

music have furnished to composers the material of their melodies and harmonies, so have the three elements of Arkite symbolism—the ark, the mountain, and the flood—yielded the fundamental idea which is embodied in the numberless myths, monuments, symbols, and inscriptions of ancient civilization.

It is quite possible that the symbols of the ark, mountain, and flood are portrayed in some of the instances quoted by Mr. Lesley, as, indeed, other investigators have pointed out likewise; but every man has his own particular hobby, Mr. Lesley's being Arkite Symbolism.

We cannot conclude this notice without expressing our thanks to the author for supplying us with so readable a book; and we hope it may not be long before a new edition is called for; which will furnish us with another opportunity of improving our acquaintance with so agreeable a fellow-traveller, writer, and lecturer.

II.—ACADIAN GEOLOGY.—THE GEOLOGICAL STRUCTURE, ORGANIC REMAINS, AND MINERAL RESOURCES OF NOVA SCOTIA, NEW BRUNSWICK, AND PRINCE EDWARD ISLAND. By JOHN WILLIAM DAWSON, M.A., LL.D., F.R.S., etc., etc. Second edition. London: Macmillan and Co. 1868. 8vo. pp. 694.

THIRTEEN years have passed since the first edition of this work was published. During that interval its distinguished author has been diligently and successfully prosecuting his investigations in Acadian geology. He has issued numerous memoirs, in British and American journals, on the physical structure of the region which he has made so completely his own, and on the organic remains discovered there—memoirs which have not only elucidated the geological history of Acadia, but have largely contributed to a just appreciation of the physical and biological conditions of the palæozoic epoch in other regions of the earth. These various memoirs, along with observations hitherto unpublished, are digested and incorporated with what was published in 1855, producing a volume very imperfectly characterized on its title-page as a “second edition, revised and enlarged,” inasmuch as it contains about five times more matter than the original work. It would be, as is evident, a vain undertaking to endeavour to present to the reader an account of the additions contained in this edition; we shall examine at greater length the important exposition of the Palæozoic flora, first glancing only at one or two other points of importance.

The earlier chapters on the Boulder-clay and subsequent deposits have a special interest at present. The chapter on the Micmac Indians, and the results produced by forest fires, abound with observations which must receive the careful consideration of those in Europe who are investigating the question of the antiquity of man. We have a long historic period in Europe, the earlier portions of which, in those districts where investigations as to man's antiquity have been carried on, are very obscure and mythical, while the prehistoric period is, as regards the measurement of time, utterly without any certain indications. Successions of events can be deter-

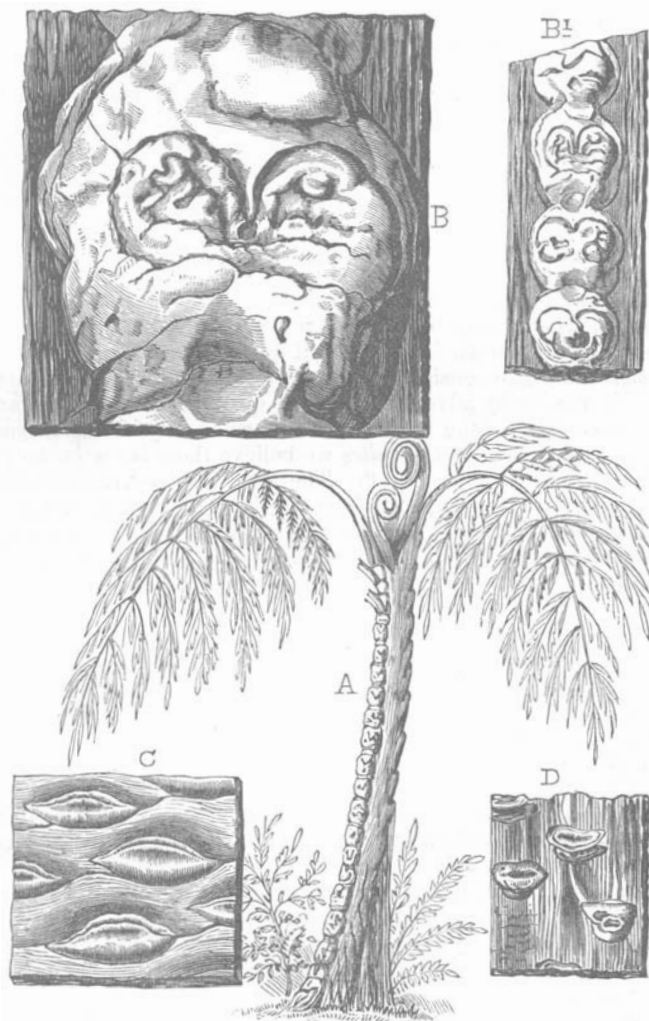
mined satisfactorily, but estimates of the time required for their occurrence are of necessity purely hypothetical. Any help to the discovery of a trustworthy time-measurer would be of great service. In the history of the Miemacs and in the succession of forests, in the same localities, resulting from natural causes, and within a known time, Principal Dawson believes that he has data for maintaining that a much shorter period was required for the ethnological and phytological changes in Denmark and other places than is generally demanded by antiquarians.

