

IX.—NOTES *on the SILURIAN ROCKS of DUMFRIESSHIRE and their FOSSIL REMAINS.* By JAMES DAIRON, V.P.

[Read 10th December, 1874, and 20th April, 1876.]

UNDERNEATH the finely rounded, green clad surface of the hills of Upper Annandale, in the south of Scotland, we find a vast series of thick-bedded rock called Silurian grit, and formerly known as Grauwacke. This grit is hard and compact, of a greenish grey, and sometimes of a purplish tint. Accompanying it there is also to be found a dark-coloured slaty shale, and these two series form the Scottish equivalents of the Upper Llandeilo beds.

In examining the black Graptolitic mudstones or shales of the Moffat district, say at Dobs Linn, Hartfell, Beld Craig, or in many other places, their position and appearance at once show that they must have been subjected to great disturbing influences long after they had been laid down quietly on the old Silurian sea bottom; for we find them tilted up at very high angles, and in many instances quite vertical. They are also very much twisted and contorted, with numerous jointings running at right angles to the line of stratification. And in connection with these jointings occur frequent small faults which spoil many a fine specimen. In their crumpled state it is exceedingly difficult to split them up, while in their normal condition it can be done with the greatest ease.

In section we see these dark shale beds passing along in an undulating or waving form, plunging beneath the reefs of hard grit, and making their appearance again and again in more distant parts. To what agency can be attributed the great force which has been at work displacing, upheaving, and contorting these rocks? There are no trap dykes, or outbursts of igneous rocks observable in the locality, such as are so common in the Western Highlands. I have only seen one spot near Moffat, where the trap rock appears at the surface, and which was shown me by the late Mr Brown of the Star Hotel in that town. Here the trap was quarried for road-making purposes, but is not at present in use.

The mineral composition of these dark-coloured mudstones or shales, seems to vary very much. In many places they are anthracitic to the extent, it is stated, of 5 per cent; other shales, again, are charged with aluminous pyrites which effloresce after they have been exposed to the air for some time, splitting them up, and gradually reducing them to powder, while another part of the shale beds may be entirely free from that substance, and, as a rule, split up easily, exposing their fossil remains in an excellent state of preservation.

In the Moffat district the Graptolitic shales may safely be divided into two well marked groups: the upper containing the more simple forms, the lower holding the remains of the branching and more complex kinds of Graptolites. I am aware that there are some writers on the Moffat shales who endeavour to make three or four Graptolitic horizons. But I am not disposed, with the evidence before me, to go that length at present, thinking that multiplication of horizons only leads to confusion. Some time ago, when at the Beld Craig, a short distance from the place where beautiful examples of the simple forms are got, I was fortunate in discovering a spot where the lower or branching species, such as *Dicellograptus*, *Pleurograptus*, are found in great abundance, none of these forms having been previously got at Beld Craig. This locality may now be classed with Dobs Linn and Hartfell, as containing the lower shales with their equivalent organisms. I may here mention that this lower shale is very easily broken across the bedding, falling into small tabular pieces, but it hardens when exposed for some time to the atmosphere. A number of years ago a person, acting under unsound advice, and deceived by the bituminous appearance of the shale, began to sink a shaft for coal near this spot, but of course had to abandon it, after spending a great deal of money. Garpel glen, so far as yet known, has yielded none of the complex forms, but in some nook of this lovely spot, it is hoped that further investigation may yet bring to light the lower group of shales and their accompanying fossils.

I have already spoken of the underground influences which have affected the Graptolitic shales to the extent that must necessarily have been at work in upturning them from their normal position. I might further point to how favourably they now lie to be acted upon by atmospheric influences. The rain gets upon their upturned edges, the frost expands and splits them

up, they fall asunder and form great taluses such as we see in many places, and these in winter are swept down by the flooded streams. I have frequently picked up excellent specimens in the river Annan, at a distance of six or seven miles from the parent rock at Hartfell, and also in Moffat water, showing the great effect of water in the removal of rocks.

