

ART. XXXI.—*On the Flora of the Devonian Period in Northeastern America*; by J. W. DAWSON, LL.D., F.R.S., Principal of McGill University, Montreal.¹

[This paper by Prof. Dawson is the one alluded to in his previous communication. The 2d part containing descriptions of species is omitted.]

The existence of several species of land-plants in the Devonian rocks of New York and Pennsylvania was ascertained many years ago by the Geological Surveys of those States, and several of these plants have been described and figured in their Reports.² In Canada, Sir W. E. Logan had ascertained, as early as 1843, the presence of an abundant, though apparently monotonous and simple, flora in the Devonian strata of Gaspé; but it was not until 1859 that these plants were described by the author in the 'Proceedings' of this Society.³ More recently Messrs. Matthew and Hartt, two young geologists of St. John, New Brunswick, have found a rich and interesting flora in the semi-metamorphic beds in the vicinity of that city, in which a few fossil plants had previously been observed by Dr. Gesner, Dr.

¹ Copied from the *Quarterly Journal of the Geological Society*, Nov., 1861.

² Hall and Vanuxem. Reports on the Geology of New York; Rogers, Report on Pennsylvania.

³ *Quart. Jour. Geol. Soc. Lond.*, xv, 477.

Robb, and Mr. Bennett of St. John; but they had not been figured or described. These plants were described in the *Canadian Naturalist*,⁴ together with some additional species, of the same age, found at Perry, in the State of Maine, and preserved in the collection of the Natural History Society of Portland. The whole of the plants thus described, I summed up in the paper last mentioned as consisting of 21 species, belonging to 16 genera, exclusive of genera like *Sternbergia* and *Lepidostrobus*, which represent parts of plants only.

In the past summer I visited St. John; and, in company with Messrs. Matthew and Hartt, explored the localities of the plants previously discovered, and examined the large collections which had been formed by those gentlemen since the publication of my previous paper. The material thus obtained proving unexpectedly copious and interesting, I was desirous of having opportunities of fuller comparison with the Devonian Flora of New York State; and, on application to Prof. Hall, that gentleman, with the consent of the Regents of the University of New York, kindly placed in my hands the whole of his collections, embracing many new and remarkable forms. Prof. C. H. Hitchcock, State geologist of Maine, had in the meantime further explored the deposits at Perry, and has communicated to me three new species discovered by him. The whole of these collections, amounting in all to more than sixty species, constitute an addition to the Devonian Flora equal in importance to all the plants previously obtained from rocks of this age, and establish for some of the species a very extensive distribution both geologically and geographically; they allow, also, more satisfactory comparisons than were heretofore practicable to be instituted between the Devonian Flora and that of the Carboniferous period.

I shall first shortly notice the geological character of the localities, with lists of the fossils found in each, and shall then proceed to describe the new species.

I. NOTICES OF THE LOCALITIES OF THE DEVONIAN PLANTS.

1. *State of New York*.—The geology of this State has been so fully illustrated by Prof. Hall and his colleagues, and the parallelism of its formations with those of Europe has been so extensively made known by Murchison and others, that it is only necessary for me to state that the fossils entrusted to me by Prof. Hall range from the Marcellus Shale to the Catskill group inclusive, and thus belong to the Middle and Upper Devonian of British geologists. The plants are distributed in the subdivisions of these groups as follows:—

⁴ Vol. vii, May, 1861.

UPPER DEVONIAN.

*Catskill Group.*⁵

<i>Aporoxylon.</i> <i>Sigillaria Simplicitas Vanuxem.</i> <i>Lepidodendron Gaspianum Dawson.</i> <i>Psilophyton princeps Dawson.</i>	<i>Cyclopteris Jacksonii Dawson.</i> <i>Rhachiopteris punctata, sp. nov.</i> — cyclopteroides, sp. nov.
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Chemung Group.

<i>Sigillaria Vanuxemii Gæppert.</i> <i>Syringodendron gracile, sp. nov.</i> <i>Stigmara exigua, sp. nov.</i> <i>Lepidodendron Chemungense Hall.</i> — corrugatum <i>Dawson.</i>	<i>Lycopodites Vanuxemi, sp. nov.</i> <i>Cyclopteris Halliana Gæppert.</i> <i>Psilophyton princeps Dawson.</i> <i>Acanthophyton spinosum, sp. nov.</i> <i>Rhachiopteris striata, sp. nov.</i>
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MIDDLE DEVONIAN.

