

SECTION IV, 1889.

TRANS. ROYAL SOC. CAN.

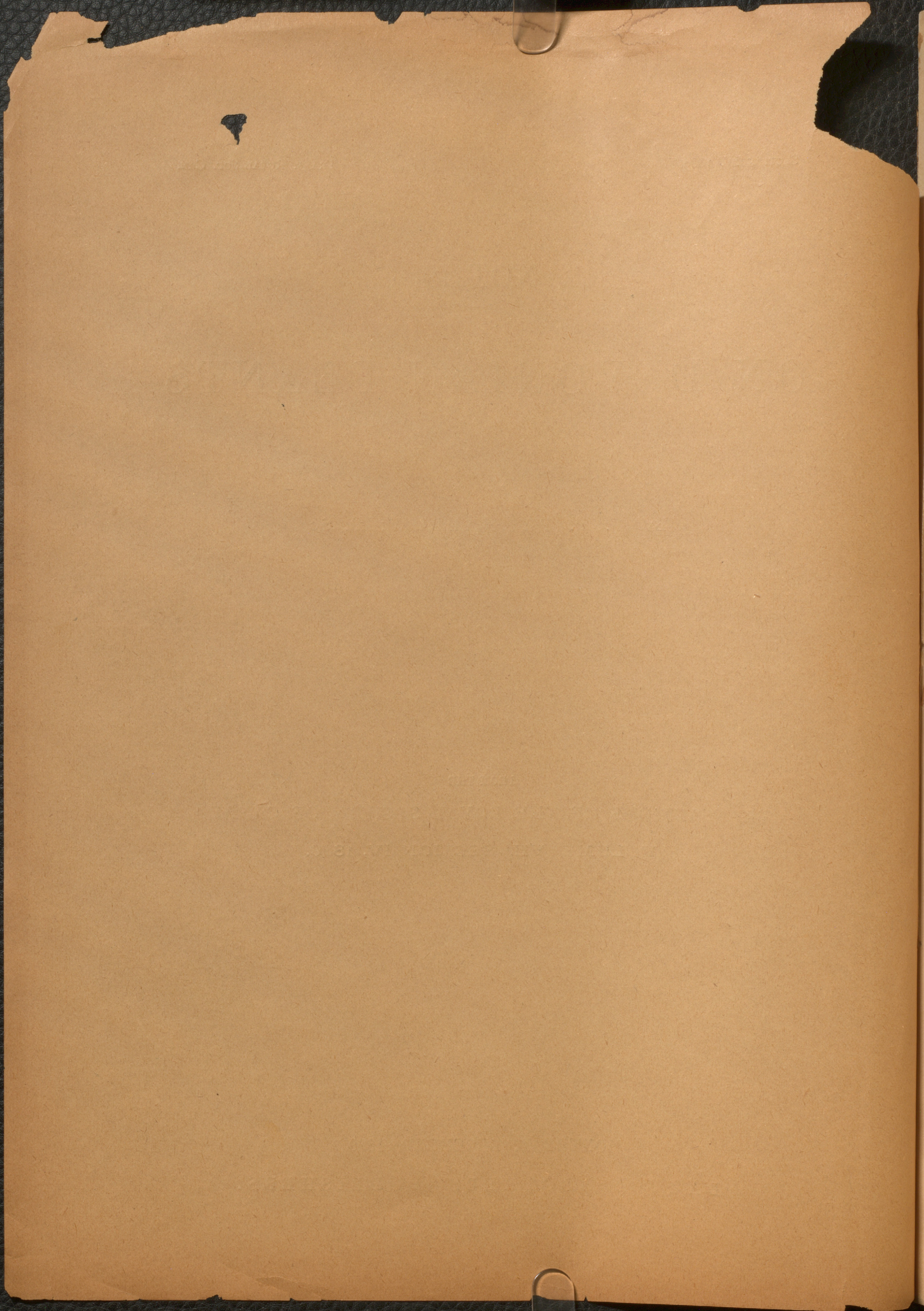
NOTES  
ON DEVONIAN PLANTS

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FROM THE  
TRANSACTIONS OF THE ROYAL SOCIETY OF CANADA  
VOLUME VII, SECTION IV, 1889.

MONTREAL, DECEMBER, 1889.

DAWSON BROTHERS, PUBLISHERS.



II.—*Notes on Devonian Plants.*

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(Presented May 8, 1889.)

In a paper presented to this Society last year, I gave the results of certain investigations into the histology of Prototaxites, and among the conclusions then reached was a confirmation of the view advanced by Carruthers, that this plant is in reality an Alga and allied to the Laminariæ of our modern flora.

During the past year I have continued my examination of these fossils whenever fresh material was brought to notice, and it is only necessary to remark here, that all the results thus obtained have only served to confirm more fully the conclusion already reached. I have also been able to add to the genus three species previously recognized under other names. In the present paper, therefore, I propose, chiefly, to deal with these latter, and present a complete revision of the genus as a whole.

NEMATOPHYTON HICKSII, *Dn.*

In a former paper on Nematophyton,<sup>1</sup> I dealt but briefly with the characteristics of *N. Hicksii*, as I did not feel that the imperfect material then available would admit of a more lengthy description. Since then, Sir Wm. Dawson has placed in my hands some additional material, which, although it does not add very largely to the facts already gathered, yet enables me to confirm and state, in a somewhat more detailed form, the characters previously assigned to this species.

The only form in which this plant is at present found, is in small fragments imbedded in clay. In its general appearance, the material suggests the operation of decay followed by the mechanical action of water—as waves on a shore—whereby the plants became broken into small fragments. It therefore resembles the material commonly found on beaches. The fragments are small and all highly silicified, and the organic matter is so far removed, or so completely broken up as to render them extremely friable. In consequence of this, complete sections showing the normal relationship of parts cannot be obtained, and almost all my observations have necessarily been made upon isolated cells. Furthermore, the destruction of the organic matter has extended so far that the specimens are essentially represented only by siliceous casts of the cells, though, in some cases, patches of carbonaceous matter adhere to the casts in such a way as to convey an approximate idea of the thickness of the original cell wall. From this I am led to consider the wall as somewhat thick. The cells are also, without doubt, tubular and non-

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<sup>1</sup> Trans. Roy. Soc. Canada, vol. vi, sec. iv, p. 45.

septate, and more recent examinations have shown so many undoubted instances of branching—as may be seen in the figure—that the relationship to *N. Logani* cannot be questioned.

