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John William Dawson

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PROCEEDINGS
OF
THE GEOLOGICAL SOCIETY.

JANUARY 5, 1859.

John Ford, Esq., Market-Raisin, Lincolnshire; Charles Francis Humbert, Esq., Watford; and Joshua Frey Jepherson, Esq., Barrister-at-Law, Sydney, New South Wales, were elected Fellows.

The following communications were read:—

1. *On FOSSIL PLANTS from the DEVONIAN ROCKS of CANADA.*
By J. W. DAWSON, LL.D., F.G.S., Principal of McGill College, Montreal.

IN 1843–44, Sir W. E. Logan ascertained, and published in his Report* for the latter year, the occurrence of a series of beds of Devonian age in the Peninsula of Gaspé, Lower Canada, containing fossil plants, apparently of terrestrial origin, and some of them evidently *in situ*. Nothing was done toward the precise determination and description of these remains until 1856, when Sir William kindly permitted the writer of this paper to examine his collection, and to describe before the American Association for the Advancement of Science the most interesting specimen contained in it—a fossil trunk exhibiting a very remarkable and previously undescribed coniferous structure†. The other specimens in the collection were so fragment-

* Report of Progress of Canadian Geological Survey, 1844, p. 36, and Appendix.

† Proceedings of American Association, 1856, p. 174.

ary or obscure, that it was not deemed expedient to attempt their description before studying them (as all fossil plants should, when practicable, be studied) in the rocks in which they occur. With this view I visited Gaspé in the past summer, and examined the localities indicated on the plans and sections of the Geological Survey. The facts and specimens thus obtained will probably be fully described and illustrated in one of the forthcoming Decades of Canadian Fossils; and in the meantime I propose to notice some of the species observed, which appear to be of especial interest in the present state of our general knowledge of the Devonian flora.

Before proceeding to these descriptions, it may be necessary to state that the deposit in which the fossils occur consists of sandstone and shale, of various colours and textures, with some conglomerate and thin-bedded coarse limestone, and a seam of bituminous coal, one inch in thickness. The whole series is estimated by Sir W. E. Logan at 7000 feet of vertical thickness. It rests on Upper Silurian rocks, and underlies unconformably the conglomerates which here form the base of the Carboniferous system. Some of the beds, especially in the lower part of the series, contain marine fossils of Lower Devonian forms, which are now in process of examination by Mr. Billings, of the Geological Survey. The greater part of the beds are, however, destitute of marine fossils, and present appearances indicative of shallow water and even of land-surfaces. Some of the species of plants occur throughout the whole thickness; but the bed of coal and most of the plants *in situ* are found in the lower and middle portions of the series. Detailed sections and descriptions of the beds will be found in the Report above referred to.

1. PSILOPHYTON, gen. nov. (Figs. 1 & 2.)

Lycopodiaceous plants, branching dichotomously, and covered with interrupted ridges or closely appressed minute leaves; the stems springing from a rhizoma having circular areoles, sending forth cylindrical rootlets. Internal structure: an axis of scalariform vessels, surrounded by a cylinder of parenchymatous cells, and by an outer cortical cylinder of elongated woody cells (prosenchyma). Fructification probably in lateral masses, protected by leafy bracts.

The most remarkable and interesting plant of the formation is one which, I believe, has frequently been observed and described elsewhere from fragmentary specimens, but which occurs in the Gaspé sections in a state of perfection unusual with palæozoic plants. It is characterized by slender, bifurcating, ridged stems, proceeding from a horizontal rhizoma, which sends forth numerous rootlets. The rhizomata, evidently *in situ*, clothe some beds of indurated clay with a mat of creeping and occasionally bifurcating cylindrical stems, filling the beds below with their vertical rootlets. They attain a diameter of an inch or more, though usually smaller, and a length of at least three feet. They are irregularly dotted with minute linear punctures, the marks probably of ramenta; and at intervals there are circular areoles with central pits, like those of *Stig-*