Hamilton Group.

<i>Syringoxylon mirabile, sp. nov.</i> <i>Dadoxylon Hallii, sp. nov.</i> <i>Aporoxylon.</i> <i>Sigillaria.</i> <i>Didymophyllum reniforme, sp. nov.</i> <i>Calamites Transitionis (?) Gæppert.</i> — inornatus, sp. nov. <i>Lepidodendron Gaspianum Dawson.</i> — corrugatum <i>Dawson.</i>	<i>Psilophyton princeps Dawson.</i> <i>Cordaites Robbii (?) Dawson.</i> —, sp. nov. — angustifolia <i>Dawson.</i> <i>Cyclopteris incerta, sp. nov.</i> <i>Rhachiopteris striata, sp. nov.</i> — tenuistriata, sp. nov. — pinnata, sp. nov.
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2. *Maine.*—The only locality in this State that has hitherto afforded fossil plants is Perry, near Eastport, in the eastern part of the State. The plant-bearing rocks are grey sandstones, resembling those of Gaspé, and associated with red conglomerate and trappean or tufaceous rocks, which, according to the recent observations of Prof. C. H. Hitchcock,⁶ rest unconformably on shales or slates holding Upper Silurian fossils.⁷ I have little doubt that these beds at Perry are a continuation of part of the series observed at St. John, New Brunswick; and it is probable that they are Upper Devonian. The following species occur at this place:⁸—

<i>Lepidodendron Gaspianum Dawson.</i> <i>Lepidostrobus Richardsonii Dawson.</i> — globosus <i>Dawson.</i> <i>Psilophyton princeps Dawson.</i> <i>Leptophkeum rhombicum, sp. nov.</i>	<i>Megaphyton ?</i> <i>Aporoxylon ?</i> <i>Cyclopteris Jacksoni Dawson.</i> — Brownii, sp. nov. <i>Sphenopteris Hitchcockiana, sp. nov.</i>
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3. *Canada.*—Devonian beds holding fossil plants occur in Eastern Canada, in Gaspé, and in Western Canada, at Kettle Point, Lake Huron. At the former place there is an extensive series of sandstones and shales, regarded by Sir W. E. Logan as representing the whole of the Devonian series, and containing

⁵ Now included in the Chemung.

⁶ Report on the Geological Survey of Maine, now in the press.

⁷ See also notices by Dr. Jackson and Prof. Rogers in the *Proceedings of the Boston Society of Natural History.*

⁸ A few additional species discovered last summer will shortly be described.

plants throughout, but more abundantly in its central portion.⁹ At the latter a few plants have been found in shales of Upper Devonian age. The plants found at Gaspé were described in my former paper, and are—

Prototaxites Logani Dawson.		Psilophyton robustius Dawson.
Lepidodendron Gaspiatum Dawson.		Selaginites formosus Dawson.
Psilophyton princeps Dawson.		Cordaites angustifolia Dawson.

The plants from Kettle Point, noticed with doubt in my former paper, I may now refer to the following species:—

Sagenaria Veltheimiana Gæppert.		Calamites inornatus, sp. nov.
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4. *New Brunswick*.—The rocks in the vicinity of the city of St. John, constituting a part of the coast metamorphic series of New Brunswick, have been described in the official reports of Dr. Gesner and Dr. Robb;¹⁰ and additional facts respecting their stratigraphical relations, ascertained by Mr. Matthew, were stated in my paper in the *Canadian Naturalist*, already referred to. The new interest attached to these beds, in consequence of the discovery of their copious fossil flora, induced me to re-examine all the sections, in company with Mr. Matthew, during my late visit; and that gentleman has recently extended the limits of our observations eastward in the direction of Mispec. The results of these observations I shall state in some detail, as the precise age of the St. John series has not until now been determined.

The oldest rocks seen in the vicinity of St. John are the so-called syenites and altered slates in the ridges between the city and the Kennebeckasis River. These rocks are in great part gneissose, and are no doubt altered sediments. They are usually of greenish colors; and in places they contain bands of dark slate and reddish felsite, as well as of gray quartzite. In their upper part they alternate with white and graphitic crystalline limestone, which overlies them in thick beds at M'Closkeney's and Drury's Coves on the Kennebeckasis, and again on the St. John side of an anticlinal formed by the syenitic or gneissose rocks, at the suburb of Portland. These limestones are also well seen in a railway-cutting five miles to the eastward of St. John,¹¹ and at Lily Lake. Near the Kennebeckasis, they are unconformably overlain by the Lower Carboniferous conglomerate, which is coarse and of a red color, and contains numerous fragments of the limestone.