As stated in my former paper, these larger cells have a diameter of 12 - 22  $\mu$ , but as this applies only to the siliceous casts, we must add to this, assuming the walls to be of the same thickness as in *N. Logani*, 10.5  $\mu$ , which would make the total diameter of the original cells 31.5  $\mu$ , or equal to some of the larger cells of *N. Logani*.

A secondary system of filaments is also evidently present. Casts of small tubular cells are very frequent. They have a diameter ranging from 1 to 1.5  $\mu$ . Together with these there are also casts of branching filaments, many of which have free terminations and exactly resemble the young hyphæ of a fungus. These latter were in all probability derived from a fungus growing in the plant as a feature of its decay. The fact, however, that the larger cells of the medulla branch, permits me to consider that some of the casts, at least, belonged to a secondary plexus of filaments which were in all essential respects the same as in *N. Logani* or *N. laxum*.

Spores are abundant. These bodies are of a reddish-brown color, measure 1.58  $\mu$  in diameter and are often aggregated into dense, spherical masses of reddish brown, resinous looking substance. To this I would refer the spherical masses of a similar character already noted as occurring in both *N. Logani* and *N. crassum*, and it seems highly probable that they were derived, in each case, from associated fungi.

The fine striation or transverse marking on the casts, as originally pointed out by Mr. Etheridge,<sup>1</sup> has been noted by me in more than one case. It is not, however, a constant feature, but occurs only now and then. If such marking represented structure in the cell wall, we might reasonably expect to find it, if not on the casts of all the cells, at least on so many of them as to leave no doubt in our minds relative to its proper connection. On the other hand, such markings are distinct from the ordinary striation of the cell wall and their position is variable. They resemble in fact markings made upon the casts by pressure of some external structure exerted through the cell wall. In my last communication on this plant,<sup>2</sup> I expressed a doubt as to these markings representing any structure in the cell wall, and from more recent examinations I do not hesitate to express the belief that that they are in reality caused by the filaments of the intercellular plexus.

From the facts stated above, it would appear that there is ample reason for confirming the position already assigned to this plant. It may be only another condition of *N. Logani*; but this, in view of the highly altered nature of the specimens so far obtained, cannot be definitely affirmed, and for the present, therefore, it must necessarily remain under its present specific name.

#### NEMATOXYLON CRASSUM, *Dn.*

The original description of this plant is as follows<sup>3</sup> :—

“Fragments of wood with a smooth, thin bark and a tissue wholly composed of elongated cylindrical cells with irregular pores or markings. No pith, medullary rays, nor rings of growth.”

<sup>1</sup> Quart. Jn'l. Geol. Soc., Aug., 1881, 492; fig. 4.

<sup>2</sup> Trans. R. S. C., vi. iv. 43.

<sup>3</sup> Quart. Jn'l. Geol. Soc., Nov., 1863, 466.

I have not been able to inspect the original specimens from which the sections were taken, but the text following the above description refers to them as fragments, the largest of which may have been two inches long, an inch wide, and half an inch thick. The statement is also made that they are calcified and, under the microscope, remind one of Prototaxites (Nematophyton); "but the cells are of one-third greater diameter than in *P. Logani*, and are destitute of its peculiar markings, and there are no rings of growth or medullary rays. The wood cells are of good length, somewhat tortuous, loosely aggregated and much thickened by ligneous deposit, which appears to be traversed by many narrow, tortuous lines or pores. The whole stem seems to be perfectly homogeneous, and the only other structure observed was a faint and doubtful trace of the existence of parenchymatous cells in some of the spaces between the fibres."

In a later communication,<sup>1</sup> Sir Wm. Dawson says: "I place these plants here, simply because of the resemblance of their tissues to those of Prototaxites (Nematophyton), with which it is possible they may have had some connection, being, perhaps, stems or slender roots of similar species of smaller size. No additional specimens have been obtained since the publication of my paper above cited (Jn'l. Geolog. Soc.), which would indicate that specimens of these plants are rare at Gaspé, and they have not been found elsewhere. The original specimens were collected by Mr. Bell of the Geological Survey."

This plant occurs in the Middle Erian of Gaspé, and it will be of interest, in connection with what follows, to bear in mind that the *Nematophyton Logani*, Dn., although found in the same locality, belongs to a lower horizon, viz., the Lower Erian.

The desirability of a revision of this species was suggested by its strong general resemblance to Nematophyton, and by the facts developed by the recent examination of the latter. The results obtained by me from the sections in possession of Sir Wm. Dawson, which were submitted to additional grinding, are as follows:—

In transverse section, the cells are large, thin walled, somewhat remote and tolerably uniform in size. Our measurements show that they average about 35  $\mu$  in diameter, varying from 32  $\mu$  to 59  $\mu$ . It will thus be seen that they are, on the whole, fully as large as the largest cells of *N. Logani*,<sup>2</sup> but they do not present the same extreme variation in size, nor is there that peculiar grouping of larger and smaller cells which, in the latter plant, gives rise to the appearance of rings in the stem. We do not lay much stress upon this fact, however, since such tracts of larger and smaller cells may have been present in the original plant, though not represented in the small fragments brought to our notice. No radial openings are to be found, but in their place there are frequent small and irregular tracts of open structure into which the cells penetrate very much as in Nematophyton. The form of the cells is in most cases well preserved; in other cases they show the effect of compression in their flattened form. Moreover, a transverse section of the stem is not transverse to all the contained cells, which are, therefore, not wholly parallel. The somewhat wide areas between the cells are largely occupied by a structure which is not easily made out in all cases, but which consists of smaller tubes running diagonally or transversely to the direction of the general structure, and this is what appears to be referred to in the original description above given, as "a faint and doubtful trace of the existence of parenchyma cells in some of the spaces between the fibres."

<sup>1</sup> Geol. Sur. of Can., Fossil Plants, part i. 20.

<sup>2</sup> Trans. R. S. C., vi. iv. 39.

The question of decay cannot be regarded as a factor in the present case since there is no alteration of structure such as it would be liable to produce, and in consequence, I find that the organic matter has not suffered redistribution, but occupies its original position. I have stated that the cell walls are thin. This is true with reference to the carbonaceous residue, but on the whole, the walls, as they appear in the specimens, are very thick and the cell cavities small or none. This great increase of thickness is stated, in the original description cited, to be due to a "ligneous deposit."

