

something new; we are still lending a helping hand to that science which all of us may be proud of.

It will be my endeavour to give you further information regarding the higher fossiliferous strata in our parish.

II. *Notes on some New Fossils (Eurypterus Scouleri, &c.) from the Tuedian or Passage Beds of Berwickshire.* By Mr DAVID PAGE.

III. *Notes on the Brachiopoda from the Upper Silurian Rocks of the Pentland Hills. (Illustrated by Specimens.)* By Mr THOMAS DAVIDSON, F.G.S., F.R.S. Communicated by Mr JOHN HENDERSON.

Thursday, 21st March 1867.

Mr DAVID PAGE, President, in the Chair.

The following Communications were read:—

On a New Genus of Graptolites, with Notes on Reproductive Bodies.
By HENRY ALLEYNE NICHOLSON, D.Sc., M.B., F.G.S., Baxter Scholar in the Natural Sciences in the University of Edinburgh. (With Plate.)

The Graptolite which I am about to consider is perhaps one of the most remarkable of all our known British forms, and was originally described by Mr W. Carruthers,* under the name of *Cladograpsus linearis*. The genus *Cladograpsus* is one which was proposed by Geinitz to include certain forms of *Didymograpsus*; but Mr Carruthers seems subsequently to have seen that the reference of *G. linearis* to this genus was inappropriate, as he had recently alluded to it,† under the title of *Dendrograpsus linearis*. The genus *Dendrograpsus* of Hall includes certain branching Graptolites, which are peculiar to the Quebec group in America, and which do not occur, as far as is yet known, in the Skiddaw slates—our undoubted representative of the Quebec series. The genus, in fact, appears to be characteristic of the lower Llandeilo period, the only known British species—the *Dendrograpsus furcata* of Salter—occurring in rocks of this age in Wales.‡ The

* Annals and Magazine of Nat. Hist., vol. iii. No. 13.

† Geol. Mag., vol. iv. No. 2, p. 70.

‡ Mem Geol. Survey, vol. iii.

generic characters of *Dendrograpsus* are the possession of a strong foot-stalk, sub-dividing more or less dichotomously into numerous branches and branchlets, which are but slightly divergent. Neither the main stem nor the primary branches are celluliferous, and the whole forms a "broad, spreading, shrub-like frond."* *Dendrograpsus*, in fact, more nearly approaches in external appearance to some of the hydroid polypes of our own seas than, perhaps, any other of the true Graptolites. In referring *G. linearis* to *Dendrograpsus*, Mr Carruthers appears hardly to have appreciated its peculiar and perfectly unique character, and an examination of a large number of specimens has led me to the conclusion that it cannot possibly be ranged with any genus yet described, but that it must be considered as constituting the type of a new genus, which I propose to term *Pleurograpsus*, and of which the following are the generic characters:—

Pleurograpsus, gen. nov. (Plate, figs. 1-5).—Entire frond consisting of two celluliferous stipes, diverging horizontally, or nearly so, from a common point (which is usually radicate), and giving off branches at uncertain intervals, sometimes from one side, and sometimes from the other, with an irregular alternation. Both the main stem and the branches are uniserrate, or monoprionidian. Branches coming off, usually, nearly at right angles, extending for a considerable distance, and sometimes giving off secondary branches, in a manner strictly analogous to that seen in the parent stipes.

If we imagine a long *Didymograpsus*, such as *D. flaccidus*, Hall, extended into a straight line, and giving off branches from both sides nearly at right angles, these in some cases again, and similarly, subdividing, we shall have some idea of the general plan of *Pleurograpsus*. The existence of secondary branches seems not to have been noticed by Mr Carruthers; but, though rare, I have observed them in a well-marked form in more than one specimen. Even tertiary branches may possibly exist, though I have never seen any traces of them. The parent stipes diverge from an initial point, round which the parts of the frond are grouped with something like bi-lateral symmetry, and which is usually marked by a long and slender radicle (fig. 2). The radicle is, however, not infrequently absent or inconspicuous (fig. 3), when the base of the organism is only to be detected by the existence in the main stipe of a point, from which the denticles are given off in different directions. The absence or presence of the radicle is not, however, a matter of generic importance.

