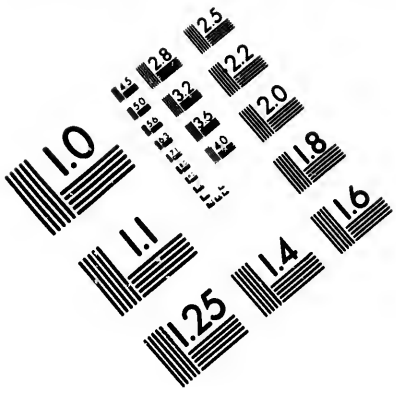

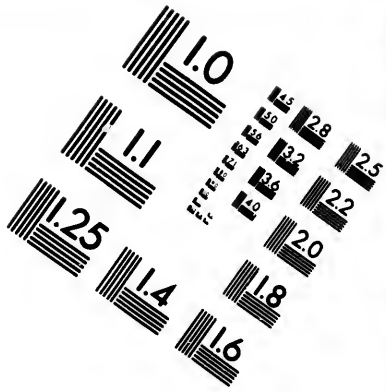

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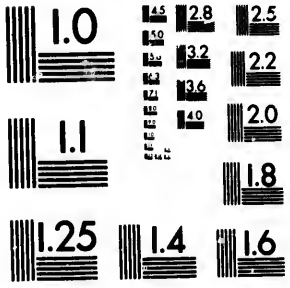

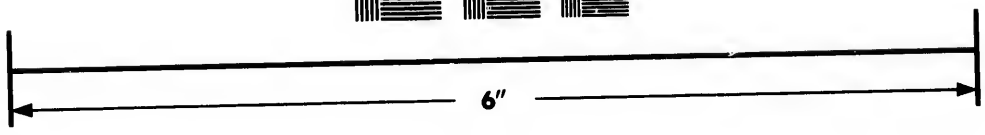

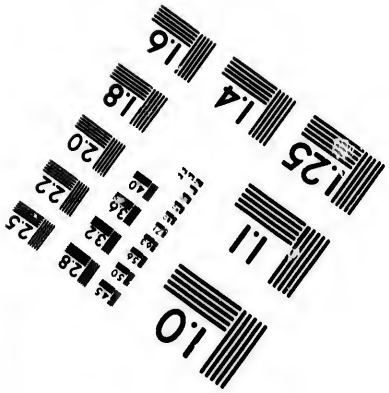

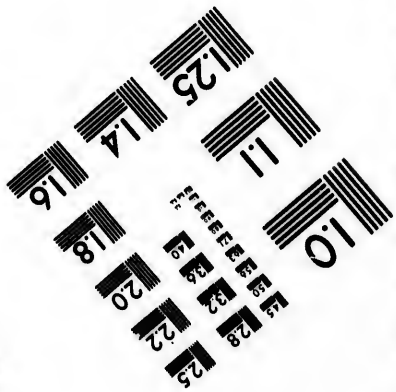

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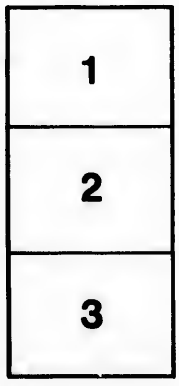

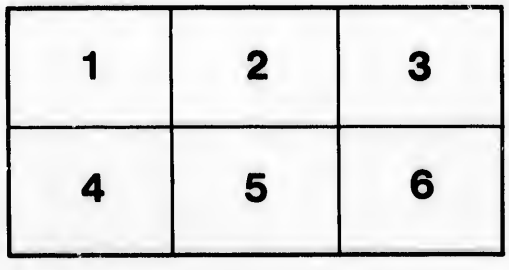

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McGILL UNIVERSITY

PAPERS FROM THE DEPARTMENT

OF

BOTANY.

No. I.—NEMATOPHYTON ORTONI, n.sp.

BY

D. P. PENHALLOW.

[Reprinted from the Annals of Botany, Vol. X, No. 37, March, 1896.]

MONTREAL, 1896

Nematophyton Ortoni, n. sp.

BY

D. P. PENHALLOW,

McGill University, Montreal.

With Plate V.

SINCE my last general summary of the genus *Nematophyton*[1], two new species from Europe have been recorded, one by Mr. C. A. Barber from the Tymawr quarry, near Cardiff, Wales, and named by him *N. Storriei*[2]; the other from the shales in the neighbourhood of Gräfrath on the lower Rhine, and designated by Count Solms-Laubach *Nematophyton dechenianum*[3].

I have now to describe a third, which differs in very important respects from all previously recorded species, from the middle or upper division of the great Ohio shales. This specimen was obtained by Professor Edward Orton, of the Geological Survey of Ohio, from whom the facts relating to its origin have been obtained, and after whom I would name it *Nematophyton Ortoni*.