The appearance of the cells is just that exhibited by a cross section of *Laminaria* stained with logwood, in which a thin outer wall is seen to be stained, while the inner and thicker wall remains colorless, showing an obvious differentiation of the cellulose substance. In *N. crassum* a similar differentiation may have been developed, and the inner thick layer may have become replaced by the siliceous cast as now found.

Treatment of a section with hydrochloric acid discloses the presence of calcite, which is almost wholly located in the intercellular regions, as upon its removal the whole section breaks up into separate cells.

In longitudinal section the cells are found to be tubular, non-septate and somewhat strongly vermicular, rather more so, perhaps, than in *N. Logani*. The open tracts are now seen to be somewhat elongated longitudinally so that they become two to four times as long as broad. The siliceous deposits are also seen to be continuous, although embracing the fractures peculiar to such formations. These fractures are the many narrow, tortuous lines or pores of the original description; and the deposits, as a whole, are the counterparts of those siliceous casts upon which the description of *N. Hicksii* is based.

The most significant fact so far observed, consists of the discovery of a distinctly branching system, similar in its general character to that of *N. Logani*, though differing from it in some important respects. In one case I found a branch projecting from the side of a large cell with a diameter of  $5.8 \mu$  and a length to the point where cut off, of about  $35 \mu$ . Two other branches near together were each  $4.6 \mu$ ; two more were  $2.3 \mu$  and  $4.6 \mu$ ; another,  $6.9 \mu$  in diameter. These were all I could find within this range of dimensions, and all, with one exception, were found in transverse section. Numerous other secondary filaments may be readily observed, especially in cross section, and they are found to have a diameter which varies but little from  $10 \mu$ . It is, therefore, clear that the larger cells of this plant branch into a secondary plexus as in *N. Logani*, and as all of the instances, in which the branches were seen to emanate from the larger cells, occurred in the open tracts above described, it would appear that these latter serve as the special regions in which the branching is effected, as in *N. Logani*. My measurements show, however, that the secondary filaments of this latter plant are smaller on the average, much more uniform in size, and more numerous than in the plant now under consideration; and this explains what is stated in the original description, that the cells "are destitute of their (*N. Logani*) peculiar markings."

The silicified thickenings of the cells are seen in the longitudinal section to be continuous, though traversed by occasional fissures, the "tortuous lines or pores" of the original description as pointed out above. So far, none of the specimens I have examined show any evidence of structural markings in the cell walls, which are perfectly continuous. I have, however, frequently noted small round bodies of a refractive nature and a deep reddish brown color, suggesting small aggregations of resinous matter elsewhere referred

to as associated with *N. Logani*. Their exact nature remains doubtful. They are usually found disposed in the cell in linear series of two to twelve or more. They are in all cases quite distinct from the cell wall. Bodies of the same kind have also been seen, though less frequently, in *N. Logani*, and abundantly in *N. Hicksii*, where they are obviously composed of pores.

From the above it is evident that our plant is a Nematophyton, though it differs from *N. Logani* in important respects. It approaches more nearly to *N. laxum*, but again differs from it in its more compact structure, greater uniformity of size in its cells, and in its less prominent intercellular plexus. We may, therefore, regard it as a distinct species for which I would retain the name *crassum* as properly descriptive.

A revised description would be as follows :—

NEMATOPHYTON CRASSUM, *Pen.*

*Nematoxylon crassum*, *Dn.*

Growth rings (?), pith and radial tracts none. The plant wholly composed of thin-walled, structureless, vermicular and non-septate cells which branch into a secondary plexus. Open tracts frequent, and of irregular size, in which the branching chiefly occurs. Cells of the medulla rather uniform and thick walled—wall double— $35\ \mu$  in diameter. Cells of the hyphal structure variable, from  $2\ \mu$  to  $10\ \mu$  in diameter.

Specimens found only in fragments. From the Middle Erian of Gaspé.

CELLULOXYLON PRIMÆVUM, *Dn.*

In the course of my examinations of Nematophyton during the past two years, certain peculiarities of structure due to alteration in the distribution of the organic matter attracted attention, and suggested their possible identity with the structure of certain fossils already brought to my notice by Sir Wm. Dawson, under the name of *Celluloxylon primævum*. These latter have therefore been subjected to a more critical examination with a view of determining if they are in reality distinct species, or merely altered forms of some other plant. As a preliminary to this examination, I may detail the peculiarities of structure in Nematophyton above referred to.

#### NEMATOPHYTON.

In most of the specimens of Nematophyton examined by me, the tubular character of the cells is so perfectly preserved as to admit of no doubt concerning their correct form and size. In section taken from very highly silicified and crystalline specimens, however, it is found that the infiltrated silica has often so far replaced the organic matter as to leave not the faintest trace of cellular structure, and very frequently no trace of organic matter. In other specimens, various intermediate stages of silification are to be observed in which both organic matter and cellular structure are more or less conspicuous, but of an obviously altered character. In many cases it has been found that the infiltration of siliceous matter, under certain conditions, has resulted in its deposition in a distinctly crystalline form which fills the tubular cells throughout. In all such cases I have

noted a variable tendency towards the redistribution of the organic matter, with a consequent breaking up of the normal structure and its replacement by a granulated, carbonaceous substance which always tends to be determined along the lines of contact between contiguous crystals. It is obvious, therefore, that if the proper conditions of structure are present in the first instance, together with sufficient growth in the crystals, the organic matter will not only suffer complete redistribution, but at the same time will take up such positions as to produce a false cellular structure which will have the same general character in both longitudinal and transverse sections; although, in the former, there will always be a tendency for the false cells to be distributed in lines, as determined by the direction of the cells from which they were derived. This view, we find, was advanced by Sir Wm. Dawson in one of his earliest papers on Prototaxites, when he pointed out that, "In parts of the larger trunks, as is usual with fossil woods, it has been replaced by a concretionary structure, or by that pseudo-cellular structure which proceeds from the formation of granular crystals of silica in the midst of the tissues.

"In fossils woods the carbonaceous matter, being reduced to a pulpy mass, sometimes partly becomes moulded on the surfaces of hexagonal or granular crystals in such a manner as to deceive, very readily, an observer not aware of this circumstance."<sup>1</sup>

The statements thus made admit of ready confirmation, since it is precisely what occurs in many specimens of Nematophyton, and not only do we find plants in which the entire structure is thus transformed, but in others, where the normal structure is preserved, there are often found localized tracts within which such alteration has taken place. From facts brought to my notice, I am led to consider a more or less advanced condition of decay as preceding the impregnation by silica, and thus essential to the changes noted.