From the description I have given it will be evident that *Pleurograpsus* presents us with a compound Graptolite, branching in a manner totally distinct from that known in the complex ramose species of the Skiddaw slates and Quebec group, and equally different from any hitherto described species from other formations. The essential point of distinction lies in this, that in all the genera of the branching Graptolites yet described (with the exception of the *Didymograpsi*), there is a non-celluliferous stem—the "funicle" of Hall—of which the celluliferous branches are secondary or, rarely, primary offsets. In *Pleuro-*

* Hall, "Graptolites of the Quebec Group," pp. 126, 127. Plate xvii.

grapsus, on the other hand, the primitive parent stem is itself celluliferous, and is therefore functionally distinct from the "funicle," as defined by Hall; the latter, if represented at all, finding a rudimentary homologue in the radicle of *Pleurograpsus*. This total absence of the funicle in *Pleurograpsus*, alone of all the branching Graptolites, is of itself sufficiently important to constitute a generic character, and a distinction of equal weight is found in the mode of branching. The compound Graptolites of the Quebec group either radiate from a central, non-celluliferous, branching funicle, as in *Dichograpsus*, *Tetragrapsus*, and *Retiograpus*, or divided repeatedly from a basal non-celluliferous stem, or foot-stalk, as in *Dendrograpsus* and *Callograpsus*. The only Quebec species which show any affinity to the genus *Pleurograpsus*, as above defined, are *Graptolithus Richardsoni*, and *G. ramulus*,* which are placed by Hall in his extremely comprehensive and ill-defined genus *Graptolithus*. It is very possible that these might, with propriety, be grouped under *Pleurograpsus*; but such an arrangement would at present be premature, as they are only known in part. Leaving the Skiddaw and Quebec group, one branching complex form alone remains for consideration, and this—the *Graptolithus gracilis* of Hall—is found in the Utica state of America.† This small but beautiful Graptolite has lately been recognised in Ireland, and I am informed by Professor Harkness that it is probably identical with the *Rastrites Barrandi* described by himself from the Dumfriesshire shales.‡ It should form the type of a new genus, and is at once distinguished from *Pleurograpsus* by the possession of a non-celluliferous stem, or "funicle," from which celluliferous branches are given off with perfect regularity and on a definite plan.

The genus *Pleurograpsus* cannot at present be asserted to contain more than a single species, viz., *P. linearis*; some specimens are more robust in their habit than others, and some, as I have said, subdivide more than once; but I think these should be considered as mere varieties.§

Pleurograpsus linearis, Carruthers, sp., spec. char.—Frons spreading and compound, consisting of two stipes diverging usually from a long and slender radicle, and giving origin to primary, and sometimes secondary, branches in the manner described under the genus. Both the main stipes and the branches are monopronidian, narrow at their origin, and gradually widening out, till a breadth of nearly one-twentieth of an inch may be attained. The main stipes appear to terminate by curving upwards in the

* Hall, *op. cit. supra*, pp. 107, 108. Plate xii.

† Pal. New York, vol. i. and iii.

‡ Quart. Jour. Geol. Soc., vol. xi.

§ Since the above was written I have come across a small Graptolite in the Skiddaw slates, which I think is referable to the genus *Pleurograpsus*. I shall, however, reserve the description of this species for the present, as belonging more properly to a paper which I am preparing on the Graptolites of the Skiddaw series.

manner of a branch. Solid axis usually invisible, or seeming sometimes to exist as an impressed line along the back of the stipe. Common canal well-marked, about half the breadth of the stipe. Cellules eighteen to twenty in the space of an inch, narrow, inclined to the direction of the axis at a very small angle. Denticles remote, angular, projecting slightly beyond the margin of the stipe; their upper margins at right angles to the axis, and extending about half-way across the breadth of the stipe (Plate, figs. 1-4).

Loc.—Hart Fell and Glenkiln Burn, Dumfriesshire.

