

"Reprinted from the Canadian Record of Science, January, 1894."

**Preliminary Note on Recent Discoveries of
Batrachians and other Air-breathers in
the Coal-Formation of Nova Scotia.**

By Sir J. WILLIAM DAWSON.

This note is intended to record the fact of the discovery, in 1893, of erect trees containing remains of land animals at two horizons in the coal-formation of the South Joggins, in addition to that in which such remains were found by Sir C. Lyell and the writer in 1851, and from which so many additional trees of this character have been extracted in subsequent years. Details as to the species in the recently discovered trees will be published when their contents have been worked out and studied.

The remarkable section of coal-formation rocks at the South Joggins, in Cumberland County, Nova Scotia, has long been known as one of the most instructive in the world; exhibiting as it does a thickness of 5,000 feet of strata of the coal-formation in a cliff of considerable height, kept clean by the tides and waves, and in the reefs extending from this to the shore, which at low tide expose the beds very perfectly. It was first described in detail by the

12

late Sir W. E. Logan,¹ and afterwards the middle portion of it was examined in greater detail by the author, more especially in connection with the fossil remains characteristic of the several beds, and the vegetable constituents and accompaniments of the numerous seams of coal.² It was on occasion of a visit of the author, in company with Sir Chas. Lyell, and in the pursuit of these investigations, that one of the most remarkable features of the section was disclosed in 1851. This is the occurrence, in the trunks of certain trees imbedded in an erect position in the sandstones of Coal-mine Point, of remains of small reptiles, which, with one exception, a specimen from the Pictou coal-field, were the first ever discovered in the Carboniferous rocks of the American continent, and are still the most perfect examples known of a most interesting family of coal-formation animals, intermediate in some respects between reptiles proper and batrachians, and known as *Microsauria*. With these were found the first known Carboniferous land-snails and millipedes. Very complete collections of these remains have been placed by the author with his other specimens in the Peter Redpath Museum of McGill University. The manner in which these remains were entombed may be stated as follows:

A forest or grove of the large ribbed trees known as *Sigillariae* was either submerged by subsidence, or, growing on low ground, was invaded with the muddy waters of an inundation, or successive inundations, so that the trunks were buried to the depth of several feet. The projecting tops having been removed by subaerial decay, the buried stumps became hollow, while their hard outer bark remained intact. They thus became hollow cylinders in a vertical position and open at top. The surface having then become dry land, covered with vegetation, was haunted by small quadrupeds and other land animals, which from time to time fell into the open holes, in some cases nine feet deep,

¹ "Report Geol. Survey of Canada," 1844.

² "Journal London Geological Society," vol. x., pp. 1 et seq., 1853; "Acadian Geology," pp. 156 et seq.

and could not extricate themselves. On their death, and the decomposition of their soft parts, their bones and other hard portions remained in the bottom of the tree, intermixed with any vegetable *débris* or soil washed in by rain, and which formed thin layers separating successive animal deposits from each other. Finally the area was again submerged, or overflowed with water bearing sand and mud. The hollow trees were filled to the top and their animal contents thus sealed up. At length the material filling the trees was by pressure and the access of cementing matter hardened into stone, not infrequently harder than that of the containing beds, and the whole being tilted to an angle of 20°, and elevated into land exposed to the action of the tides and waves, these singular coffins present themselves as stony cylinders projecting from the cliff or reef, and can be extracted and their contents studied.