⁹ Reports of the Geological Survey of Canada; paper on the Devonian plants of Gaspé. *Quart. Journ. Geol. Soc. Lond.*, xv.

¹⁰ Gesner's Second and Third Reports on the Geological Survey of New Brunswick; Robb, in Johnston's Report on the Agriculture of New Brunswick.

¹¹ At this place the limestone is penetrated by a thick vein of graphic granite, holding black tourmaline; and at Drury's cove, not far distant, it contains dykes of dark colored trap.

At Portland, the crystalline limestone appears in a very thick bed, and constitutes the ridge on which stands Fort Howe. Its colors are white and grey, with dark graphitic laminæ; and it contains occasional bands of olive-colored shale. It dips at a very high angle to the southeast. Three beds of impure graphite appear in its upper portion. The highest is about a foot in thickness, and rests on a sort of underclay. The middle bed is thinner and less perfectly exposed. The lower bed, in which a shaft has been sunk, seems to be three or four feet in thickness. It is very earthy and pyritous. The great bed of limestone is seen to rest on flinty slate and syenitic gneiss, beneath which, however, there appears a minor bed of limestone. Above the great limestone are beds of a hard grey metamorphic rock, apparently an indurated volcanic ash, associated with some sandstone; and this is succeeded by the great series of gray, olive, and black shales and flags which underlie the city of St. John. These rocks are well exposed on both sides of Courtney Bay, in the city of St. John, and in Carlton. Though somewhat contorted, they have a general dip to the southeast, at angles of 50° to 70° . In some of the beds there are great numbers of *Lingulæ*, which have not as yet been identified with any described species. There are also trails of worms, and scratches which may have been produced by the feet of Crustaceans or the fins of fishes.

The comparatively coarse shales above described are succeeded by a thick band of black papyraceous shale, much contorted, and with a few thin seams of calcareous matter arranged in the concretionary forms known as 'cone-in-cone.' No fossils were found in them, but two thin seams of anthracitic coaly matter are stated to have been seen on their line of strike eastward of Courtney Bay.¹²

Overlying these beds, is a group of very different character. It consists of purplish-red and green grit and shale, with beds of red conglomerate and red sandstone. Interstratified with these are massive beds of a greenish rock, consisting of trappean and feldspathic fragments, imbedded in a shining reddish paste, or sometimes presenting the appearance of a compact trap or amygdaloid. This rock usually presents an appearance of greater alteration than the neighboring beds, and contains veins of epidote, quartz, and calc-spar. Its hard and massive character causes it to resist denudation, and to project above the surface in irregular masses. It has usually been regarded as a trap; I am disposed however, to consider it as more probably a tufaceous or volcanic ash rock, except in a few places, where it is either an amygdaloid trap or a mass of fragments of such material too

¹² Gesner's Second Report.

intimately connected to be separated from each other. It is evidently a stratified member of the series, though its beds are very unequal in hardness and texture, and probably also in thickness. This portion of the series is well exposed on the east side of Courtney Bay, in the southern part of the city of St. John, and in the direction of Carlton, where its tufaceous or trappean members constitute prominent elevations. It seems also to be this member of the series which, turning to the south, constitutes Cape Meogenes.

Reposing on the rocks last described, is the most interesting member of the series, consisting of hard buff and gray sandstones, with black and dark-gray shales. The sandstones contain numerous Coniferous trunks; and the shales, which are sometimes highly graphitic, abound in delicate vegetable remains, often in a very perfect state of preservation. These rocks appear on the east side of Courtney Bay, near Little River, at the extremity of the point of land on which the city of St. John stands, and in the ledges and cliffs on the shore westward of Carlton. In all these places they are quite conformable with the underlying rocks, though the dip gradually diminishes in ascending.