The Glacial phenomena, with the associated drift, are ascribed to the action of the sea and its currents bearing ice at certain seasons of the year, accompanied with a gradual subsidence and re-elevation of the land, while the action of Glaciers was very subsidiary. Considerable confusion has arisen from generalizing on the origin of Boulder-clays from observations made in circumscribed localities. The Boulder-clays of the South of England differ, as is well-known, from those of Scotland. They contain boulders from distant localities, associated with some obtained from neighbouring rocks, while in Scotland the deposits are local, all the boulders being derived from higher portions of the water-system in which they occur, and the clay itself deriving its colour from the predominant rocks of the district where it occurs, and from which it was derived. The local glacier will alone account for the Scottish Boulder-clay, while the phenomena of the English deposit requires the floating iceberg. It is quite evident that the Acadian Boulder-clays agree more with those of the South of England; but while arguing for their oceanic origin, Dr. Dawson must admit the local glacier origin of other deposits.

We must pass over the tempting record of the discovery of the land animals of the Devonian and Carboniferous periods, and the interesting account given of this singular fauna, which have been unearthed first and chiefly in Acadia, and by the labours of Principal Dawson; but we must especially notice the important observations he has made on the Flora of these periods. The learned author has devoted his special attention to the investigation of this vegetation which has left so large a record in the earth's crust. He has greatly added to the number of known species, he has examined into the conditions of the accumulation of coal, and determined the various microscopic structures which are met with in the coal itself. And now he proceeds a stage further, and re-uniting the broken and scattered fragments of the plants, he builds up in a series of restorations what appears to him to have been the aspect of the living plant. In the animal kingdom the work of restoration depends more on observation than on imagination, as the different parts of an organism bear a tolerably definite proportion and relation to each other; but in the vegetable kingdom, on the other hand, imagination must be the chief source of restoration where the preserved materials are few and imperfect, as no relationship exists between the size of the fruit, the flower, or the leaf, and the branch, the trunk, or the root. A careful comparison of the various organisms

and structures preserved together may check the imagination, and cautious inductions on their affinities may come very near to a de-

FIG. 1.



A. *Megaphyton magnificum*, Dawson, restored.¹

B. Leaf-scar of the same, two-thirds nat. size.

B.¹ Row of Leaf-scars, reduced.

C. *Palæopteris Hartii*, Dawson, scars half nat. size.

D. *Palæopteris Acadia*, Dawson, scars half nat. size.

¹ We are indebted to the publishers of the "Acadian Geology" for the use of this and the three other woodcuts from that work.