These statements are partly based upon the following observations, which will serve to indicate the correctness of my position.

No. 1.—A transverse section. The organic matter was found to be nearly eliminated, but still enough was present to show its redistribution to such an extent as to completely destroy the normal structure and give rise to a false cellular structure, closely resembling that of Celluloxylon in all its essential features. Upon measurement it was found that ten cells, selected at random, gave a mean diameter of 60  $\mu$  and an extreme variation of from 40  $\mu$  to 90  $\mu$ .

No. 2.—A silicified specimen in which the organic matter was much more abundant, but subjected to precisely the same redistribution and closely resembling Celluloxylon. Ten measurements gave an average diameter of 62  $\mu$  and an extreme variation from 40  $\mu$  to 130  $\mu$ .

No. 3.—A silicified specimen in which the tubular cells were occasionally found, but for the most part the organic matter was redistributed as in the previous cases. Ten measurements gave an average diameter of 61  $\mu$  and an extreme variation of from 40  $\mu$  to 90  $\mu$ . In this specimen it was also noted that still larger cells were obviously formed by coalescence of two or more smaller cells, and this fact explains the unusually large one observed in No. 2.

No. 4.—A silicified specimen in which the normal structure was largely preserved,

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<sup>1</sup> Month. Mic. Jn'l., x, 69, 70.



and containing areas of altered structure where the tissue appeared as in the other specimens. Ten measurements gave an extreme variation of from 30  $\mu$  to 70  $\mu$  and an average diameter of 51  $\mu$ .

In addition to these I have also examined a special series of sections taken from plants in different degrees of silification. In all of these, the characters above noted were present, but the size of the false cells appeared to present greater variation. It is from one of these that the photo-micrograph (Plate I fig. 1) was taken. I have also noted that, on the whole, the false cells are of greater size in those specimens where the crystallization of the silica was carried to the highest degree. The same fact is apparent by comparison of the measurements in Nos. 1-4 as above stated. From this it would appear clear to us that the degree of crystallization, and hence, the redistribution of the organic matter, depend upon and are directly related to the previous operation, as well as the extent, of decay in the organic structure. Therefore, the more advanced the condition of decay at the time when silica was deposited, the larger will be the crystals and false cells dependent upon them. The significance of these facts, as bearing upon the true character of Celluloxylon, will hardly admit of question.

#### CELLULOXYLON.

The original specimens from which were cut the sections of Celluloxylon examined by me, were obtained by Sir Wm. Dawson from the collection of Prof. H. M. Clarke, of Amherst, Massachusetts having been found in the Hamilton Group (Middle Erian), Canandaigua, New York.<sup>1</sup> This is described as "A silicified trunk showing in cross-section large and somewhat unequal, hexagonal cells, with an appearance of lines of growth caused by concentric bands of smaller cells. No medullary rays. The longitudinal section shows either cells superimposed in vertical rows, or a sort of banded prosenchymatous tissue but the structure is much masked by the crystallization of the quartz.

"Additional specimens received from Prof. Clarke show that the appearance of rings of growth is caused by large cells disposed in concentric, narrow bands between the wider bands of fine, fibrous tissue. In the longitudinal section, three bands of large cells appear to be parenchymatous and not vascular. There are no medullary rays, but rounded patches of cellular tissue appear here and there in fibrous layers."

The original specimens from which the sections were cut have been again examined by me. With one or two exceptions, all of these pieces are so curved as to show that they are parts of concentric layers about one-fourth of an inch thick. A concentric lamination in the stem, similar to that of *N. Logani*, is evident. All of the specimens are of the same kind with respect to silicification, and show that the alteration has been carried on to a high degree. The texture is finely granular and, under a lens of low power, the material appears to be very finely crystalline, quite similar to that found in large stems of *N. Logani*, where the crystallization is also advanced. A certain longitudinal striation, of not very pronounced character, may also be detected. The absence of any radial markings is conspicuous, as noted in the original description. This, in the highly altered condition of the material, does not of necessity imply their absence from the original structure.

<sup>1</sup> Quart. Jn'l. Geol. Soc., May, 1881, p. 302.

An examination of the internal structure shows that the following characters are common to all the sections. The structure is coarsely cellular. In transverse section the cells are variable in size, averaging about  $50 \mu$  in diameter. The walls are not well defined and continuous, but are often poorly defined and consist of a granulated carbonaceous substance which often becomes irregularly scattered, sometimes intruding upon the cell cavity, though in most cases localized along definite lines. We have found cells of only one kind, and are therefore unable to confirm the statement of the original description to the effect that "the appearance of rings of growth is caused by large cells disposed in concentric, narrow bands between the wider bands of fine, fibrous tissue," although from analogy we should infer that this might have been the case in the original stem.

In longitudinal section the cells are found to present the same appearance as to their general characteristics, as in the transverse section, and also a marked similarity in size—measuring about  $50 \mu$  in diameter. There is, however, a more or less marked tendency, as noted in the original description, for the cells to fall into longitudinal rows which follow a somewhat vermicular course. This is most conspicuous under a low power, although to be observed, in many cases, under a  $\frac{1}{8}$  objective.

My measurements show that, as determined from cells taken at random, the average size in transverse section is  $48 \mu$ , the range being from  $40 \mu$  to  $70 \mu$ . In longitudinal section, the same number of measurements give an average of  $54 \mu$ , and an extreme range between  $30 \mu$  and  $70 \mu$ .

These facts, taken in connection with the similarity here noted between this plant and *Nematophyton* in certain conditions, lead to the conclusion that it is only a highly altered condition of this latter. This view is also supported by the opinion expressed some time since by Sir Wm. Dawson that "Celluloxylon is allied to *Prototaxites*."<sup>1</sup>

Furthermore, while it is quite possible that this may have been a distinct species, which I have no present means of proving, the fact that it occurs in the Middle Erian and not in the lower horizon, where alone *N. Loganii* has been found, together with the probability that the radial openings of *N. Loganii* were represented here by scattered, open areas of small size as in *N. crassum*, would lead one to refer it, for the present at least, to the latter species.