[1] Notes on Devonian Plants. Trans. R. Soc. Can. VII. iv. 19.
[2] *Nematophycus Storriei*, Ann. Bot. VI. 329.
[3] Ueber devonische Pflanzenreste aus den Lenneschiefern der Gegend von Gräfrath am Niederrhein. Jahrbuch der königl. preuss. geologischen Landesanstalt. 1894, 67.

[Annals of Botany, Vol. X. No. XXXVII. March, 1896.]

The hand-specimen transmitted to us for examination is 15 cm. high and 14 cm. broad at the base, from which it gradually tapers upward in such a way as to suggest that it must be the base of a stem. This idea is strengthened by the presence of a number of basal and lateral processes with their outward terminations presenting fractured surfaces, showing that they represent the bases of more or less prolonged organs such as roots. Between these processes are rounded indentations, such as may be supposed to have been made by large pebbles. In fact, to those who are familiar with the branching base of a Laminarian stipe, the resemblance between the two is very striking. But Prof. Orton informs me that this specimen was originally part of a very much larger one which was broken in getting it out of the shale. The largest fragment thus obtained measured about 20 inches long and 8 to 10 inches wide. A photograph of it shows the surface to be irregularly indented with several processes, the whole presenting the general aspect of the smaller specimen taken from it. It is clear then that the original plant must have been one of rather large dimensions, on the scale of a tree, and the general external characters of the specimens justify the view that they represent the base of a stem or stipe at the point whence the roots issue.

Internally the specimen is highly silicified throughout, and shows no evidence whatever of concentric structure. Externally there are limited areas covered with a friable, carbonaceous film which, in places, attains a thickness of about 1·5 mm., but for the most part it is very thin. It in all probability represents the carbonised residue of the cortical tissue, although microscopical examination fails to disclose any definite structure. We can therefore only assume that it represents cortex, a view, however, which finds its justification in our general knowledge of the alterations in such structures under similar conditions.

The first sections examined were received from Prof. Orton, but they got badly broken in transit, in consequence of which, and also for the purpose of ascertaining the relation of struc-

ture to special locations, a new series of sections was prepared at the Peter Redpath Museum. It was found upon examination that there were no material differences of structure exhibited by the two sets, so that no special reference to them is required. The structure was found to be most beautifully preserved, and in this respect it is comparable with the Gaspé specimens of *N. Logani.*

In transverse section the structure is seen to consist of numerous round, thick-walled, and rather widely separated cells of rather uniform size, the larger having a diameter of about 67 μ. Between these cells others are to be seen running more or less transversely at various angles, and therefore interlacing with the first or longitudinal series. The spaces between the cells are occupied by small crystals of silica and a limited amount of carbonaceous matter, which shows no disposition indicative of structure. So far very searching examinations have failed to disclose anything of the nature of smaller hyphae such as distinguish the structure of *N. Logani*, *N. crassum*, and *N. laxum*, and it is impossible to say if such were at any time present, though the presence of carbonaceous matter among the siliceous crystals would seem to suggest the possibility of hyphae, or at least of some structure, having been present, since it has already been shown in the case of *N. Logani* and *N. crassum*, that the carbonaceous matter of the original structure often becomes distributed in such ways through the influence of crystallization [1].

There is no evidence whatever of radial spaces such as were found in *N. Logani.* But there are rather numerous isodiametric areas, about 0·30 mm. broad, occupied entirely (Fig. 3) by masses of very narrow and densely interlacing hyphae, having a diameter of 4·8 μ. In the sections so far submitted to examination, the structure of these hyphae has, in most cases, been destroyed by crystallization, and in the few instances where the structure was intact it was not possible to ascertain if they were septate, though the occurrence of

[1] M. Micr. Jnl. X. 69, 70. Trans. R. Soc. Can. VII. iv. 23; Proc. U. S. Nat. Mus. XVI. 115.

septa in the similar hyphae of *N. Logani*, as determined by Mr. Barber[1], would seem to indicate the possibility of their presence in this case. In no instance do these hyphae appear to cling to the walls of the large tubes of the medulla as in *N. Storrici*, but they fill isolated cavities which, for want of a better term, I may designate as the medullary spots. These spots exhibit the same general form and dimensions in all planes of section, and on smoothly cut surfaces of the hand-specimen they often appear as small cavities about 1·0 mm. broad, frequently containing minute crystals. We thus have evidence that these spots are not always occupied by small hyphae, a fact which suggests either (1) that the spaces are normal, and the hyphae intrusive growths, or (2) that the small hyphae are normal, and in some cases have been removed by decay or other causes. Which of these views is correct our material does not permit me to say; but the view advanced by Mr. Barber, and strengthened by our knowledge of similar openings in the various known species of *Nematophyton*, that these spaces have some connexion with the aeration of the plant[2], would seem to offer a reasonable explanation of their occurrence. It may also be pointed out that the most marked alterations of structure, through decay (?) and crystallization, to be met with in the present species are found in the hyphae of these areas. With respect to the occurrence of these medullary spots, the present species approaches somewhat closely to *N. crassum*.