In most of the above localities, and in many others at or near the base of the hills, we find large patches of a red sandstone which elsewhere assumes the appearance of a breccia, containing, as it does, a considerable mixture of angular pieces of the older Silurian grits, and other rocks. It is well represented at the foot of Hartfell, and again at Frenchland burn; also, in the bed of Wellburn, where there is also a small patch. At Dobs Linn it has more the appearance of a decomposed sandstone, and is very red in colour. Observing this at so many points, I think we may be justified in supposing the hills around to have been capped with a thick bed of sandstone which was denuded away, and washed into the hollows in the old Silurian valleys below. These red patches have been referred to the Permian series.

The Graptolitidæ, so far as is at present known, are entirely confined to the Silurian rocks, dying out at the close of that formation. Although those ancient Zoophytes have thus not a wide range stratigraphically, yet, geographically it is greater, as they are found in various parts of the globe. And indeed wherever the old Silurian grits are exposed, the Graptolitic black mudstones or shales will generally be found accompanying them. No fossil remains have as yet been got in the grits of Moffatdale, but their equivalents in Cumberland have yielded, I believe, a few species, though in a bad state of preservation. These grits make an excellent building stone, and are extensively used for that purpose. The zoological position of the Graptolitidæ has given scope for various opinions as to their family relationship, many authorities holding that they are allied to the living *Virgularia*, while others refer them to *Sertularia*. The late Mr Salter up to his death thought they should be placed with the Polyzoa, but it is now generally admitted they have their nearest allies in the Sertularian Zoophytes or sea firs. The remains of the Graptolite, as found embedded in the dark-coloured shales, showing a long row of denticles, is nothing more than an outside

frame-work or skeleton filled in with foreign matter, and there can be no doubt that in its living state it was invested with a chitinous or horny covering, such as forms the chitine envelope of the colonies of Sertularians. The differences between the Sertularian Zoophyte and the Graptolite may be thus summed up—they both consist of a colony of Zooids, each of which inhabits a chitinous cell or “hydrothecæ;” they both have forms of a single row, and also a double one; they have both a common canal. One point of difference, however, is that the Graptolitidæ were supposed to be free floating organisms, while the Sertularians were invariably fixed. Another difference is, that the cells or “hydrothecæ” of the Sertularians are not in contact or overlapping each other, while those of the Graptolitidæ are mostly overlapping, the genus *Rastrites* forming an exception. Another difference still is, that the Sertularians have no stipe or solid axis and common canal, as possessed by the Graptolites.

To determine and name species of this class of organisms would require great caution on the part of a collector, as there are many causes which may alter the appearance of the Graptolitic remains, such as the position in which they lie in the matrix, the degree of pressure they have sustained, and the age of the organisms; these variations in each circumstance may all tend to mislead, and cause new varieties or species to be made out of the same Graptolitic form. In proof of this, we have only to take up one of the specimens that I have brought forward for illustration, viz.: *Diplograptus tamariscus*, Nicholson. The upper part of the organism is in relief in a beautiful state of preservation, while the under part is squeezed or compressed, being the state in which it is generally found. I venture to say, that any one not acquainted with the fossil would certainly be liable to make two distinct species out of it if each portion was found separate from the other.

In order to show the process of development, I have brought forward a slab crowded with the young forms or “germs” of Graptolites, many of them assuming a dagger-like shape, and from one-eighth to one quarter of an inch in length. Lobes or cells begin to grow at a certain distance from the initial point upon the solid axis, increasing in number and size, until they reach the distal termination; but in the genus *Diplograptus* they taper generally to the distal point before the completion of the adult form.