The length of this beautiful and very remarkable Graptolite appears to have been almost indefinite, and Mr Curruthers states (*op. cit. supra*), that he has succeeded in tracing one specimen for nearly three feet. In connection with this species I have observed a very curious phenomenon, which is of importance, if duly confirmed by further researches. In a specimen kindly lent me by Mr D. J. Brown, of Edinburgh, the stipe is studded with small rounded tubercles, about as large as the head of an ordinary pin, and apparently springing from the common canal on either side (Plate, fig. 5). As nothing of this kind normally exists in any Graptolite, I am inclined to believe that we have here an instance of ovarian vesicles in their young condition, which may either remain permanently attached, or may possibly become free at a later stage. If this conjecture should prove to be correct (and it is difficult to see to what else these bodies could be referred), it will form another, and a strong confirmation of the view that the Graptolites should be classed among the Hydrozoa. I am, however, bound to admit that this is the only instance in which I have succeeded in detecting these bodies, so as to be able to speak with certainty as to their existence. I certainly think I have seen similar tubercles in other specimens of *P. linearis*, and also in *Diplograpsus bicornis*, Hall; but the difficulties of observation are very great, and I should not like to make any positive assertion on this point.

This leads me to make a few remarks upon the bodies recently described by myself, as being probably the "gonophores," or ovarian vesicles, of Graptolites (Geol. Mag., vol. iii. p. 488, Plate xvii.), concerning which I have been fortunate enough to obtain further and more conclusive evidence, in a series of well-preserved specimens. When perfect, and compressed laterally, these bodies are oval, bell-shaped, pyriform, or rounded, provided with a mucro at one extremity (the proximal?), and surrounded entirely by a filiform border resembling in texture the axis of a Graptolite (Plate, fig. 8). When more advanced in growth the capsule apparently ruptures, and the distal margin then becomes ill-defined and irregular, owing to the destruction and absence of the border above mentioned (Plate IV. fig. 9). When compressed from above downwards, the mucro is to be found somewhere within the circumference, as an elevated point surrounded by several concentric, circular, or elliptical rings (Plate

figs. 10, 11). The resemblance in these cases to orbicular Brachiopods is purely mimetic and illusory, and could not deceive any one who had examined a large series of specimens. They are at once distinguished by their often large size, by the irregularity of the concentric rings, by the variable position of the mucro—which is sometimes centric, sometimes eccentric—and by their total want of any persistent figure, outline, or striation; while their texture is graptolitic, and entirely different from that of any Brachiopod, such as the *Siphonotreta micula*. In the case of that variety—if variety it be—of *Graptolites Sedgwickii*, described by Professor Harkness* under the name of *Rastrites triangulatus*, I believe I have now made out with certainty that these capsules are reproductive in function, having obtained them in attachment in such numbers, and under such circumstances as seems to preclude the possibility of accident. They seem, however, to become detached before they attain their full growth and size; and the specimen which I figured in the paper I have alluded to,† appears really to have been an instance of mere juxtaposition. The mucro would seem to be the point of attachment, and the organ whereby it is effected, as we might expect from analogy; but I have no certain evidence in support of this view. The capsules apparently arise from no absolutely constant point of origin, some springing from the common canal (Plate, fig. 16), others from the apex of a cellule (Plate, figs. 14, 15), and others from the under-surface of a cellule (Plate, figs. 13, 14), the last two modes being the most frequent. The largest capsule which I have seen attached in this way has not measured more than one-tenth of an inch in diameter, many being much smaller. After attaining this size they seem to become detached; numbers, often nearly half an inch in length, occurring in this condition in the shales, along with innumerable germs. The sequence of phenomena thus described has not been observed by me in any other Graptolite except *G. Sedgwickii*; but it accords perfectly with the excellent description and figures given by Hall of the reproductive process in *D. Whitfieldii*.‡ I have myself, in many instances, seen bodies essentially similar to those described by Hall, though not so well preserved, attached to the stipe of this same species from the Dumfriesshire shales, and their occurrence appears to me to be inexplicable, except on the hypothesis that they are reproductive.

In certain other beds in the same locality (viz., Garple Linn), in which *G. sagittarius* is the prevailing form, to the almost total exclusion of *G. Sedgwickii* (*Rastrites triangulatus*), and in which the capsules occur in the greatest profusion, I have, nevertheless, failed to detect any organic connection between the two. I

* Quart. Jour. Geol. Soc., vol. vii.

† *Op. cit. supra*, Plate xvii. fig. 8.