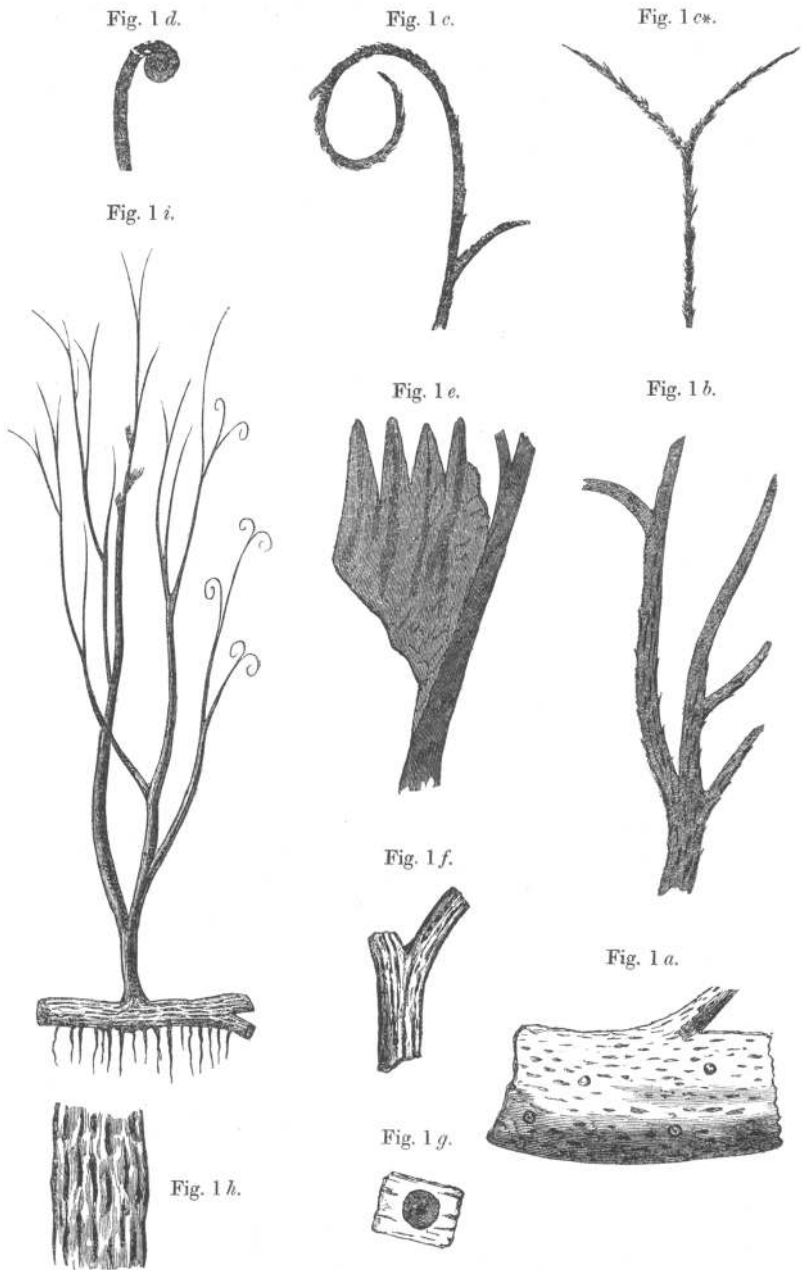


Fig. 1. *Psilophyton princeps*. a, rhizome; b, stem; c, c*, termination of branches; d, vernation; e, fructification; f, stem, twice nat. size; g, areole of rhizome; h, large stem, nat. size; i, restoration.

maria, but irregularly disposed, and giving origin to the roots, which, however, unlike those of *Stigmaria*, subdivide in descending into the soil. Apart from the stems, these rhizomata might be included in the genus *Karstenia* or *Halonia*, or even as abnormal species in *Stigmaria* (figs. 1 *a, g*). The aerial stems vary from a fourth to a tenth of an inch in diameter at their origin, rise obliquely from the rhizoma, and bifurcate very regularly. The extreme points divide nearly at right angles, and in some, probably young, branches the ultimate branchlets bend into a spiral curve with a somewhat unilateral arrangement of the leaflets. In the shale overlying the small coal-seam above-mentioned, there are immense numbers of these little branchlets, rolled so closely as to resemble spiral shells. They probably indicate a circinate vernation like that of ferns. (See figs. 1 *b, c, d*.) The surface of the stems is very smooth and glossy, quite destitute of scars, but marked with numerous interrupted ridges spirally arranged, and sometimes seen to project a little at the upper ends, as if rudimentary leaves. This leaf-like character is more distinct towards the extremities of the branches; but the leaves are not sufficiently well preserved to show anything more than that they are slender and acicular. (Figs. 1 *c, f, h, p*, 479.)