No rocks newer than the above are seen at Carlton or in the city of St. John; but near Little River a few beds of red shale and coarse sandstone seem to indicate the commencement of a new member of the series, the coast-section failing at this point. Mr. Matthew has, however, succeeded in finding a continuation of the section further inland, exhibiting first, in ascending order, gray sandstone and grit, with dark shale holding fossil plants, among which is *Calamites Transitionis*. This may perhaps be regarded as the top of the group last mentioned. Above it, and passing into it at their base, are reddish sandstones, grits, and conglomerates, alternating with green, greenish-gray, and red shale. Resting on these, is a thick-bedded, coarse, angular conglomerate, succeeded by evenly bedded shales, shaly sandstones, and grits, of dark-red and purplish colors. These are the highest beds seen, as beyond this place they are bent in a synclinal, and reappear with reversed dips.

Another most important observation of Mr. Matthew is that near Red Head the member of the St. John series last described is overlain unconformably by a conglomerate similar to that of the Kennebeckasis, and probably the Lower Carboniferous conglomerate. It dips to the northwest, or in the opposite direction from that of the underlying beds, at an angle of 30° ; but Mr. Matthew regards the dip as due in part to false bedding.

The whole of the deposits above described may be summed up as follows, the thicknesses stated being from measurements

and estimates made by Mr. Matthew, and to be regarded as merely approximate.¹³

Carboniferous System.

Coarse red conglomerate, with pebbles of the underlying rocks, and constituting in this vicinity the base of the Carboniferous System. Feet.

Devonian System (or perhaps, in part, Upper Silurian).

1. Dark-red and greenish shales; flaggy sandstones and grits; coarse angular conglomerate, - - - - - 1850
2. Reddish conglomerate, with quartz pebbles; reddish, purple, and grey sandstones and grits; deep-red, gray, and pale-green shales. A few fossil plants, - - - - - 2350
3. Blackish and gray hard shale and arenaceous shale; buff and gray sandstone and flags. Many fossil plants; Crustaceans and *Spirorbis*, - - - - - 2000
4. Reddish conglomerate, with slaty paste and rounded pebbles; trappean or tuffaceous rock; red, purplish, and green sandstones and shales. Thickness variable, - - - - - 1000
5. Black papyraceous shale, with layers of cone-in-cone concretions, - - - - - 400
6. Hard, generally coarse and micaceous, gray shales and flags, of various shades of color, and with some reddish shale and tuffaceous or trappean matter at the bottom. *Lingula*, burrows, and trails of animals, - - - - - 3000 feet or more.
7. White and gray crystalline limestone, with bands of shale and beds of graphite, - - - - - 600 feet or more.
8. Gneissose and other metamorphic beds, with bands of quartz-rock and slate. Thickness unknown.

The Devonian age of the upper members of this great series of beds I regard as established by their fossils,¹⁴ taken in connection with the unconformable superposition of the Lower Carboniferous conglomerate. The age of the lower members is less certain. They may either represent the Middle and Lower Devonian, or may be in part of Silurian age. Their only determinable fossil, the *Lingula* of the St. John shales, affords no decisive

¹³ In my paper in the *Canadian Naturalist*, I gave a sectional view of the general arrangement, as observed on a line of section from the Kennebeckasis River to the extremity of the peninsula on which St. John stands. The sections referred to in the text represent the same series, as seen on the east side of Courtney Bay, immediately to the east of St. John, with the continuation ascertained by Mr. Matthew towards the Mispec River.

¹⁴ The scanty animal remains of the plant-beds No. 3 accord very well with the evidence of the fossil plants. They are a small Trilobite, apparently a *Phillipsia*, and three other Crustaceans, one of which is probably a *Stylonurus*, another a *Euryp-terus*, and the third a Decapod not apparently referable to any described genus. These Crustaceans are now in the hands of Mr. Salter. (See his paper on these fossils, read before the Geological Society, May 21, 1862.) There is also a shell, apparently a *Lozonema*, and a *Spirorbis*.

solution of this question, and the evidence of mineral character is not to be relied on in the case of beds so remote from those regions in which the Devonian rocks of America have been most minutely studied.