#### NEMATOTOXYLON TENUE, *Dn.*

This plant was originally described by Sir Wm. Dawson, as follows<sup>2</sup> :—

"Slender stems with thick, coaly bark and woody fibres of much smaller diameter than in the last species (*N. crassum*) and marked with minute dots." In connection with this it was also stated that "the stems of this species are small, not exceeding half an inch in diameter, but are distinctly surrounded by a thick, shining, coaly bark. The wood is calcified and appears to be perfectly homogeneous. . . . It may be doubted if this species has any real affinity with the last (*N. crassum*), but they correspond in their negative characters, and both appear to indicate the existence of certain woody plants of singularly simple and homogeneous structure."

<sup>1</sup> Geolog. Surv. of Canada, Fossil Plants, part ii, p. 126.

<sup>2</sup> Quart. Jn'l. Geol. Soc., Nov. 1863, 467.

My first examination of sections of this plant, showed that I had to deal with a structure of much finer quality than found in any of the species of Nematophyton, and I was at first led to consider that it might be a plant of very different type. Upon closer inspection, however, this view required important modification and, as will be seen from the following description, it now seems most probable that we have to deal with an organism which, if not generically related, is at least allied to Nematophyton through the general character of its structure.

The specimens examined by me are all somewhat highly crystalline and the structure has, in consequence, suffered important modifications which, although the general form and disposition of the cells can still be made out, have tended to obscure the structure and render details difficult of determination. The material is also, in consequence of its crystalline character, very friable, and this has seriously interfered with securing sections of sufficient thinness to make a close examination possible.

In transverse section the structure is found to consist of small and closely compacted cells—the tissue being so dense as to make the contiguous cells appear in most intimate contact. This relation is probably the result of alteration and not that which existed in the growing plant, since cells are found at intervals which are as distinct as in Nematophyton, while it is also evident from the oblique section of many, that they were not all parallel to the axis of growth.

The cell walls are thin, and it is also a fact of some interest, in this connection, that the tissue presents almost the exact appearance of the intercellular structure seen in cross sections of *N. Logani*, with reference to size, form and general disposition of the cells and thickness of the walls. Occasionally, somewhat linear tracts are found, within which the cells follow a direction transverse to the axis of growth.

Scattered through the otherwise homogeneous tissue at rather wide intervals, are relatively large, rounded or oval openings. These, so far as can be determined at present, appear to be structureless, i.e. there is no separate wall, nor are there any surrounding cells such as form the resin passages of modern plants. They measure 10–13.5  $\mu$  in diameter and their proper significance is at present a matter of doubt, although the invariable presence in them of highly crystalline silica suggests that they may have been caused by mechanical separation of the surrounding cells. Small and irregular open tracts are also to be seen in the tissue, similar, although much smaller, to those in *N. crassum*.

In longitudinal section the cells are found to be distinctly vermicular, and although the more compact nature of the structure tends to render them less sinuous than in either *N. Logani* or *N. crassum*, yet the peculiar way in which the cells interlace and sometimes cross one another very abruptly, leaves no room for doubt upon this point. Furthermore, the cells are non-septate and in diameter are tolerably uniform, measuring 5–8  $\mu$ . In this latter we again notice a curious resemblance to the intercellular structure of both *N. Logani* and *N. crassum*, and also of *N. laxum*. In *N. Logani* the filaments show a variation in size ranging 3.7–8.9  $\mu$ . In *N. laxum* the corresponding structures range 3–9  $\mu$  and in *N. crassum* 2–10  $\mu$ , so that the cells of the medulla in this plant may be fairly regarded as essentially of the same size. Moreover, in *N. laxum*, it frequently happens that the secondary filaments constitute the only structure within fairly large areas, and in such cases these cells are generally found to run parallel to the axis of growth

and form a very compact structure which presents a most striking resemblance to the longitudinal structure of the plant now under consideration.

The rounded openings, observed in transverse section, are here seen to be continuous tubes filled with highly crystalline matter, while the open tracts appear as rounded and small areas of irregular size and form. The branching of the cells has not as yet been determined as fully as might be desired. In only one case thus far have we found the large cells to branch, but this was of so pronounced a nature as to admit of no question. What appear to be secondary filaments, having a diameter about one-fifth that of the large cells, have been observed in both transverse and longitudinal sections, in every case appearing in the open tracts above described. While, therefore, it seems probable that such an intercellular structure exists, I must, for the present, speak with some reserve on this point.

The "minute dots" on the cell walls, referred to in the original description, cannot be regarded as having any structural significance, and we have so far found the walls to be wholly structureless. Many of the cells show irregularly scattered, dark bodies which, of variable size, are sometimes spherical, again distinctly angular. The material of which they are composed has been so altered as to render their true character a matter of some doubt; but from what has been observed in the various species of Nematophyton thus far described, it is quite probable that they have similarly originated from spores.

The evidence thus far obtained points, with considerable force, to an affinity with Nematophyton to which genus I would transfer it, retaining the specific name originally given.

#### GENUS.—NEMATOPHYTON, *Dn.*

Quart. Jn'l. Geolog. Soc. XV, 484; Nov., 1862, 299, 307, 326; Nov., 1863, 466, 467; May, 1881, 302; Aug., 1881, 482; May, 1882, 104; Geolog. Surv. of Can., 1863, 401; 1871, 16 and 20; 1882, II, 97, 107; Can. Nat. V, 9; VI, 177, 179; (New Ser.) VII, 173; Ann. and Mag. Nat. Hist. 5, IX, 59; M. Mic. Jn'l. VIII, 160; X, 66, 208; XI, 83; Quart. Jn'l. Mic. Soc. XIII, 313; Amer. Nat. V, 185, 245; Geolog. Hist. of Plants, 21, 42; Trans. Roy. Soc. Can., VI, iv, 27; Proc. Amer. Ass. Adv. Sci., 1856.

Plants of arborescent form from a branching, root-like base. Stem branching, often exceeding 1° in diameter. Structure composed of unjointed, interlacing, structureless cells which branch into an intercellular system of small and closely-woven filaments.

#### 1.—*N. LOGANI, Dn.*

*Prototaxites Logani, Dn.*

*Nematophycus Logani, Carr.*

Stem distinguished by its concentric layers, which simulate an exogenous structure; irregular and disjointed radial openings of variable length, and often a thin cortical layer appearing in the form of coal.

Cells of the medulla, thick-walled, 13–35  $\mu$  in diameter, interwoven, loosely aggregated and turning into the radial spaces. Hyphal structure composed of branching filaments 4–9  $\mu$  in diameter, which branch from the cells of the medulla and form a closely-woven intercellular plexus.

Lower Erian of Gaspé; Silurian (Upper Ludlow) of England; and Silurian (Cape Bon Ami) of New Brunswick (*Dawson*).