The greater part of the specimens are flattened, with the epidermis alone preserved in a coaly state; but a few fragments were found

Fig. 1 *k*.



Fig. 1 *l*.



Fig. 1 *m*.

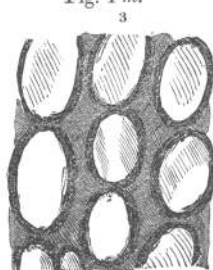


Fig. 1 *n*.

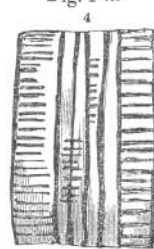


Fig. 1 *k*, longitudinal section of stem, nat. size; *l*, cortical cells (300 diam.); *m*, parenchyma (300 diam.); *n*, scalariform tissue of axis (300 diam.).

with the internal structure remaining. It consists of a slender axis of scalariform vessels, surrounded by a space now occupied by calc-spar, but showing in parts the remains of a loose cellular tissue. Externally to this is a cylinder of well-preserved, elongated, woody cells, without distinguishable pores, but with traces of very delicate spiral fibres. (Figs. 1 *k, l, m, n*.)

The structure and external appearance above described indicate affinities with the *Lycopodiaceæ*, and especially with the genus *Psi-*

*lotum**, with which these plants very closely correspond in all except their rhizomes and the circinate terminations of the branchlets. The name proposed above is intended to express this relation, as well as the most apparent distinction between these plants and those of the genera *Lycopodites* and *Selaginites*†. To the species above-described I would give the name of *Psilophyton princeps*. I have attempted a restoration of its general appearance in fig. 1 *i*.

Some of my specimens appear to indicate a second species, characterized by more robust stems, more finely ridged, and having slender alternate branches, which bifurcate frequently and usually bend

Fig. 2 *a*.



Fig. 2 *b*.



Fig. 2. *Psilophyton robustius*. *a*, stem; *b*, markings of stem (nat. size), ligenous surface.

downward. The specimens are not well preserved, but are very distinct from *P. princeps*, while probably generically related to it. I would name this species *P. robustius* (figs. 2 *a*, *b*).

Neither of the species exhibit distinct fructification. Certain obscurely cuneate carbonaceous spots attached to the sides of the branches of *P. princeps* are, perhaps, of this character; and the ob-

* See Brongniart, Vég. Fos. vol. ii. pls. 6 & 11. I have been favoured by Prof. Gray, of Harvard College, with specimens of *P. flavidum* from Tahiti and *P. triquetrum* from Australia, which closely resemble the fossils in structure and surface-markings.

† I should have preferred the term "Psilotites;" but this has been preoccupied by a Jurassic plant, of which, however, I cannot find any detailed description. See Unger, Gen. et Spec. &c. p. 279; Brongniart, Tableau des Genres, p. 41.

ject represented in fig. 1 *e*, which appears to be thus attached, may be an example in better preservation than usual. It consists of four thick lanceolate leaves or bracts with single midrib, arising from a flattened carbonaceous patch, which shows traces of similar leaves on its surface. These leaves or bracts have evidently enclosed the fructification of some lycopodiaceous plant; and, from their association with *Psilophyton princeps*, I regard it as highly probable, though by no means certain, that they belong to that species.

The rhizomata of *Psilophyton princeps* occur *in situ* in a number of argillaceous beds, in a manner which shows that they crept in immense numbers over flats of sandy clay, on which their graceful stems must have formed a thick, but delicate, herbage, rising to the height of from two to four feet. The rhizomes and the bases of the stems may possibly have been submerged; but I should infer, from the appearance and structure of the latter, that they were rigid, woody, and perhaps brittle. In many beds in which the rhizomes have not been distinctly preserved, the vertical rootlets remain, producing an appearance very similar to that of the Stigmarian underclays of the coal-measures. Sir W. E. Logan has noted in his detailed sections numerous cases of this kind.