The singular combination of accidents above detailed was, of course, of very rare occurrence, and in point of fact until the year 1893 these conditions were known to occur in only one set of beds: under the thick-bedded sandstone in Division 4, Section XV. Coal-group 15, of my section of the South Joggins.¹

In the spring of 1893, however, Mr. P. W. McNaughton, of the Joggins Coal Mine, who had been so kind as to watch the exposures of trees in the cliff at my request, was so fortunate as to find two productive trees in beds considerably below that which had afforded the previous discoveries. According to Mr. McNaughton's observations, the lowest of these trees is in Division 4, Section XII., Coal-group 26, of my section, or 414 feet lower in the series than the original bed, and about 1,617 feet distant from it along the shore. The intervening beds, besides sandstones, shales and underclays, include fifteen small seams of coal, and five beds of bituminous limestone and calcareo-bituminous shale, so that they must represent a considerable lapse of time. The tree was rooted in a shaly underclay, with coaly streaks and

¹ "Acadian Geology."

stigmaria roots. It was one 1 foot 11 inches in diameter near the base. Below this, as is often the case with erect sigillariæ, there was a slight swelling or bulb. The lower part is imbedded in gray sandstone and shale for 5 feet 2 inches. Above this are 2 feet 6 inches of gray shale. Above this is a sandstone 12 feet thick, but the tree penetrates this only about 8 inches, when it is broken off. Thus the total remaining height is 8 feet 4 inches. The tree was probably a ribbed *Sigillaria*, and the bark at the base is unusually thick and rugged for trees of this kind. The remains of woody matter contained in it have not yet been examined microscopically. In the figure the tree is represented in its original vertical position, without reference to the dip (Fig. 1.)

Five feet of the lower part of this tree are filled with matter which must have been introduced into it while it remained an open pit, accessible to land animals. This material, while all probably introduced by rain-wash or accidental falling from the surface, is of varied character. At the bottom there is a layer of mineral charcoal about an inch in thickness, and immediately above this is a black shaly layer, with bones of small batrachians, remains of millipedes and coprolitic matter. Above this is a hard material, composed partly of indurated calcareous clay and partly of vegetable fragments arranged in very irregular layers, which have usually a shallow basin shape, being hollowed toward the centre. This is partly an effect of compression of the vegetable matter, and is partly caused by the greater thickness of the earthy beds toward the sides, a consequence of rain-wash from the surface. Here and there, throughout this part of the stem, there are thin, black, coaly or shaly bands marking surfaces of some duration. Toward the upper part of the productive five feet, sandstone predominates, but there are still occasional dark beds. Throughout all these layers there are animal remains, which are, however, more abundant in the dark and laminated beds. There is, more especially in the lower part of the tree, much coprolitic matter, sometimes in dis-

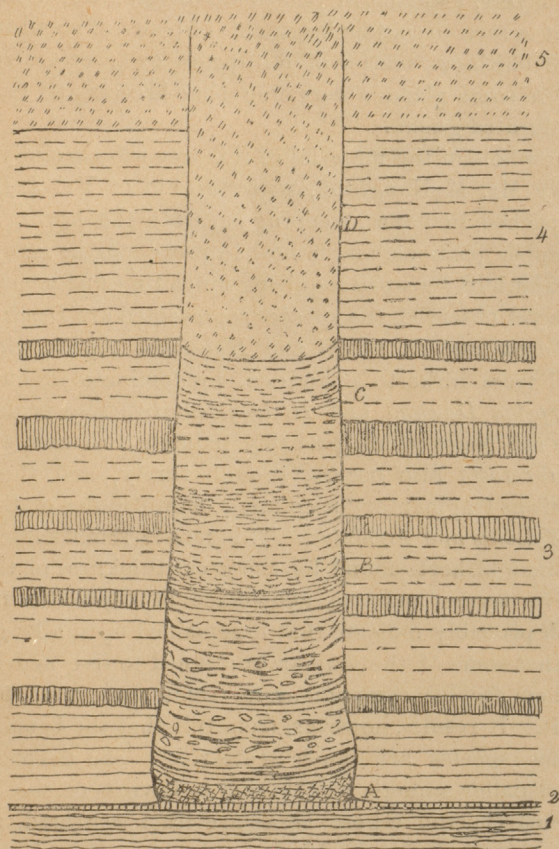


FIG. 1.—Section of tree No. 1, Division 4, Section XII., Coal-group 26, of South Joggins section; as observed *in situ* by Mr. P. W. McNaughton. (Scale 2 feet to an inch.)