I will now give brief descriptions of a number of species, from the Moffat district, belonging to the following genera, and of which specimens are before you, viz. :—

*Climacograptus.*

*Dicellograptus.*

*Graptolites.*

*Pleurograptus.*

*Diplograptus.*

*Dicranograptus.*

*Rastrites.*

*Retiolites.*

By the aid of a model which I have constructed, and which shows the internal and external structure of *Climacograptus teretiusculus*, one of four well-known forms, I hope to be able to describe more plainly than I could by any drawing, the characteristics of several species. *Climacograptus teretiusculus*, His., was described and named by Prof. M'Coy as *Diplograptus rectangularis*, and of this I bring forward various specimens: one in relief shewing the notches and cell mouths in their original position; another a scalariform example; and several others shewing the cell mouths and partitions. It is very abundant, having a wide range, passing up through the Skiddaw Slates, Lower and Upper Llandeilo, Carradoc, and Lower Llandovery. It will be observed that the frond of this species shows no row of denticles or hydrothecæ, as in *Graptolithus sagittarius*, Linn., *G. Nilsoni*, Barr., and many others, but merely elliptical indentations forming the cell mouths on both sides of a cylindrical frond or tube, which are not level to each other but alternate. Its width when fully developed is about one-eighth of an inch, the solid axis being prolonged both proximally and distally to a considerable length, the external appearance of the frond varying according to the amount of pressure it may have sustained. There are about 30 hydrothecæ to an inch. The cylinder or frond of *Climacograptus teretiusculus*, His., is made up of two semi-circular compartments, placed back to back, the median septum, with the solid axis placed in the centre of it, forming a mutual gable or partition, as it were, between the two colonies of Zooids, which have each their own row of cells and common canal, each colony being thus quite independent of the other. The localities for this species are Dobs Linn and Duffkinnel burn, Hartfell, etc.

In the genus *Dicellograptus* the polypary is composed of two simple branches, springing bi-laterally from the radical or initial point. The branches or arms are monopriodon, and assume different angles in different species. The cells or hydrothecæ are

generally opposite to the radical or initial point, but in some examples they are found on the same side. The size of the radical or spines varies very much in different species, and in some they are altogether wanting. It seems not easy to determine to what uses those spines could have been applied, as there is no evidence that they were objects of attachment. If we look at their different positions, with regard to the spines inside of the angles, or concave parts rendering these, one would think it impossible that they could be used for the purpose of attachment; besides, as already stated, there are some forms without any radical or initial point whatever.

The genus *Dicellograptus* was founded by M'Coy as *Didymograptus* (1851), and includes those Graptolites which are bifid, or of a twin character. The vertical range of this genus has its commencement in the Skiddaw and Quebec groups, and also attains its maximum in those rocks, in which it is represented by numerous and remarkable examples. It besides occurs in the Lower Llandeilo, and is also well represented in the Upper Llandeilo, but is scarcely known in the Carradoc rocks of this country; several examples are, however, found in the rocks of this age in America. This genus is not known in the Upper Silurian series, and may safely be said to be characteristic of the Lower Silurian period. The localities where I found it in Moffatdale are Dobs Linn and Hartfell.

The polypary of the genus *Dicranograptus*, Hall, has a double row of cells towards the proximal point, but divides at a certain distance up from the radical into two monoprionidian branches, on the outside only; or keeping the same line as commenced at the proximal point, and having two small lateral spines at each side of minute radical. The structure of *Dicranograptus ramosus*, Hall, resembles the form *Diplograptus* for so far up or at the branching point, but the hydrothecæ appear to have the same form and structure as *Climacograptus*. The branching of the two arms at a certain distance makes it easily distinguishable from the allied forms *Diplograptus* and *Climacograptus*. In its vertical range the genus *Dicranograptus*, so far as at present known, is entirely confined to the Upper Llandeilo of Britain, but is found in the Carradoc rocks of North America. Its localities here are Dobs Linn and Hartfell.

The genus *Monograptus*, or the simple Graptolite, consists of a

single row of cellules, ranged on one side of a long fibrous rod or solid axis, and which is often prolonged beyond each end. Between the base of the cells and solid axis is a cylindrical space, called the common canal, in which was enclosed a fleshy substance or coenosarc, from which the buds took their form, and is thought to have been thrown off at stated intervals. This common canal is frequently observed running along between the cellules and solid axis; the cells or hydrothecæ receiving their origin from the coenosarc are merely small cups or tubes which each contained one inhabitant. The cells are supposed to have had four borders; the inner is not defined, in consequence of it forming the under part of the cellule which rests on the common canal; the outer border forms the cell mouth. In some forms this margin is very small, as seen in *Monograptus Sedgwickii*, and in some others, and may be said to scarcely exist. The inferior margin bounds the cellule proximally, the superior forming the distal point. Its localities near Moffat are Beld Craig, Garpel burn, and Dobs Linn.