When broken into fragments and imperfectly preserved, *Psilophyton princeps* presents a variety of deceptive appearances. When perfectly compressed in such a manner as to obliterate the markings, it might be regarded as a dichotomous fucoid or a flattened root. When decorticated and exhibiting faint longitudinal striæ, it presents, especially when the more slender branchlets are broken off, the aspect of a frond of *Schizopteris* or *Trichomanites*. When rendered hollow by decay, it forms bifurcating tubules, which might be regarded as twigs of some tree with the pith removed. Lastly, the young plants might be mistaken for ferns in a state of veneration. In all conditions of preservation, the stems, rhizomes, and rootlets, if separated, might be referred to distinct genera. I have little doubt therefore that many imperfectly preserved Devonian plants of this general form, noticed under various names by authors, may belong to this genus, and some of them to the species above described. In particular I may refer to certain dichotomous fucoids in the genera *Fucoides* and *Chondrites*; to a plant from the Hamilton Group of New York, figured by Vanuxem in his Report, p. 161; to the dichotomous roots from Orkney and Caithness described by Mr. Salter in the 'Proceedings' of this Society for last year; and to the bifurcating plants with curved tendril-like branchlets figured by Hugh Miller, 'Old Red Sandstone,' plate 7, and 'Testimony of the Rocks,' p. 434. From the description in the former work, Chap. 5, it would appear that the author had observed not only the stems but the rhizomes with their Stigmaria-like areoles, though without suspecting them to belong to the same plant. I have little doubt therefore that materials exist in the Old Red Sandstone of Scotland for the reconstruction of at least one species of this genus. Various fragments which I have collected induce me to believe that it may be found also in the Lower Coal-measures.

I have noticed above the resemblance of flattened specimens of *Psilophyton* to ferns of the genus *Trichomanites* (Gœppert). To this genus, indeed, I was disposed to refer the specimens, until I found that the internal structure was lycopodiaceous, and that the branching filaments are true branchlets covered with minute leaves. A comparison of the plants above described with *Trichomanites Beinertii* of Gœppert, and *Sphenophyllum (T.) bifidum* of Lindley and Hutton, will show at a glance the strong resemblance that subsists; and, since the specimens on which these species are founded do not appear to have exhibited either internal structure or venation, I think it still admits of a doubt whether they are really ferns. By way of further caution on this point, I may remark that in flattened stems, either of *Psilotum* or of its ancient relative, the slender woody axis may leave a mark resembling the nervure of a leaf, and thus complete the resemblance to a frond of *Trichomanes*.

Since writing the above, Professor G. S. Newberry has kindly pointed out to me the close resemblance between the first species above described and *Haliserites Dechenianus* of Gœppert ('Flora der Uebergangsgebirges,' p. 88). I can scarcely doubt that this so-called fucoid is in reality a plant of the genus above described, but in such a state of compression that the stem appears like a narrow frond, and the woody axis as a midrib. As this plant is said to occur very abundantly at certain levels in the Devonian Series of the Rhine, if my suspicions as to its nature be correct, further examination might disclose its rhizomes, leaves, or fructification*.

2. LEPIDODENDRON. (Fig. 3.)

A single species of this genus is found rather plentifully in the beds containing the plants just described, and is distinct from any that I have observed in the Coal-formation. The specimens observed were all of small size and fragmentary, nor was their state of preser-

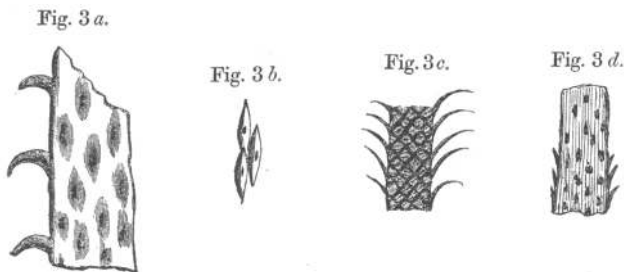


Fig. 3. *Lepidodendron Gaspianum*. a, decorticated stem and leaves; b, areoles; c, small branch and leaves; d, decorticated branch and leaves.

vation very good, though most of them were accompanied by the leaves. In specimens about two inches in diameter, the areoles are

* It is possible that some of the fragments, from the Devonian of the Thüringerwald, included by Prof. Unger in his order *Rhachiopterideæ* may be allied to *Psilophyton*. (See Denkschr. Kais. Akad. Wissen. Wien, vol. xi. p. 139.)

two lines in length and one in breadth, and placed closely together. They are elliptical, acuminate, with central leaf-scar, the form and markings of which could not be perceived. The leaves are thick at the base and short, slightly ascending, and then curving downward. The branches are slender, straight, and very uniform in thickness in the portions observed. This plant may be identical with the *L. Che-mungense* of Hall, from the Devonian rocks of New York; but I am not aware that any specimens of that species hitherto observed show the leaf-scars or leaves; and, when these are obtained, should the present species prove distinct, I would name it *L. Gaspianum**. Its characters, as above stated, are represented in figs. 3 a-d.