2.—N. HICKSII, *Dn.*

*Prototaxites Hicksii*, *Dn.*

*Nematophycus Hicksii*, *Eth.*

Cells of the medulla, 12–22  $\mu$  in diameter, and somewhat compact. Hyphal filaments, 1–1.5  $\mu$  in diameter,<sup>1</sup> forming a rather less prominent plexus than in *N. Logani*, otherwise the same.

Specimens occurring only in small fragments and the structure represented wholly by siliceous casts, with occasionally adherent fragments of carbonaceous matter.

Denbighshire Grit (Silurian) of Wales (*Hicks*).

3.—N. CRASSUM, *Pen.*

*Nematoxylon crassum*, *Dn.*

*Celluloxylon primævum*, *Dn.*

Radial tracts none; open tracts frequent, small and of irregular form and size.

Cells of the medulla thick-walled, showing two layers, and rather uniform, 35  $\mu$  in diameter. Cells of the hyphal structure variable, 2–10  $\mu$  in diameter. Highly crystalline forms often show a replacement of the normal cells by a pseudo-cellular structure (Celluloxylon).

Specimens found only in fragments. Middle Erian of Gaspé (*Bell*), Hamilton Group (Middle Erian) of New York (*Clarke*).

4.—N. LAXUM, *Pen.*

Concentric layers and radial openings, none. Cells of the medulla, 15–31  $\mu$  in diameter, thick-walled, remote and branching into hyphal filaments, 3–9  $\mu$  in diameter, which form a compact network constituting the greater part of the structure, which is thus rendered very loose and spongy.

Lower Erian of Gaspé (*Dawson*).

5.—N. TENUE, *Pen.*

*Nematoxylon tenue*, *Dn.*

Concentric rings and radial tracts, none; open tracts small, irregular and frequent. Structure dense, and traversed at intervals by tubular openings 10–14  $\mu$  in diameter.

Cells of the medulla, thin-walled, closely approximated and 5–8  $\mu$  in diameter. Cells of the hyphal structure 1  $\mu$ +. Structure highly crystalline and friable. Stems small and invested by a thickish layer of coal.

Lower Erian of Gaspé (*Bell*).

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<sup>1</sup> These measurements refer only to the siliceous casts, and are, therefore, not strictly comparable with those for other species.

## DESCRIPTION OF FIGURES.

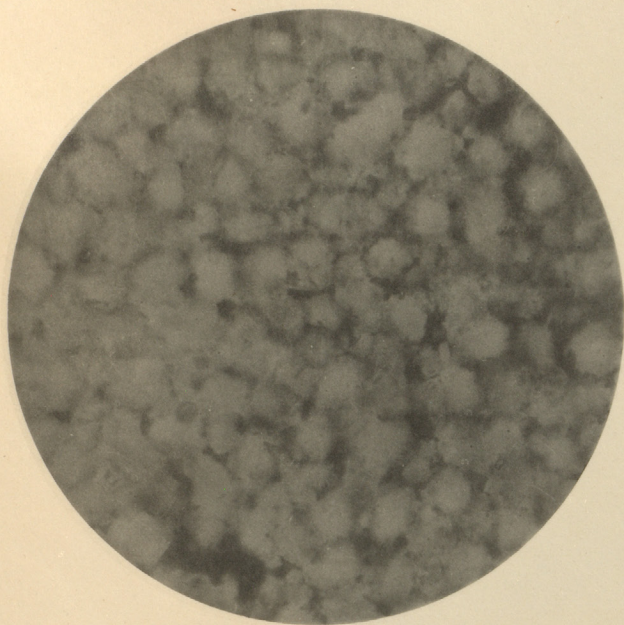
## PLATE I.

- FIG. 1.—*Nematophyton Logani*.—Transverse section, showing conversion of the normal into a pseudo-cellular structure through crystallization. Taken from a specimen also showing normal structure.  $\times 154$ .
- FIG. 2.—*Nematophyton crassum* (?).—Transverse section showing effects of crystallization.  $\times 154$ .
- FIG. 3.—*Nematophyton crassum* (?).—Longitudinal section showing tendency of false cells to follow lines of normal structure.  $\times 154$ .
- FIG. 4.—*Nematophyton Logani*.—Longitudinal section of normal structure showing the secondary filaments crossing the cells of the medulla.  $\times 154$ .
- FIGS. 5 & 6.—Transverse and longitudinal sections of *Nematophyton crassum*. Normal.  $\times 154$ .

## PLATE II.

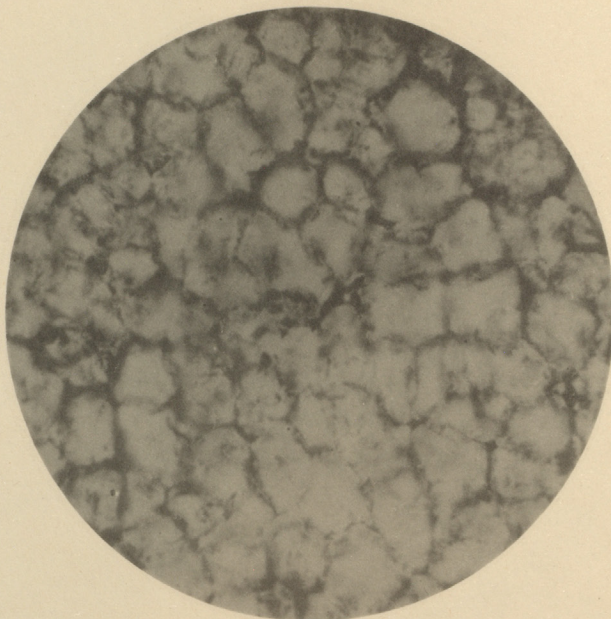
- FIG. 1.—*Nematophyton Hicksii*.—Showing siliceous casts with carbonaceous fragments adherent to them.  $\times 210$ .
- FIG. 2.—*Nematophyton tenue*.—Longitudinal section, showing general character of the structure. One of the large tubular openings is seen in the centre.  $\times 300$ .

Fig. 1.