The curious genus *Pleurograptus* is one of the branching forms, the frond being composed of two serrated branches, springing right and left from an initial point or radical process; but sometimes this latter is not present. A second growth of branches breaks off from the main stem or primary branch, and this is repeated on the opposite side of the stem. They are not level to each other, but alternate, growing at nearly right angles to the stem, and other branches growing from them again. One of the many specimens of this genus which I have, shews another branch, especially a specimen from Beld Craig, which gives off branches repeatedly, while the one figured by Mr Carruthers only gives off two from the main stem. *Pleurograptus linearis*, Carr., is the only known species of this genus. I have found it in the Moffat district at Hartfell and Beld Craig.

The genus *Rastrites*, Barrande, is well represented in the Moffat shales. It has a slender solid axis, often fragmentary, curved, and sometimes of a scroll form, upon which the cells are ranged at right angles. The cellules vary in distance from one-eighth to one-sixteenth of an inch, as in the species *R. peregrinus*, Barr., each cell or tube standing quite clear and independent of another, differing from the genus *Monograptus* by the cells which are mostly in a sloping direction, and overlapping each other. Its

localities in Moffatdale are Garpel burn, Beld Craig, and Dobs Linn.

Time will not at present permit me to describe in detail all the different genera and species before you, but I intend, at some early date, to bring before the Society another collection of Hydrozoa and Crustacea from the Moffat shales, and which may be made the subject of another paper.

#### EXPLANATION OF PLATE I.

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| Fig.     |  |                  |
| 1.       | <i>Rastrites peregrinus</i> , Barrande. Natural size.                                | Beld Craig.      |
| 2.       | ———— <i>capillaris</i> , Carruthers. Slightly enlarged.                              | Beld Craig.      |
| 3.       | <i>Monograptus intermedius</i> , Carr. Natural size.                                 |                  |
| 4 & 10.  | ———— <i>lobiferus</i> , M'Coy. 4 enlarged, 10 nat. size.                             | Polmoody Burn.   |
| 5.       | ———— <i>sagittarius</i> , Hisinger. Slightly enlarged.                               | Garpel Burn.     |
| 6.       | ———— <i>Sedgwickii</i> , Portlock. Natural size.                                     | Dobs Linn.       |
| 7.       | ———— <i>Clingani</i> , Carr. Natural size.   | Duffkinnel Burn. |
| 8.       | ———— <i>tenuis</i> , Portl. Slightly enlarged.                                       | Garpel Burn.     |
| 9.       | ———— <i>Sedgwickii</i> , Portl. (var. <i>spinigerus</i> , Nich.) Natural size.       | Polmoody Burn.   |
| 11.      | ———— <i>Sedgwickii</i> , Portl. (var. <i>triangulatus</i> , Harkness). Natural size. | Polmoody Burn.   |
| 12.      | ———— <i>fimbriatus</i> , Nich. Natural size.   | Polmoody Burn.   |
| 13.      | ———— <i>Halli</i> , Barr. Natural size.  | Polmoody Burn.   |
| 14.      | <i>Diplograptus palmeus</i> , Barr. Natural size.                                    | Polmoody Burn.   |
| 15.      | ———— <i>folium</i> , Hisinger. Natural size.   | Garpel Burn.     |
| 16.      | ———— <i>cometa</i> , Geinitz. 16A enlarged.  | Beld Craig.      |
| 17 & 18. | ———— <i>angustifolius</i> , Hall. 18 nat size, 17 enlarged.                          | Polmoody Burn.   |
| 19 & 27. | <i>Climacograptus teretiusculus</i> , His. Both enlarged.                            | Dobs Linn.       |
| 20.      | <i>Diplograptus vesiculosus</i> , Nich. Natural size.                                | Dobs Linn.       |
| 21.      | <i>Climacograptus Wilsoni</i> , Lapworth. Natural size.                              | Dobs Linn.       |
| 22.      | ———— <i>pristis</i> , His. Natural size.   | Dobs Linn.       |
| 23.      | ———— <i>acuminatus</i> , Nich. Twice enlarged.                                       | Polmoody Burn.   |
| 24.      | ———— <i>Whitfieldii</i> , Hall. Twice enlarged.                                      | Dobs Linn.       |
| 25.      | <i>Climacograptus bicornis</i> , Hall. Slightly enlarged.                            | Dobs Linn.       |
| 26.      | <i>Glossograptus Hincksi</i> , Hopkinson.  | Hartfell.        |