3. PROTOTAXITES, gen. nov. (Fig. 4.)

Woody trunks with concentric rings of growth and medullary rays. Cells of pleurenchyma scarcely in regular series, thick-walled, and cylindrical, with a double series of spiral fibres. Disc-structure indistinct in the specimens observed.

I propose the above generic appellation for a tree having the spirally marked cells characteristic of the genera *Taxites* and *Spiropitys* of Gœppert, but differing from any conifer known to me in the cylindrical form and loose aggregation of the wood-cells, as seen in the

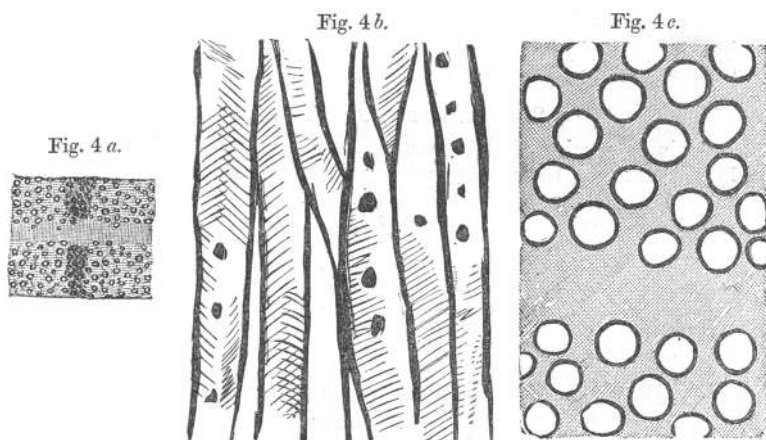


Fig. 4. *Prototaxites Logani*. a, cross-section, magnified 40 diams., showing growth-line and medullary-ray; b, longitudinal section (300 diams.); c, transverse section (300 diams.).

cross-section, in which particular it more nearly resembles the young succulent twigs of some modern conifers than their mature wood. A fine silicified trunk of this tree was brought from Gaspé by Sir

* *L. (Sagenaria) Veltheimianum*, another ancient and widely distributed species, resembles the above in the form of the areoles and position of the scars; but the leaves and young branches differ, and my specimens show no median furrow in the areoles. *L. nothum* (Unger) also seems closely allied.

W. E. Logan, and was shortly described in the 'Proceedings of the American Association' for 1856.

The specimen is nine inches in diameter, and presents throughout a series of rings of growth, rather more than one-tenth of an inch in average thickness. Under the microscope, the cross-section exhibits cells perfectly circular in outline, not crowded, but becoming much smaller at the margins of the rings of growth, where some large irregular openings perhaps represent resin-ducts. The medullary rays are marked by clear structureless spaces. In the longitudinal section, parallel to the medullary rays, the wood-cells are seen to be much elongated, and to terminate in conical points; and their sides are covered with the remains of a double series of spiral fibres, among which are a few scattered roundish spots, which perhaps indicate a single row of discs*. The cells of the medullary rays have been entirely disorganized; but the space which represents them in a tangential slice, shows that they must have consisted of several rows of cells. (Figs. 4 a-c.)

In my late visit to Gaspé, I was so fortunate as to find a second tree of this species imbedded in the strata, though having its structure in a less perfect state of preservation than the specimen above described. It was in a prostrate position, the trunk lying S.W. and N.E., in a thinly bedded, crumbling, pyritous sandstone. The trunk is silicified, one foot five inches in its greatest diameter, and eleven inches in its least, the difference being due to compression; a branch five inches in diameter sprang from its side. On the external surface was a thin layer of crumbling coal, probably representing the bark. No pith was perceptible; but there was a channel or depression along the upper surface, as if a pith-cavity had existed and, when the wood became softened by decay, had given way to pressure. The age of this tree, as indicated by its rings of growth, would be about one hundred and fifty years; so that, though the tissue appears lax, it was not of more rapid growth than in modern conifers. The growth-rings also in the specimen previously described, as well as in this, are well marked, indicating a decided difference of temperature in the seasons of the Devonian year. I cannot propose for this monarch of the old Devonian forests of Gaspé a better or more appropriate name than that of its discoverer, and shall therefore name it *Prototaxites Logani*.