In mineral character, Nos. 1 and 2 of the above sectional list might very well represent the Old Red Sandstone, or Catskill group, of the New York geologists. Nos. 3 and 4 might be regarded as the analogues of the Chemung and Portage groups. No. 5 would represent the Genesee Slate; No. 6 the remainder of the Hamilton group; No. 7 the Corniferous Limestone; and No. 8 might be regarded as a metamorphosed equivalent of the Oriskany and Schoharie Sandstones. The entire want of the rich marine fauna of these formations is, however, a serious objection to this parallelism. If, on the other hand, we employ as our scale of comparison the development of the Devonian system in Gaspé, Nos. 1 and 2 will correspond very well with the upper member of the Gaspé series, and No. 3 with the rich plant-bearing beds of the middle of that series; but no mineral equivalent of the St. John shales and limestones occurs at Gaspé, unless we seek for it in the Upper Silurian.

The rocks of the St. John group extend along the coast as far as the frontier of Maine, and there can scarcely be any doubt that the plant-bearing beds at Perry represent some portion of the St. John series, most probably Nos. 2 and 3 of our sectional list. At Perry, the plant-beds rest on a trappean bed, which may be the equivalent of our No. 4, a member of the series much more constant in its occurrence than would be anticipated from its composition. According to Prof. Hitchcock, this last bed at Perry, rests unconformably on shales containing a *Lingula*, apparently not identical with that of St. John, and also other fossils of distinct Upper Silurian forms. The analogy of Perry, therefore, as well as of Gaspé, would point to an Upper Silurian age for the lower members of the St. John series, though at St. John they appear to be conformable with the overlying beds. On the other hand, the unconformability at Perry renders it possible that the lower members of the St. John series may be wanting there; and to assign a Silurian date to the lower beds at St. John would imply the entire absence of the copious and characteristic Lower Devonian marine fauna observed at Gaspé and in Nova Scotia, as well as in Maine, though not in immediate connection with the Perry beds; while, if the whole series of St. John be Devonian, the absence of this fauna would be accounted for by the metamorphism of the lower beds.

In the present state of the evidence, it would be premature to decide this question, which may be settled either by the discovery of portions of the lower beds in a less altered state, or by tracing the St. John series into connection with the similar

deposits in Maine. In the meantime, therefore, we may be content to regard the upper members of the series as belonging to the later part of the Devonian Period, leaving the lower members to be regarded as Lower Devonian or possibly Upper Silurian.

The fossiliferous portion of the St. John series presents the richest local flora of the Devonian Period ever discovered. It far excels, in number of genera and species, the Lower Carboniferous flora as it exists in British America, and is comparable with that of the Middle Coal-measures, from which, however, it differs very remarkably in the relative development of different genera, as well as in the species representing those genera.

It is only just to observe, that the completeness of the following list is due to the industrious labors of an association of young gentlemen of St. John, who, under the guidance of Messrs. Matthew and Hartt, have diligently explored every accessible spot within some distance of the city, and have liberally placed their collections at my disposal for the purposes of this paper.

Dadoxylon Ouangondianum Dawson.
Sigillaria palpebra, sp. nov.
Stigmaria ficoides (var.) Brongn.
Calamites Transitionis Gæppert.
 — *cannæformis* Brongn.
Asterophyllites acicularis, sp. nov.
 — *latifolia*, sp. nov.
 — *scutigera*, sp. nov.
 — *longifolia* Brongn.
 — *parvula* Dawson.
Annularia acuminata, sp. nov.
Sphenophyllum antiquum Dawson.
Pinnularia dispalans, sp. nov.
Lepidodendron Gaspianum Dawson.
Lycopodites Matthewi Dawson.
Psilophyton elegans, sp. nov.
 — *glabrum*, sp. nov.
Cordaites Robbii Dawson.
 — *angustifolia* Dawson.
Cyclopteris Jacksoni Dawson.

Cyclopteris obtusa Gæppert.
 — *varia*, sp. nov.
 — *valida*, sp. nov.
Neuropteris serrulata, sp. nov.
 — *polymorpha*, sp. nov.
Sphenopteris Hœninghausi Brongn.
 — *marginata*, sp. nov.
 — *Harttii*, sp. nov.
 — *Hitchcockiana*, sp. nov.
Hymenophyllites Gersdorffii Gæppert.
 — *obtusilobus* Gæppert.
 — *curtilobus*, sp. nov.
Pecopteris (Alethopteris) discrepans, sp. nov.
 — (—) *ingens*, sp. nov.
 — (—) *obscura* (?) Lesquereux.
Trichomanites, sp. nov.
Cardiocarpum cornutum, sp. nov.
 — *obliquum*, sp. nov.
Trigonocarpum racemosum, sp. nov.

(To be continued).