#### EXPLANATION OF PLATE II.

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| Fig. |  |             |
| *1.  | <i>Thamnograptus crucifer</i> , Dairon. Natural size.  | Hartfell.   |
| 2.   | <i>Dicellograptus anceps</i> , Nich. Natural size.     | Dobs Linn.  |
| 3.   | <i>Dicranograptus ramosus</i> , Hall. Natural size.    | Hartfell.   |
| *4.  | <i>Retiolites branchiatus</i> , Dairon. Enlarged half. | Dobs Linn.  |
| 5.   | <i>Amphigraptus divergens</i> , Hall. Natural size.    | Beld Craig. |
| 6.   | <i>Dicranograptus sextans</i> , Hall. Natural size.    | Hartfell.   |
| 7.   | ———— <i>Nicholsoni</i> , Hopk. Natural size.           | Dobs Linn.  |

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- FIG.  
 8. *Dicellograptus divaricatus*, Hall. Natural size. Dobs Linn.  
 9. ————— *elegans*, Carr. 9A enlarged. Dobs Linn.  
 10. *Amphigraptus divergens*, Hall. Natural size. Hartfell.  
 11. ————— shewing a bud from main stem. Hartfell.  
 12. *Leptograptus flaccidus*, Hall. Dobs Linn.  
 13. *Corynoides calicularis*, Nich. Enlarged twice. Hartfell.  
 14. *Lasiograptus costatus*, Lapw. Dobs Linn.  
 \*15. *Dicellograptus guilloche*, Dairon. Dobs Linn.  
 16. ————— *divaricatus*, Hall. Shews radical,  
                     with spines. Dobs Linn.  
 17. *Pleurograptus linearis*, Carr. Hartfell.  
 18. *Lasiograptus margaritatus*, Lapw. Dobs Linn.  
 19. *Diplograptus quadrimucronatus*, Hall. Hartfell.  
 20. *Leptograptus flaccidus*, Hall. Hartfell.  
 21 to 26. Germs of various species twice enlarged. Dobs Linn.

The figures are drawn from specimens in my own collection. The nomenclature is taken from Mr Lapworth's list in the Catalogue of Western Scottish Fossils, Glasgow, 1876. I adopt it for the sake of uniformity, although I do not agree with it in all cases.

\* Figures 1, 14, and 15 of Plate II. will be described in a future paper.—J. D.

X.—NOTES on a Tract of VERTICAL TREES in CARBONIFEROUS STRATA. By WILLIAM GROSSART, Surgeon, Salsburgh.

[Read 11th March, 1875.]

THE finding of fossil trees in an erect position is not a new fact. The mere fact of their occurrence, however, gives us no information as to the *modus operandi* that placed them in position, whether they grew on the spot we now find them, or were drifted by currents, deposited in soft mud, finally sunk, and by some unknown physical law raised to an erect position. No efforts ought to be spared, when opportunity offers, of noting carefully the condition and arrangement of the accompanying stratification, as it is not to the tree-trunks alone, but to their surroundings, that we must turn for information on this very interesting period in the earth's history. To further this object is the aim of the following brief communication.

The lower Drumgray coal is wrought at eight different points in the west end of Shotts parish, at an average thickness of twenty-two inches; the normal arrangement of the strata immediately above the coal being nearly uniform throughout. It