‡ Graptolites of the Quebec Group, p. 38. Plate B. figs. 6–11.

should be inclined to explain this by the belief, that the gonophores of *G. sagittarius* were thrown off when still extremely minute, subsequently attaining their full development. This view is borne out by the occurrence of these bodies in all stages of growth, from small rounded bodies, not bigger than a pin's head, up to nearly half an inch in length, and it is further supported by analogy with many of our recent Hydrozoa. I may observe, too, that in the rare instances in which *G. Sedgwickii* is found in this bed, the capsules are found attached just as in the specimens from the beds in which it is the dominant species. If this view is not correct, it is still possible that in the case of *G. sagittarius*, and, perhaps, other species, the gonophores were attached to the sides of the polypites, or to "gonoblastidia," as in many living Hydrozoa. In this case the capsules would, of course, never be found in organic connection with the Graptolites in a fossil condition. Another difficulty is presented by the existence of beds like those of Hart Fell, where Graptolites are very abundant, but where the capsules do not appear to occur at all. Here, however, all, or almost all, the known species, except *Pleurograpsus linearis*, are referable to the genera *Diplograpsus* and *Didymograpsus*, whilst *G. sagittarius*, *G. Sedgwickii*, and other common monoprionidian species are, as far as my experience goes, totally absent. In the case, then, of the Hart Fell species, such as *Diplograpsus pristis*, *D. teretiusculus*, *D. mucronatus*, *Didymograpsus flaccidus*, *D. sextans*, &c., it might be assumed, with some probability, that the gonophores were unprovided with a corneous envelope, and were therefore incapable of leaving any traces of their existence. I do not, of course, assert that this absolutely was the case; I merely start it as an hypothesis, capable of explaining the apparent absence of the capsules in certain localities. Whilst cases such as the above occur, it should be borne in mind that the capsules have never yet been found except in rocks where Graptolites abound; whilst they present the most striking similarity in form to the gonophores of many recent Hydrozoa. Further, if the capsules do not stand in some relation to the Graptolites, but are to be considered as independent organisms, it appears to me that the palæontologist will be compelled to create a new family for their reception; since, I venture to say, there is no known genus or family to which they could with any likelihood be referred. I may add, finally, that even in the total absence of reproductive bodies, or of any proofs of their direct connection with the Graptolites, I should still think the evidence very strong against the view, that the Graptolitidæ are referable to the Polyzoa. I rest this statement upon the fact, that the true Graptolites (omitting *Dictyonema*, and with the possible exception of *Dendrograpsus* and *Callograpsus*) are all free, whilst the Bryozoa are mostly fixed;

upon the undoubted presence of a "common canal" in many,* if not in all, of the former; upon the mode of growth and nature of the embryonic forms; upon the absence of calcareous matter in the test; and upon the existence of allied forms, like Corynoides. Should the views which I have briefly expressed concerning the nature of the "capsules," be confirmed by future and more extended observations, the zoological position of the Graptolitidæ will no longer be a matter of doubt, and they can unhesitatingly be classed amongst the Hydrozoa. This is a subject which I trust to take up hereafter in greater detail, and I must at present content myself with stating that I do not think the Graptolites can be referred to any known order, or even subclass, of the recent Hydrozoa. In many external characters they certainly appear to approximate closely to the Order Sertularidæ; but they are at once excluded from the entire Subclass of the Hydroida, by the fact that the polypidom (in the true Graptolites at any rate) was free, and was not fixed by a "hydro-rhiza," there being other important differences as well. As far as the evidence yet collected goes, I should be disposed to believe that the Graptolitidæ will have to be placed in a new Subclass, which will occupy a position intermediate between the fixed and the oceanic Hydrozoa.

I may conclude this paper by a short description of a species of *Diplograpsus*, seemingly distinct from any known form, which I have named after my friend Professor Harkness, to whose researches we owe most of our knowledge of the Graptolitic rocks of Dumfriesshire. The characters of the species are so peculiar that I feel quite justified in describing it as new, though I possess but a single specimen.

Diplograpsus Harknessii, n. sp. (fig. 6). *Spec. Char.*—Stipe three-tenths of an inch in length, and about a line in breadth, celluliferous on the two sides.