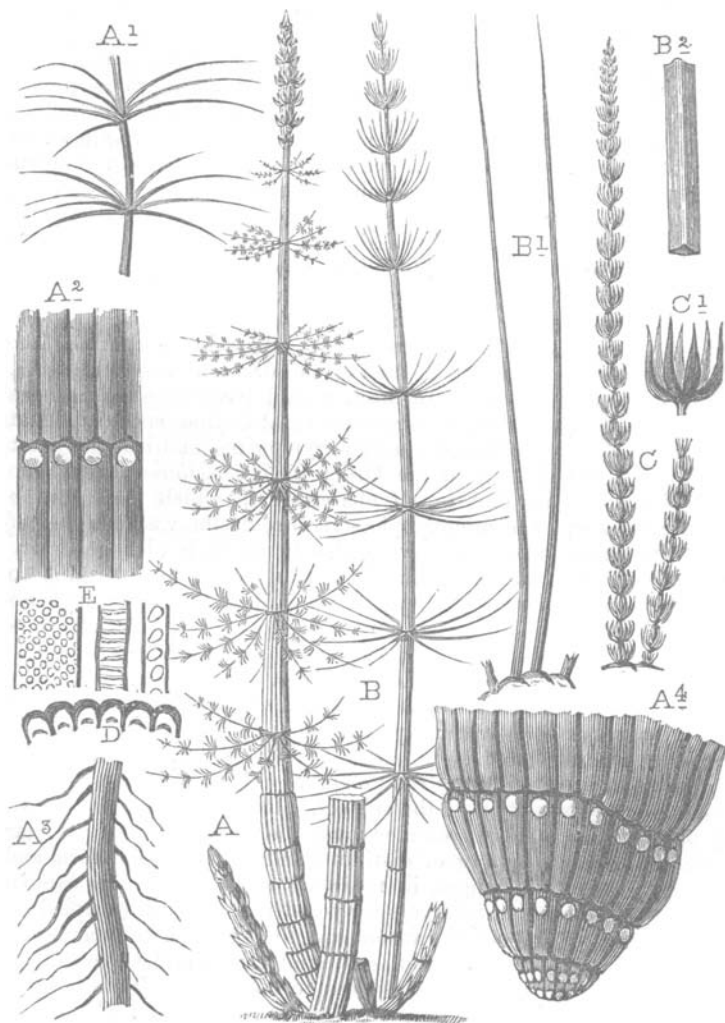
monstration of their relations; but the only method of determining with certainty the different parts of a vegetable organism is the discovery of these parts in organic connection. Thus in *Sigillaria*, as long as we know that it had a long fluted and scarred trunk and stigmalaria root, and only this, we may restore it as a simple, dichotomous branching, or irregularly and repeatedly branching stem covered with small, long, or fern-like leaves; and each of these, as far as the materials over which our restoration is based, with equal accuracy.

The most curious restoration in the volume is that of *Megaphyton*, (Fig. 1) of which genus all that we know is that it had a large trunk with two opposite rows of large reniform or oval scars and numerous smaller scars covering the rest of the stem. This Dr. Dawson restores as a tree-fern bearing opposite pairs of enormous fronds. We cannot understand how the vascular tissue was developed to form so large a stem when the leaves were far removed on the opposite surfaces, and their bases not amplexicaul. So opposed is this to what is known in any recent plant that we prefer, with M. Ad. Brongniart, to consider the large scars as produced by branches, by peduncles, or by adventitious roots, rather than by leaves, and to place *Megaphyton* along with *Ulodendron* as an ally of *Lepidodendron*.

In the restoration of *Calamites* we believe there is reason for going further than is done in Fig. 2. The structure and arrangement of the fruit and the foliage in *Asterophyllites*, *Annularia*, and *Sphenophyllum* are the same. Their remains are associated with those of *Calamodendron*, and when the structure of the stem is preserved it is found to be the same as that of this genus. Dr. Dawson has himself observed this, for in speaking of *Asterophyllites*, he says that they had a "stout internal woody cylinder, in which respect they resembled miniature *Calamodendra*." The ribs on the stems were internal in the branches known as *Asterophyllites* just as in *Calamodendron*. The vascular bundles were parallel in the internodes, but interlaced at the nodes as in *Equisetum*, and the whorl of scars (A^3 and A^4) associated with the interlacings at the nodes represent the opening of the meshes through which the vascular bundles passed to the whorl of leaves or branches produced at the nodes. Nothing is known of *Calamodendron* by those who retain it as a distinct genus, but that it was a stem; associated with it are these branches, leaves, and fruit, which agree in structure with it—and that they actually belonged to it can scarcely we think be doubted. The fruit was certainly that of a cryptogam belonging to the Order *Equisetaceæ*—but to this is opposed the statement that disc-bearing tissue characteristic of gymnosperms enters into the composition of the stem of *Calamodendron*. We have carefully examined several beautiful stems belonging to Mr. Binney, and a large series of our own from the Ash-bed in Arran, but have failed to detect any disc-bearing tissue. The whole vascular portion of the stem is made up of scalariform tissue, as in the larger number of vascular cryptogams, but differing in this respect remarkably from the recent *Equisetaceæ*. It would greatly add to the value of Dr. Dawson's restorations and

of one's estimate of the systematic position of the plants he is dealing with if it were obvious how far the structure he ascribes to them had been found by him in sliced sections of prepared specimens of the

FIG. 2.



