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XXXIX.—*On a Specimen of Diplograpsus pristis with Reproductive Capsules.* By JOHN HOPKINSON, F.G.S., F.R.M.S.

IN looking over a few Graptolites which had recently been received by Mr. Etheridge at the Geological Museum, I detected a specimen which appeared to be a *Diplograpsus* bearing reproductive capsules. About half of the graptolite as it is now seen was visible; and this portion showed the reproductive organs, but no hydrothecæ, the proximal end being imbedded in the shale. On clearing away the shale, the specimen, which Mr. Etheridge kindly lent me for examination, proved to be a tolerably well-preserved impression of *Diplograpsus pristis*.

The graptolite appears as a silvery pyritous impression on the surface of the shale. The proximal termination is indistinct. A slender radicular process, continuous with the solid axis, can just be made out. At the distal end the shale is broken right across the polypary, which here shows no signs of coming to a termination. One inch only is exposed.

The solid axis is clearly seen throughout. The hydrothecæ, towards the proximal end, are very distinct; the apertures of those on the left-hand side are clearly seen, extending partly over the periderm, while those on the right-hand side are partially hidden. There are twenty-four in the space of an inch. Towards the distal end the apertures only of a few of the hydrothecæ are seen; they appear as "scalariform impressions" on the surface of the polypary.

The reproductive organs, which I consider to represent the gonothecæ of the recent Sertularian zoophyte, are developed almost immediately opposite each other from each side of the periderm and throughout its whole length. Though at equal intervals from each other, they are in no even numerical relation to the hydrothecæ, there being ten to the inch. They appear to have budded from the periderm at right angles to

the hydrothecæ, and thus have caused the polypary to be unevenly compressed. The most perfect are pear-shaped in form, 1-6th of an inch long, and at their narrow end, by which they are attached, about 1-30th of an inch wide. They have apparently been bounded by a single marginal fibre, which is slightly thickened at its edges, and, where the pyrites is removed, has impressed a fine double groove on the surface of the shale. If the fibres were slender tubes, this appearance would naturally be presented; for their outer margins would offer the greatest resistance to compression. The so-called solid axis of the graptolite frequently presents a similar appearance. At the proximal end of the polypary these fibres only are preserved, the oldest or first-formed gonothecæ having fulfilled their function and perished. The distal extremity of even the most perfect is not clearly defined, the impression of the capsule in most cases becoming gradually less perceptible from the proximal to the distal end. Sometimes the capsules are irregularly ruptured, their torn jagged edges being distinctly seen, while one has split along its marginal limit, along the line of the marginal fibre, which appears to have parted abruptly near the distal end of the capsule at one side, and split acutely for some distance along the other side. This would appear to indicate that the capsule may be composed of two membranes joined together at their edges, through which the fibre, if it be not merely a tube formed by a kind of double marginal seam, has run. In no case can a distinct unruptured distal orifice be traced.

The gonothecæ present other peculiar appearances. Towards their proximal end they are sometimes longitudinally corrugated or crumpled, or traversed by fibres which extend for some distance into the body of the polypary. Some are much twisted and bent about, occasionally overlapping each other. Between two which thus overlap, or perhaps only

Fig. 1.

Diplograpsus pristis
with reproductive capsules.
Magn. 3 diameters.

come into contact with each other, just at the point of contact and apparently within one of the capsules, are two minute young graptolites, one lying across the other. Each consists of a thin membrane, probably forming the first partially developed pair of hydrothecæ, a minute radicle, and a slender solid axis which is prolonged beyond the membrane. They are similar in form and proportions; but one is a little larger than the other. Its length, from the extreme point of the radicle to the distal end of the axis, is 1-20th of an inch. The membrane itself is about half this length, and 1-60th of an inch wide, tapering towards the proximal end. The smaller specimen is 1-30th of an inch in entire length, and 1-80th wide. If these young forms had not been in connexion with a mature graptolite, they would have been considered to belong to the genus *Diplograpsus*, but it would have been impossible to refer them to any species. In their present position I think we may without hesitation infer that they are the young of the graptolite with which they are associated. That they have not yet entered upon independent existence we cannot conclude; for they are in different stages of growth, and young graptolites are frequently met with in a less advanced state than either; indeed on the same piece of shale there are several young graptolites referable to the same species, and no more developed, some even less so.

Fig. 2.

Young graptolites.
Magn. 6 diams.

This is the only graptolite with undoubted reproductive organs yet known to have been found in Britain. In America, however, Professor James Hall has detected diprionid graptolites with what he describes as "reproductive sacs" or "ovarian vesicles." These are figured and described in his 'Graptolites of the Quebec Group.' In Britain Dr. Nicholson has described and figured, in the 'Geological Magazine,' monoprionid graptolites with what he has termed "grapto-gonophores." If these should prove to be, as Dr. Nicholson believes, the reproductive *buds* of graptolites, the monoprionid graptolite is reproduced in a totally different manner to the diprionid; but I think we have as yet had no sufficient evidence brought forward to prove that these problematical bodies have even any connexion with graptolites. The discovery of this specimen throws no light upon this mode of reproduction. It affords, on the other hand, a decided confirmation of Hall's observations; and as his views have not been generally accepted, the specimen is perhaps of more value than if it were unique. The reproductive sacs figured by Hall are essentially similar to the gonothecæ I have

here described; upon the surface of the shale on which they occur there are numerous young graptolites in various stages of growth; and in one specimen figured, "in connexion with one of the sacs there are two minute germs, one of them lying beneath the sac, and the other just beyond its outer margin and barely separated from its fibres"*.

The presence of these reproductive capsules throws some light upon the affinities of graptolites. It confirms the evidence which their internal structure has already furnished, of their near alliance with the Hydroida. The reproductive organs of the Actinozoa and of the Polyzoa being internal, graptolites cannot, as some think, belong to either of these classes. In the Hydrozoa they are external; and in some of the Hydroida (the only subclass of the Hydrozoa with which graptolites, having a chitinous polypary, can be compared) there are reproductive capsules essentially similar to those of the graptolite, although in no single instance entirely agreeing with them. We have no single recent Hydroid with reproductive organs enclosed in chitinous capsules which are destitute of any distinct orifice, are bounded by a marginal fibre, or composed of two membranes united at their edges, and at the same time bud from the periderm without interfering with the continuity of the hydrothecæ; but these appearances are all presented by one or other of the Hydroid zoophytes. In *Sertularia*, *Diphasia*, &c., the gonothecæ bud from the periderm in the same manner as in the graptolite; in several genera they are ribbed or thickened at their edges, and in one genus, if not in more, they have no definite distal orifice. In *Aglaophenia*, I have been kindly informed by the Rev. Thomas Hincks, the gonotheca "is oval in form, without orifice, and bounded by a very thin and delicate chitinous wall."

I need only add that graptolites, having, as is here shown, true gonothecæ as well as hydrothecæ, are most nearly and intimately allied to that order of the Hydroid Cœlenterata known as the Thecaphora or Sertularina.

The specimen which has formed the subject of these remarks was collected by the Geological Survey of Scotland, at Leadhills, Lanarkshire, along with a series of fossils which parallel the rocks of this locality with those of Moffat, Dumfriesshire, or with the Llandeilo Flags of Wales.

* Grapt. Quebec Group, expl. pl. B. fig. 8.