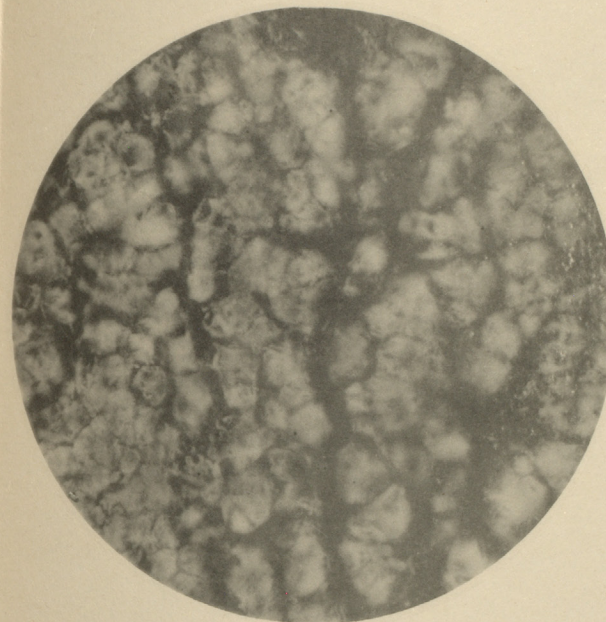
Nematophyton Logani. Dn.

Fig. 2.



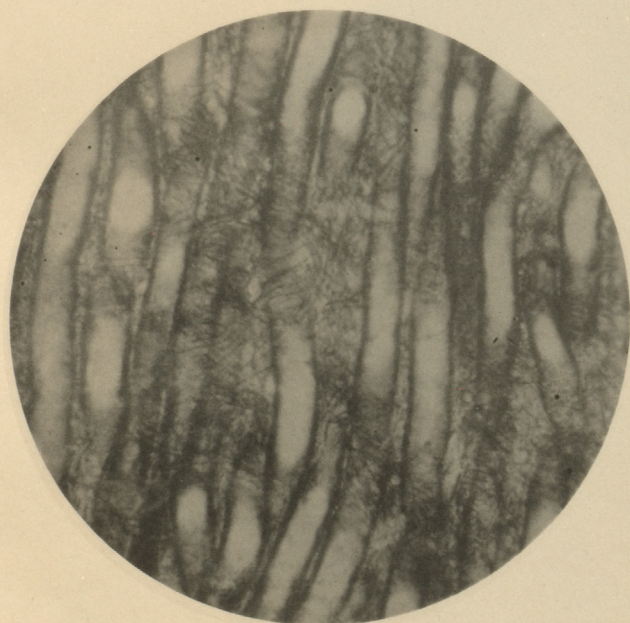
Nematophyton crassum? Pen.

Fig. 3.



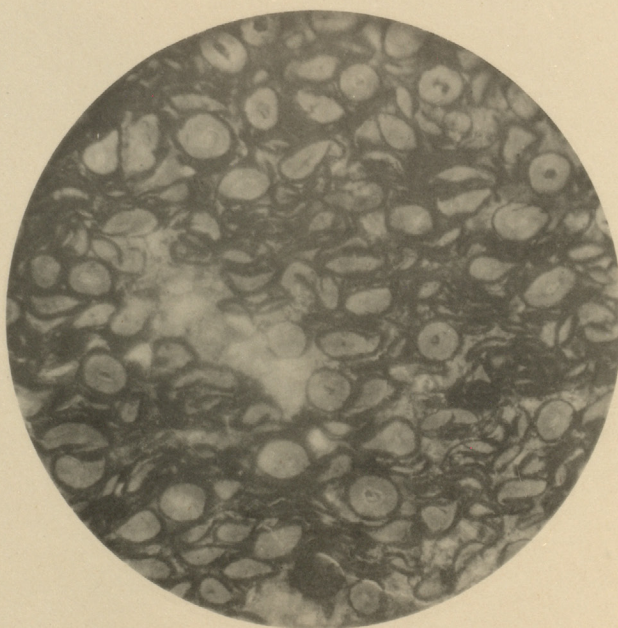
Nematophyton crassum? Pen.

Fig. 4.



Nematophyton Logani. Dn.

Fig. 5.



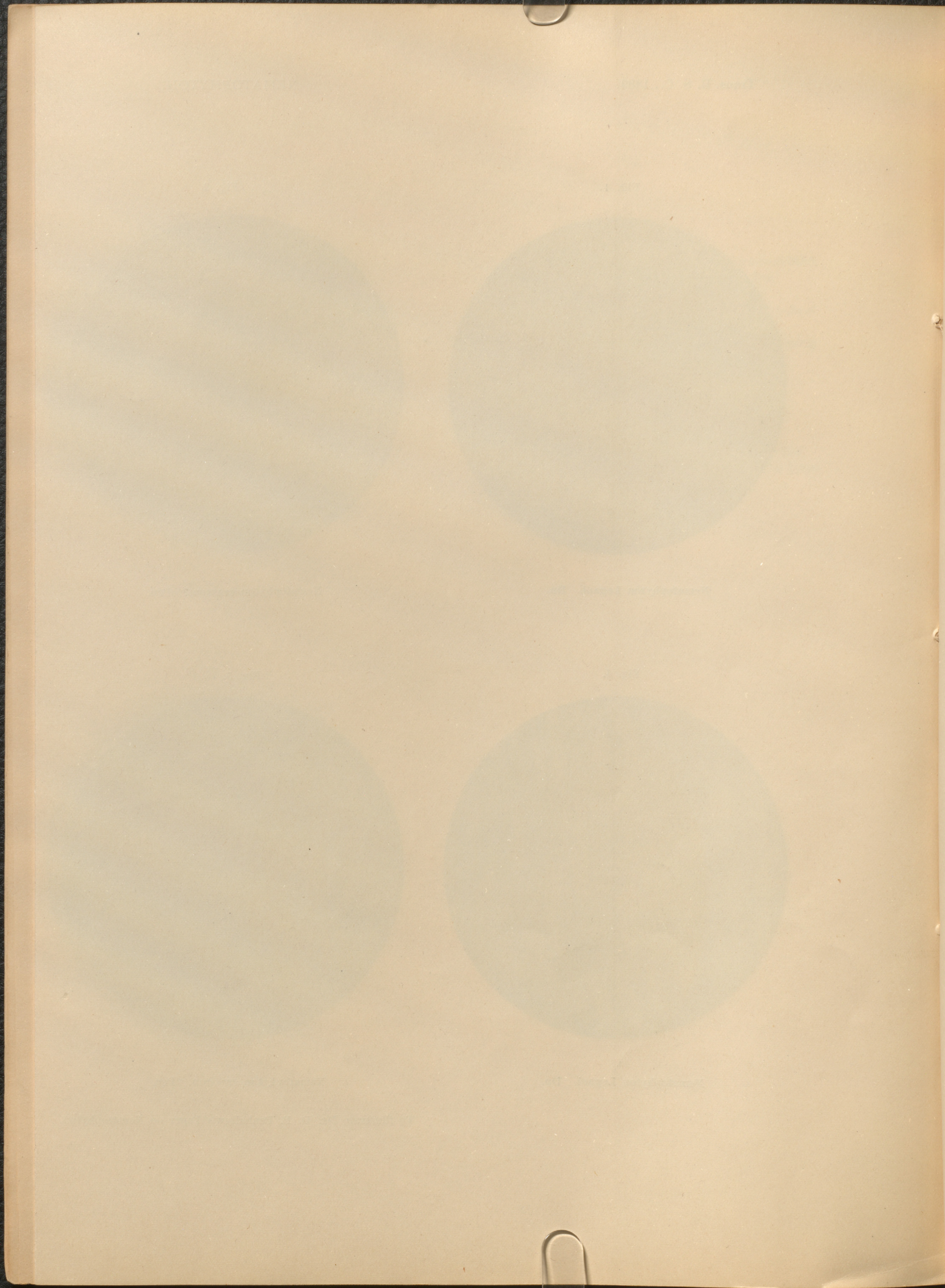
Nematophyton crassum. Pen.