A. *Calamites Suckovii*, Brongn., restored.

A1. Foliage.

A2. Ribs and scars.

A3. Roots.

A4. Base of stem.

B. *Calamites Cistii*, Brongn., restored.

B1. Leaves.

B2. Leaf enlarged.

C. Leaves of *C. nodosus*, Schlo'th.

C1. Whorl enlarged.

D. Structure of stem.

E. Vessels magnified.

stems themselves, which could without doubt be referred by their external characters to a particular genus.

The beautiful specimens of *Calamites nodosus*, Schloth., figured by Lindley and Hutton, belonged to a repeatedly branching plant, and were not simple plants as represented at C, Fig. 2; an examination of the original specimens now deposited in the Newcastle Museum shows that the form to which they gave this name are really the branched fruiting spikes, and not the true foliage of *Calamites*.

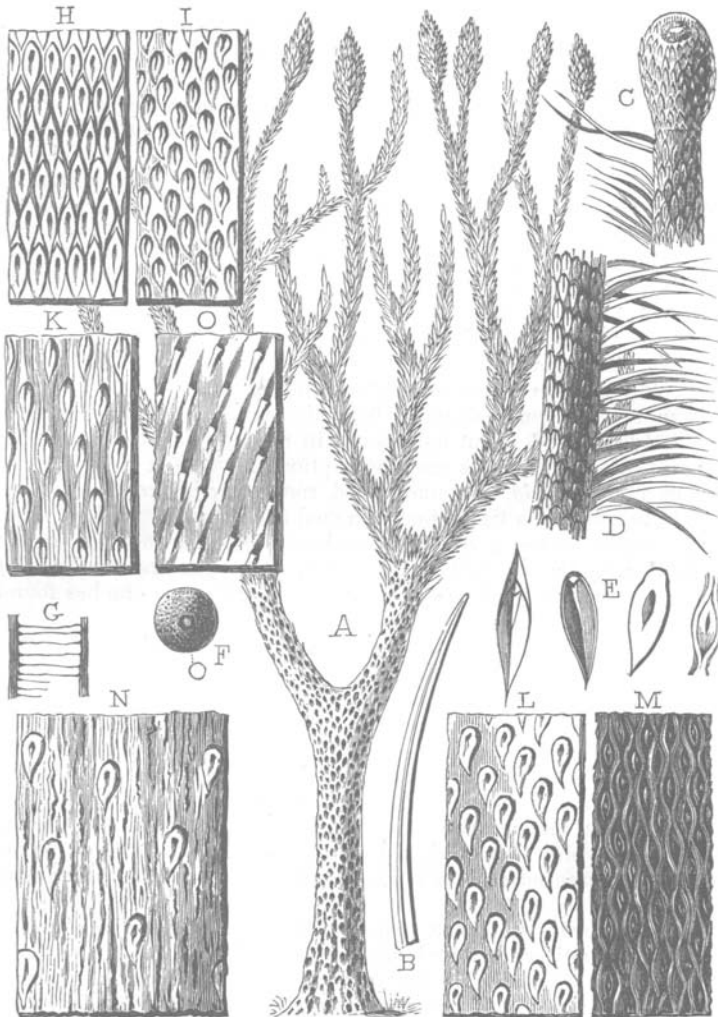
Our own observations in regard to the structure of these plants differ so much from those of Dr. Dawson that we are compelled to modify somewhat the systematic position he gives to *Sigillaria* as well as to *Calamodendron*. It is remarkable that so little is known of a genus of plants which are so abundant in Carboniferous strata, and the more so that every particular is known regarding the structure of its associated genus *Lepidodendron*. Dr. Dawson has ample authority for his restoration of his *L. corrugatum* (Fig. 3) as far as it goes. The sporangium may have been of a different form, and only one connected with each scale, as in *Lepidostrobus*; but otherwise there can be no hesitation in co-relating all the other parts. The author has done good work in tracing the different forms of scars, which without persevering research would have been, by a more hasty and careless worker, referred to several distinct species. That *Lepidodendron* belongs to the vascular cryptogams, and had the habit of, if it did not belong to the Order of *Lycopodiaceæ* every one acknowledges. And that in all characters in which they can be compared—except the microscopic structure of the vascular axis of the stem—these two genera were closely allied is also generally admitted—indeed it is very difficult in many cases to determine to which of the genera some species should be referred, and no characters can be drawn which will suffice to distinguish the *Favularia* group of *Sigillaria* from the group of *Lepidodendron* to which Dr. Dawson applies the name *Lepidophloios*.