Enclosing Beds.—(1) Underclay; (2) coaly layer; (3) alternations of shale and sandstone, 5 feet 2 inches; (4) shale, 2 feet 6 inches; (5) sandstone, 12 feet.

Filling of Trunk.—(A) Mineral charcoal and thin carbonaceous laminae. (B) Arenaceous and argillaceous matter, irregularly bedded and with many vegetable fragments. (C) Sandy layers, depressed in centre, with occasional shaly bands and vegetable fragments; remains of land animals up to top of C. (D) Barren sandstone, same with overlying bed.

tinet layers, and rich in phosphate of calcium. Under the lens it is seen to contain fragments of bones of small reptiles and of chitinous matter of millipedes or insects. It is in short in some places a very fine bone-breccia and in others an indurated guano.

The whole of the material of this tree was carefully taken out by Mr. McNaughton, with the aid of Mr. J. Devine, and packed in boxes, keeping separate the lower, middle and upper portions, and is now in process of being split up and examined—a work requiring much time and labour. So far as yet observed, the species represented are *Dendrerpeton Acadianum* and *D. Oweni* and *Hylonomus Lyelli*, which, as in all trees hitherto examined, predominate in numbers. *Hylerpeton Dawsoni* and *H. longidentatum* also occur, and there are bones which probably indicate two new species. *Pupa vetusta* also occurs, though rarely, and there are numerous fragmentary specimens of millipedes of the genera *Xylobias* and *Archiulus*. This tree is remarkable above all others hitherto found for the great thickness of the productive layers and the abundance of coprolitic matter, which probably indicate that it remained open a long time, and that some of the animals continued to live and subsist on their feebler companions for some time after they fell into it. It results, however, from this that the bones of the smaller species are much scattered. The devourers of these smaller animals would seem to have been the species of *Dendrerpeton* whose bones are least scattered, and in some cases associated with carbonised cuticle. One specimen of *Dendrerpeton Acadianum* is the largest yet found, the skull being 4 inches in length. It may have been nearly 3 feet long, and could not therefore extend itself within its prison.

The second tree found by Mr. McNaughton is in Division 4, Section XIII, Group 20, of the Section. It is thus 203 feet 7 inches below the original bed at Coal-Mine Point, and is about half way between this and the new tree in Group 26. It is remarkable as standing on a bituminous shale, one of the few beds of this kind which have been elevated

to constitute forest soils. It is 22 inches in diameter, and is about seven in height; but only about 18 inches of the lower part are productive, and are largely composed of a dark-coloured laminated material, much damaged by the percolation of ferruginous water. The enclosing beds are, in ascending order, coarse shale and sandstone 3 feet, sandstone 4 feet, and beds of coal with shaly partings 2 feet. The contents of this tree have as yet been only cursorily examined, and though it contains many small bones, these are for the most part not in so good preservation as in the other tree. They include specimens of *Dendroperon* and *Hylonomus*.

It is probable that at least twenty batrachians found a grave in the first mentioned tree. Among the vegetable matter mixed with the bones, I have noticed fragments of *Lepidodendron* and *Calamites*, and leaves of *Cordaites* and ferns, and stems with numbers of aerial roots of the type of *Psaronius*; but most are mere scraps of bark and decayed wood, such as might drop in, or be washed in from the surface by rain.

On the whole the preliminary examination of these trees does not indicate material change of fauna during the deposition of fifteen successive coal-beds and their accompaniments. It would also seem to show that the trees previously extracted, about thirty in number, have nearly exhausted the terrestrial vertebrate fauna of the locality.

For descriptions of the species hitherto discovered in these singular repositories; reference may be made to the author's "Geology of Nova Scotia, New Brunswick and Prince Edward Island," chapter xviii., to his "Air-breathers of the Coal Period," and to his paper on "Erect Trees containing Animal Remains" in the Transactions of the Royal Society of London, Part II., 1882, and for a summary of the facts to "Salient Points in the Science of the Earth," chapter x. More detailed notices of the fossils found in the trees recently discovered will appear in the future.