Fig. 6.



Nematophyton crassum. Pen.

To illustrate Mr. D. P. Penhallow's Paper on Nematophyton.





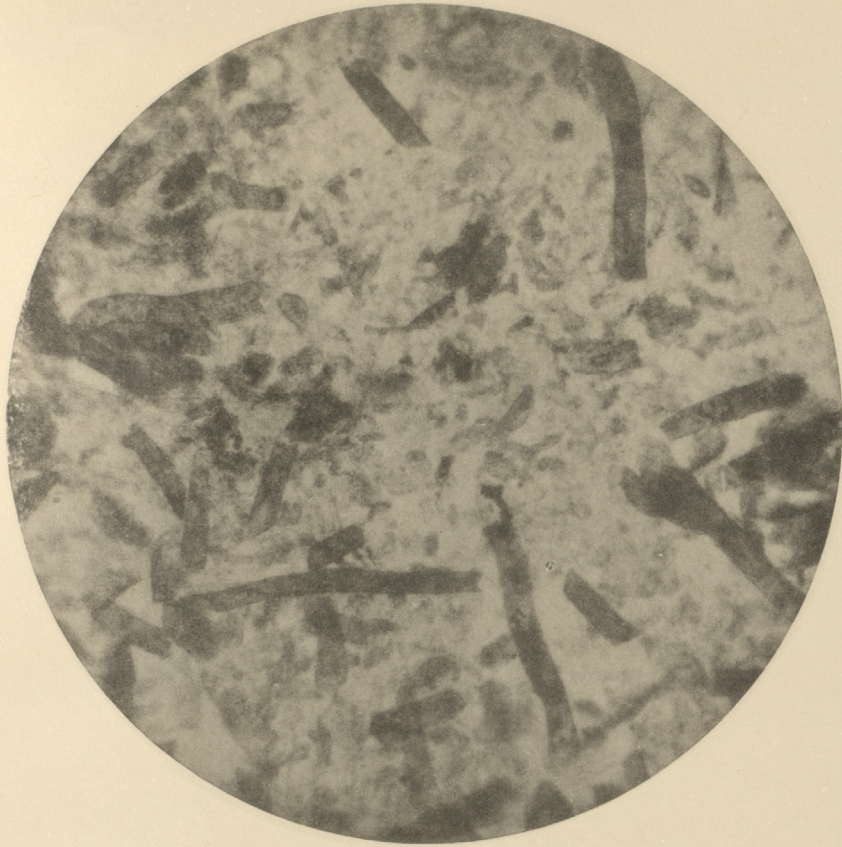


Fig. 1. *Nematophyton Hicksii*. Dn.

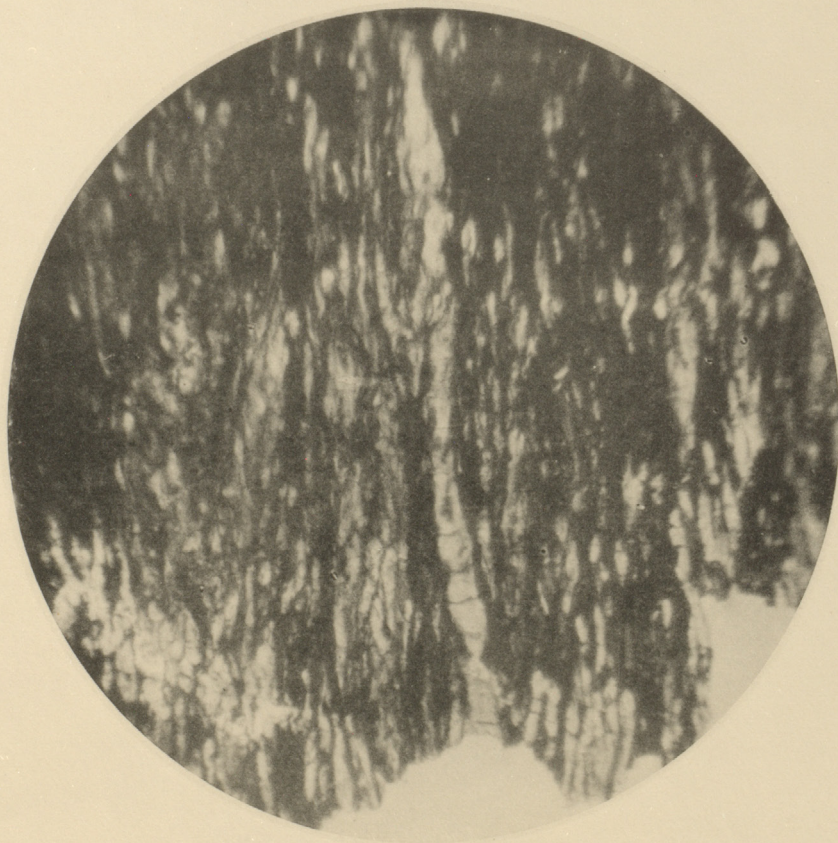


Fig. 2. *Nematophyton tenue*. Pen.

To illustrate Mr. D. P. Penhallow's Paper on *Nematophyton*.

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