With respect to the affinities of the genus, I can only say that the markings on its wood-cells most nearly resemble those of the two genera of fossil Taxine trees above-mentioned, which are, however, found in much more modern geological formations. Among recent trees known to me by specimens or figures of their tissues, *Taxus baccata* and *Torreya taxifolia* most nearly resemble the Gaspé fossil. In the meantime, therefore, it may be included in the subfamily *Taxineæ*.

I could detect no leaves or fruit likely to belong to the species;

* This disc-like structure was first pointed out to me by Mr. Poe, of Montreal, a very zealous and successful microscopist.

but this is not wonderful, since in the Coal-formation the wood of conifers is very abundant, while their foliage is extremely rare.

Before leaving this ancient taxine conifer, it may be useful to notice the deceptive appearances which its wood presents when imperfectly preserved. In some parts of my second specimen the woody tissue has been entirely obliterated, and is replaced by a kind of oolitic concretionary structure, apparently connected with the presence of iron-pyrites. In other portions the wood seems to have been resolved into a homogeneous paste before silicification; and this, being moulded on minute granular crystals of quartz, assumes the aspect of a tissue of fine parenchymatous cells—a deceptive appearance very common in badly preserved fossils penetrated by calcareous or siliceous matter. In other parts of the specimen the cell-walls remain, but in an opaque coaly condition, which conceals their spiral fibres and discs. I am not quite certain that this last form may not represent the natural state of the heart-wood of the tree. In the first specimen, that obtained by Sir W. E. Logan, the whole trunk appears to be well preserved, with the exception of the medullary rays.

4. POACITES, KNORRIA (fig. 5), CARBONIZED WOOD (fig. 6), ETC.

In addition to the plants above described, the Gaspé sections contain, especially in the beds near the coal-seam, abundance of what seem to be long parallel-sided leaves, with delicate longitudinal striæ, and varying from a fourth of an inch to an inch in breadth. They may be placed provisionally in the genus *Poacites*, but are perhaps leaves of *Noeggerathia*.

Fig. 5 a.



Fig. 5 b.



Fig. 5. *Knorria*?
 a, nat. size;
 b, magnified.

There is also in the Collection of the Geological Survey of Canada a remarkable fragment, covered with sharp, flat, angular scales. Were it not for its carbonaceous character, I should be inclined to regard it as of animal rather than vegetable origin. If a plant, it must, I presume, be referred to the genus *Knorria* (see fig. 5). In the same collection is a flattened and obscurely marked stem, from rocks of the same age at Kettle Point, Lake Huron. Its markings are scarcely sufficiently distinct for description, but cannot be distinguished from those of some of the varieties of *Knorria imbricata*. Another suite of specimens in the Museum of the Geological Survey indicates the existence of a large plant, the precise nature of which it is perhaps at present impossible to determine.

One of the specimens from Gaspé has the aspect of a long flattened trunk, having in a few places the remains of a carbonaceous coating, presenting longitudinal ribs like those of *Calamites*. It is crossed at intervals by markings not quite at right angles to the sides of the stem, each of which consists of a sharp ridge with a furrow at either side. The specimen is four inches in breadth and about four feet in length. Other specimens from Kettle Point vary from five inches to one inch in breadth; and some of them show traces of longitu-

dinal ribs, but others are quite smooth, or marked only by the rhombic structure-lines of the coaly matter. All show transverse or diagonal ridges, though some of these seem to be merely cracks filled with mineral matter. Crushed Calamites, in a very bad state of preservation, might assume these appearances; but, until better specimens occur, the true nature of these plants must remain doubtful. They are very possibly of the same nature with the Calamite-like stems described by Miller in his 'Testimony of the Rocks,' p. 439.

In every part of the Gaspé sections, beds occur having their surfaces thickly covered with fragments of carbonized vegetable matter, evidently drifted by the currents which deposited the sand composing

Fig. 6.