* I altogether question the absence of the "common canal" in any true Graptolite; though Mr W. Carruthers has recently denied that it exists as a distinct structure, referring especially to *Diplograpsus pristis*, His., *D. folium*, His., *D. cometa*, Gein., and *Graptolites sagittarius*, Linn. (Geol. Mag. vol. iv. p. 70). In this opinion Mr Carruthers stands, I believe, alone amongst those who have written on the subject; and Hall's observations in particular appear to be almost conclusive against it. Thus Hall has shown ("Graptolites of the Quebec Group," p. 28, Pl. A, figs. 4, 5, 9) that the cell partitions may extend to the axis, and may, nevertheless, leave room for a common canal, as in *D. bicornis*. The mere fact, therefore, that the cell partitions reach the axis, as they certainly seem to do in *D. folium*, and in *D. cometa*, does not justify us in asserting that there is no common canal, in the absence of sections such as those made by Hall. In the case of *D. pristis* and *G. sagittarius* I believe that Mr Carruthers is in error, and that the cell partitions do not really reach the axis, at any rate in full-grown specimens. In *D. pristis*, His., I have observed conclusive evidence of the existence of the common canal as a distinct structure, since the axis, where prolonged beyond the distal extremity of the stipe, is in some specimens bordered by the common canal on both sides, the cellules alone being wanting, either because they have fallen off previously to fossilisation, or because they had not yet been developed.

Solid axis projecting slightly beyond the end of the stipe, slender and inconspicuous. Cellules about thirty in the space of an inch, alternating slightly with one another; united internally; but free externally on both sides for about half their length. In the lower half of the stipe the cellules are more closely set, and are only free below. The cellules form somewhat quadrangular tubes, the free extremities of which are bifid, or bi-labiate. In the lower cellules the inferior prolongation of the cell-mouth is furnished with a bi-furcate spine or mucro, one arm of which is directed upwards, the other downwards; but in the upper cellules the spines are not well preserved, and sometimes appear to be undivided.*

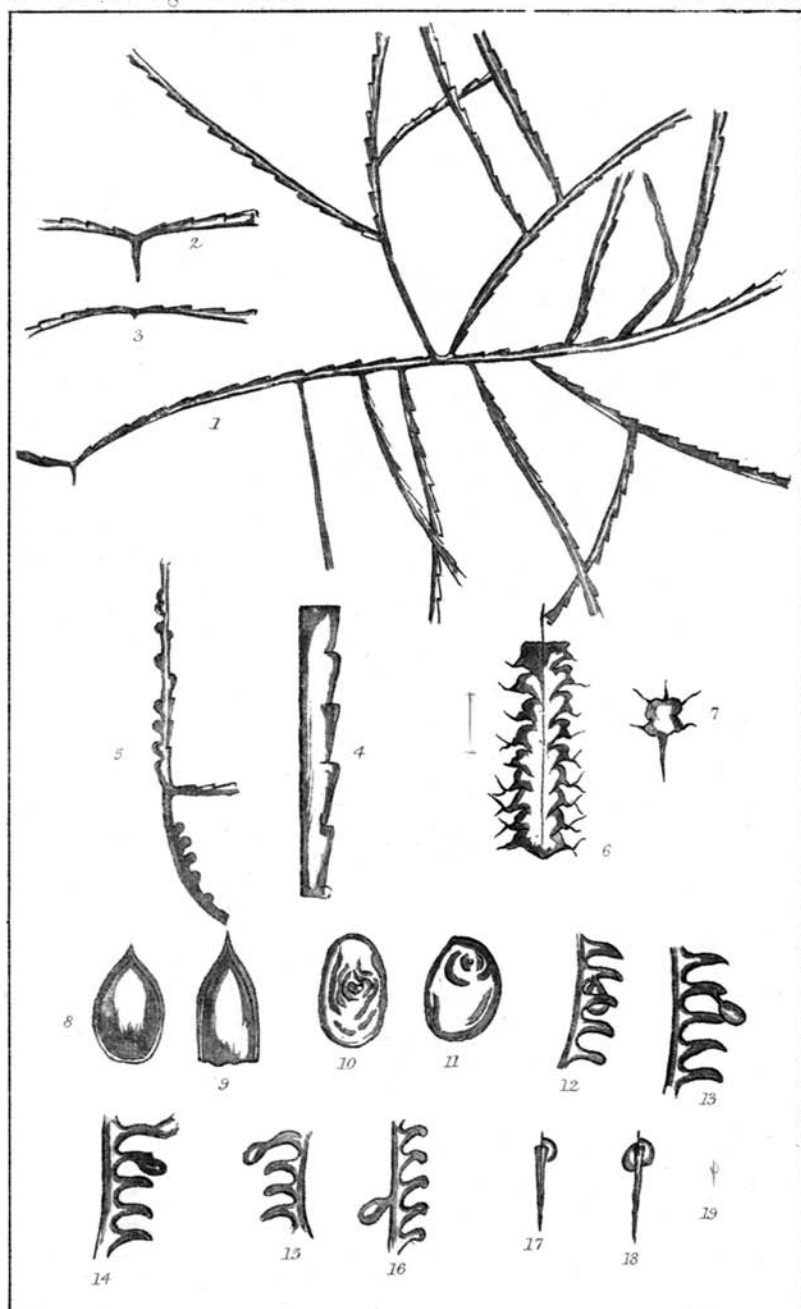
Loc.—Hart Fell, near Moffat.

