal characters of the class, and of which they represent somewhat the archetype. The Elasmobranchs are not abundant at Lebanon, the principal forms belong to sharks and rays. The Ganoids are not represented in this fauna, for the Hoplopleurides are not true Ganoids. The third sub-class, the Teleosteans, are the most important, and constitute nearly the whole of this fauna. Of this sub-class, the *Halecoides* contain nineteen out of fifty-one species;

¹ Nouvelles recherches sur les Poissons fossiles de Mont Liban, par MM. F. J. Pictet et A. Humbert, Geneva, 1866.