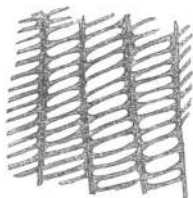


Fig. 6. Scalariform tissue
 (magnified 300 diams.).

the beds. A large proportion of these comminuted plants belong to the genus *Psilophyton*; but many are fragments of the wood of larger vegetables. Nearly all are in a very imperfect state of preservation; and most of those that retain their structure show a scalariform tissue similar to that represented in fig. 6, and probably belong to the axis of *Lepidodendron*. Others exhibit elongated woody cells, without minute markings, perhaps from the cortical portion of the same

genus, or possibly coniferous*. Another form of carbonaceous matter, abundant in some of the sandstones, consists of scaly fragments resembling the remains of decayed cones, probably *Lepidostrobi*.

The great abundance of vegetable fragments throughout an immense thickness of rock indicates the existence of extensive land-surfaces clothed with vegetation, though this apparently consisted of but a few species. The small bed of coal occurring in the lower part of the section is composed entirely of irregularly laminated shining coaly matter without mineral charcoal. From its appearance and the vegetable remains in its underclay, I infer that it consists principally of the accumulated rhizomata of *Psilophyton in situ*. Its roof-shale is filled with the Poacites-like leaves before mentioned, and with stems of *Psilophyton*; and it is remarkable that these last are in great part coiled up in the state of vernation, as if overwhelmed by a succession of spring-floods.

5. ANIMAL REMAINS, RAIN-MARKS, ETC.

The animal remains found in the plant-beds were *Entomostraca* (*Beyrichia*), *Spirorbis* (resembling that of the coal-measures), Worm-tracks, and *Ichthyodorulites* (*Onchus* and *Machæracanthus*†). In one of the beds above the coal Sir W. E. Logan found a few brachiopodous shells, apparently identical with those at the base of the series, and also some remarkable transversely marked furrows, which may have been produced by worms or by marine gasteropods.

* *Aporoxylon* (Unger).

† Prof. Newberry regards one of these as identical with his *Machæracanthus sulcatus* from the Devonian of Ohio.

Near the upper part of the section, where the plants become more rare, and the rocks are more abundantly tinged with the red peroxide of iron, the beds are plentifully and often very grotesquely marked with ripple-furrows, shrinkage-cracks, and current-lines. In one or two beds there are surfaces covered with rounded projections resembling casts of rain-marks; and in proof that this is their true character, the surface being irregular, we have not only the rain-marks themselves, but the little rills formed by the gathering drops as they rolled along in this, one of the most ancient showers of which we have as yet any geological record.

The general character of the conditions indicated by the Devonian rocks and flora of Gaspé does not differ materially from that of the Carboniferous period, though the vegetation would appear to have been poorer in species and more exclusively Lycopodiaceous; in which respects it more nearly resembles that of the Lower than of the Middle or Upper Coal-measures. The general history is that of a sea-bottom elevated or filled up in such a manner as to afford sandy or muddy flats, on portions of which plants grew, and on other portions vegetable fragments were drifted, or bare surfaces were exposed to the alternate influences of aqueous deposition and aerial desiccation,—these various conditions being more or less prevalent throughout a long period, during which the area may have been gradually sinking, to be again disturbed and elevated at the commencement of the Carboniferous period.

In explanation of the siliceous and plant-bearing character of the Gaspé beds, as compared with their more calcareous and marine character in some other parts of America, I may point to their vicinity to the old Laurentian land on the north side of the Gulf of St. Lawrence, and to the possible existence of a nearer belt of Lower Silurian land, indicated by the unconformability, in this part of Canada, of the Lower and Upper Silurian rocks.

In the collection of Sir W. E. Logan there are some vegetable remains from the limestones of Cape Gaspé and its vicinity, which perhaps indicate a still older terrestrial flora than that above described. They afford, I think, evidence of the existence of at least one species of *Psilophyton* and one of *Nœggerathia* or *Poacites*; but whether identical or not with those above described, I cannot determine from the specimens. The beds in which they occur certainly underlie the Gaspé sandstones, and are probably Upper Silurian.

2. *On some Points in CHEMICAL GEOLOGY.* By T. STERRY HUNT, Esq.,
of the Geological Commission of Canada.

[Communicated by Prof. A. C. Ramsay, F.R.S., F.G.S.]

§ I. IN a paper read before the American Association at Montreal in August 1857, as also in some previous communications to the Royal Society, and in the 'Report of the Geological Survey of