The characters derived from the internal structure of the stem are those upon which the two groups are separated into genera, and by some authors placed widely apart systematically. Brongniart's admirable memoir on the structure of *Sigillaria elegans* is still the most complete exposition of the subject. He describes it as consisting of a cellular axis surrounded by a double cylinder of vascular tissue, the inner consisting of distinct bundles of a lunate form and the outer regularly arranged in radiating series, sometimes broken up by narrow radiating intervals supposed to have been occupied by medullary rays. Beyond the vascular cylinder was a cellular layer, becoming more dense towards the circumference, and traversed by the vascular bundles which passed out to the leaves. This description agrees with the figure given by Dr. Dawson (Fig. 4, C), except that Brongniart saw no indication of diaphragms (*a*) in the cellular axis, or of a cylinder of disc-bearing tissue (*b*); and also with the section of (*Lepidodendron*) *Lepidophloios Acadianus* (Acadian Geology, p. 457, fig. 1).

Dr. Hooker, in his Essay on the Carboniferous Flora, doubts

whether the appearance in the fossil which Brongniart considers as representing medullary rays are really so or not. The relation of

FIG. 3.



- A. *Lepidodendron corrugatum*, Dawson, restored.
 B. Leaf, nat. size.
 C. Cone and branch.
 D. Branch and leaves.
 E. Various forms of leaf areoles.
 F. Sporangium.
 G. Scalariform vessel, magnified.
 H, I, K, L, M. Bark with leaf-scars.
 N. Ditto of old stem.
 O. Decorticated stem (*Knorria*).

these so-called medullary rays to the vascular axis and to the separate internal vascular bundles, together with the entire absence of any indication of the cellular structure of the medullary ray in radial sections, put it, in our estimation, beyond a doubt that they cannot be considered as medullary rays. We have never met with a specimen of *Sigillaria* in which the woody cylinder was preserved, but we have examined a large series of *Stigmariæ* in which the vascular tissue was in a good state of preservation. The vascular axis of *Stigmaria* is certainly composed entirely of scalariform vessels, perfectly free from medullary rays, but traversed in an upward and outward direction by vascular bundles which pass from the interior of the cylinder through the meshes made by the opening and closing of the vascular tissue.¹ So far this agrees with what was observed and figured by Brongniart in the stem of *Sigillaria elegans*, with Binney's *Sigillaria vascularis*, with Lindley and Hutton's *Lepidodendron Harcourtii*, and with several specimens of *Lepidodendron* which we have examined. If true disc-bearing gymnospermous tissue has been found *in situ* forming an outer layer surrounding the scalariform tissue, the notions hitherto entertained regarding the systematic position of this genus deduced from the structure of the stem will be greatly modified. But its absence in those exquisitely preserved stems of which drawings and descriptions have been published, as well as in *Stigmaria*, the undoubted roots of *Sigillaria*, makes us hesitate to refer such tissue found in coal to this genus, and set aside any argument based upon this to place *Sigillaria* as high in the vegetable kingdom as the Gymnosperms. No argument can be built upon the supposed fruits of *Sigillaria*, for, as yet, no one has found them so related as to make their connection probable.

The only Gymnosperm in Principal Dawson's list is, we believe, the genus *Dadoxylon*, and it is worthy of remark that if complexity in the structure of the medullary ray be any indication of higher organisation, then these Palæozoic conifers were more highly organised than any that have followed them.