Germes of Graptolites.—On the surface of the same slab as the preceding are two or three germes apparently belonging to the same species. Each of these (Plate, fig. 7) consists of a delicate mucro, or radicle, surmounted by an oval mass, which is indented at the sides, the primary cellules being furnished with spines at their apices. In the shales of Dobb's Linn I have recently observed certain bodies exactly resembling in form the di-prionidian germes, so common in all the Dumfriesshire beds, but of a very much greater size. They consist of a long and slender radicle, about four-tenths of an inch in length, with a central solid axis, and with a semicircular lobe at the top at one side (fig. 17). Another lobe soon appears alternating with the first, and on the opposite side of the axis (fig. 18); and when more advanced two more lobes are superadded to these. These bodies would seem to be the germes of some di-prionidian Graptolite, perhaps of *D. teretiusculus*, but their great size is very remarkable and anomalous, the ordinary germes (fig. 19) being little more than one-twentieth of an inch in length.

Explanation of Plate.

- Fig. 1. *Pleurograpsus linearis* (Carruthers sp.), nat. size. The denticles are made much more distinct than they are in nature, for purposes of illustration, and the radicle is put in—though not shown in this particular specimen.
- „ 2. Commencement of *P. linearis*, showing the long and slender radicle. Enlarged.
- „ 3. Ditto, without a radicle. Enlarged.
- „ 4. Portion of *P. linearis*, enlarged to show the cellules.
- „ 5. Fragment of the stipe of *P. linearis*, showing reproductive (?) tubercles. Enlarged.
- „ 6. *Diplograpsus Harknessii*, n. sp. The straight line beside it shows the natural size of the specimen.
- „ 7. Germ, probably of the same. Enlarged.
- „ 8. Ovarian capsule, or gonophore, unruptured, showing the strong external border. Enlarged.
- „ 9. Another, after rupture has taken place. Enlarged.
- Figs. 10 and 11. Ovarian capsules compressed vertically. Enlarged.
- „ 12 to 15. *Graptolites Sedgwickii* (*Rastrites triangulatus*, Harkn.), with ovarian capsules attached to the cellules. Enlarged.
- Fig. 16. Another specimen, where the capsule appears to come from the common canal. Enlarged.
- Figs. 17 and 18. Germes of a di-prionidian Graptolite (?). Natural size.
- Fig. 19. Ordinary germ of the natural size, introduced for comparison.

* I take this opportunity of stating, that I now am inclined to believe that one variety, at any rate, of the *Diplograpsus tubulariformis*, which I lately described from the Moffat shales (Geol. Mag. vol. iv. p. 109. Plate vii. figs. 12, 13), is really identical with *D. cometa*, Geinitz, and must therefore be abandoned as a distinct species. Geinitz's description, however, and figures have been founded on imperfect specimens, and do not recognise the essential characters of the species.



H.A. Nicholson del.

E.F.

GRAPTOLITES FROM DUMFRIESSHIRE.