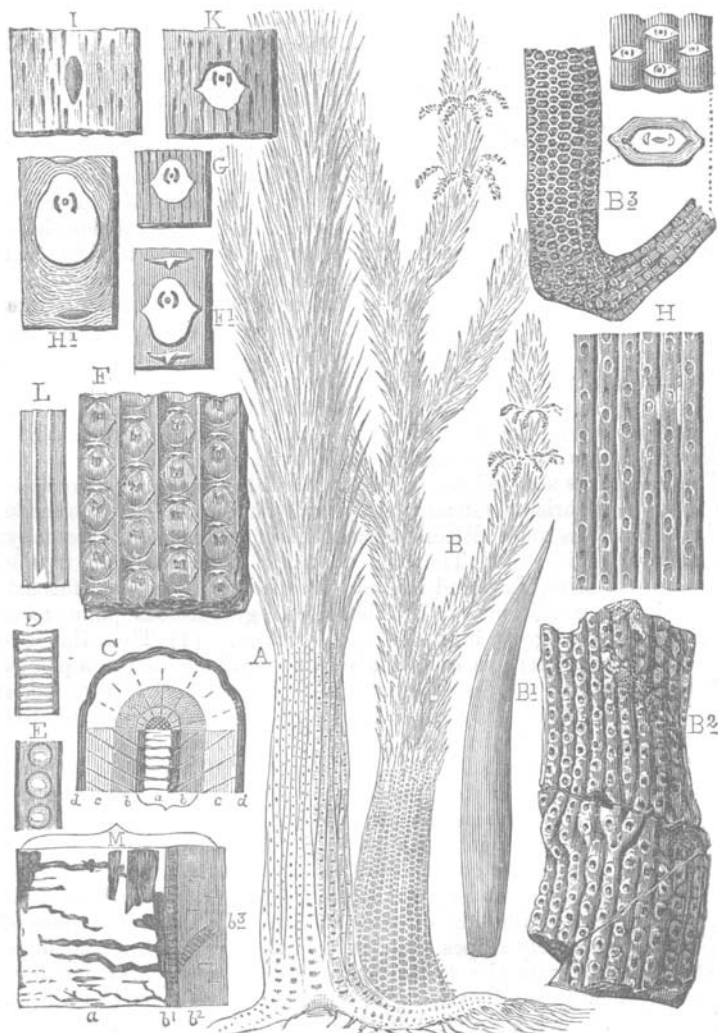
To conclude, the evidence before us is greatly in favour of reducing *Sigillaria* from the Gymnosperms to the neighbourhood of *Lepidodendron* among the vascular cryptogams, and of placing *Megaphyton* beside them rather than among the ferns, and of reducing also *Calamodendron* and uniting it with *Calamites* as a genus of *Equisetaceæ*.

While differing in these respects from the conclusions of Dr. Dawson, it requires only a glance at the work by a student of these ancient forms of vegetable life to perceive that there is here one of the most important of modern contributions to the science of palæontological botany.

W. CARRUTHERS.

¹ We write this remembering that Cotta has figured a longitudinal section of *Stigmaria fœoides*, the vascular tissue of which is composed of Cycadean-like vessels traversed by the muriform cells of medullary rays, but it is quite certain that if this is a faithful representation of the wood of the fossil, the fossil is not *Stigmaria fœoides*.

FIG. 4.



A. *Sigillaria Brownii*, Dawson, restored.

B. *S. elegans*, Brongn. restored. B¹. Leaf of *S. elegans*. B². Portion of decorticated stem, showing one of the transverse bands of fruit-scars. B³. Portion of stem and branch reduced, and scars nat. size.

C. Cross section of *Sigillaria Brownii* (?), reduced, and portion at (M) nat. size.—(a). Sternbergia pith.—(b¹). Inner cylinder of scalariform vessels.—(b²). Outer cylinder of discigerous vessels, with medullary rays and bundles of scalariform vessels going to the leaves at (b³).—(c). Inner bark.—(d). Outer bark.

D. Scalariform vessel, magnified.

E. Discigerous woody fibre, magnified.

F. *S. Bretonensis*, Dawson. (F¹). Areole, half nat. size.

G. *S. striata*, Dawson, nat. size.

H. *S. eminens*, Dawson, reduced. (H¹). Areole, half nat. size.

I. *S. catenoides*, Dawson, half nat. size.

K. *S. planicosta*, Dawson, half. nat. size.

L. Portion of leaf of *S. seutellata*, Brongn.