In longitudinal section it is wholly unnecessary to distinguish between the radial and tangential planes, since the structure presents the same aspects in each case. The structure consists of broad, tubular cells running in a direction generally parallel to the axis of growth, together with others less numerous, but yet in large numbers, traversing the stem in all directions, so that unlike the species hitherto described, there is a want of definiteness in direction. Occasionally these cells are exposed to a great length, but more commonly the plane of section cuts them off at frequent intervals so

[1] Ann. Bot. VI. 333. [2] Ann. Bot. VI. 337.

that only short fragments appear (Figs. 2 and 3). A marked peculiarity of the cells in this plant is the frequency with which local expansions of the lumen occur. These we can only regard as representing the trumpet-hyphae and situations of sieve-plates so common in the Laminarieae. Although in the majority of cases no sieve-plate could be observed, in a few instances the fact of such structures having been present was quite obvious (Figs. 2 and 3). One of the trumpet-hyphae is shown on a much larger scale in Fig. 5. I have had no very good opportunity of instituting a comparison between these structures and the forms occurring in the larger species of the Laminarieae. My chief comparison, therefore, has been with the forms common to the North Atlantic coast; but through the kindness of Dr. W. G. Farlow, it has been possible to take into consideration *Macrocystis pyrifera*[1]. Although differing in detail, the general character of these structures in *Nematophyton* and *Macrocystis* is so similar as to suggest the belief that our fossil is related to those modern types of seaweeds of which *Macrocystis* is an example. As in the transverse section, no small hyphae are to be found between the large cells, but the latter are seen to branch somewhat frequently and always, so far as determined from the present material, in the immediate vicinity of a medullary spot (Fig. 4).

From the details thus outlined it is clear that the plant is an Alga, and of an alliance with the Laminarias. Having regard to the general character of the stem-structure, it is evident from our specimens that the cortical layer was relatively thin, the medulla strongly predominating, and in these respects the stem presents features which are well represented by *Laminaria digitata*.

This species differs from all others so far known, in the very loose character of the medulla, a feature which may be characteristic of the species as a whole, but which may belong more particularly to certain regions of the plant, and this

[1] In this connexion comparison may be made with the various forms of trumpet-hyphae in *Macrocystis*, as figured by Prof. F. W. Oliver in Ann. of Bot. I. 95.

view gains strength from the fact that our sections were apparently taken from one of the hapteres near its junction with the principal axis.

In his article on *N. Storriei*, Mr. Barber finds it difficult to agree with my views respecting the organic connexion between the large cells of the medulla and the small hyphae, basing his objections upon examinations of *N. Logani* and *N. Storriei*; but in view of the evidence at hand, it is impossible for me to accept the modifications he suggests[1]. Evidently when his article was written he had not seen my second paper on *Nematophyton*[2], in which five species are described. In speaking of *N. crassum*[3], I then made use of the following description :—

'The most significant fact so far observed, consists in 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 μ and a length to the point where cut off of about 35 μ. Two other branches near together were each 4·6 μ; two more were 2·3 μ and 4·6 μ; another 6·9 μ in diameter . . . It was 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 branching is effected.'

We have here, then, the fact that in *N. crassum* the large cells do branch into small filaments of the same general diameter as the small hyphae of the spaces, and that such branching takes place where these hyphae are most abundant. If this be taken in connexion with Mr. Barber's admission that the branching is most frequent in the region of the spaces, it will be seen that there are good grounds for denying his contention with respect to *N. Logani*, *N. crassum*, and *N. laxum*, while the presumption would be in favour of

[1] Ann. of Bot. VI. 335.

[2] Trans. R. Soc. Can. VII. iv. 19.

[3] L. c., p. 22.

regarding similar structural conditions to exist in the other species where the evidence is not so well defined. Nevertheless, it must be remembered that the genus *Nematophyton*, as we now know it, is made up of several apparently distinct species of whose entire structure we know but little: and it is quite within the range of possibility—as is even now suggested by the striking structural differences presented by *N. Ortoni*—that when we are able to reconstruct the entire organism in each case, it may be found that more than one genus is represented, or that some of those which now appear distinct, may in reality be different parts of the same species.

Our present knowledge of the genus *Nematophyton* shows that it embraces what appear to be eight distinct species as follows:—

1. **N. Logani**, Dn. Lower Erian of Gaspé; Silurian (Upper Ludlow) of England and Silurian (Cap Bon Ami) of New Brunswick. (*Dawson.*)
2. **N. Hicksii** (Eth), Dn. Denbighshire grit (Silurian) of Wales. (*Hicks.*)
3. **N. crassum** (Dn.), Penh. Middle Erian of Gaspé (*Bell*); Hamilton Group (Middle Erian) of New York. (*Clarke* and *Prosser.*)
4. **N. laxum** (Dn.), Penh. Lower Erian of Gaspé. (*Bell.*)
5. **N. tenue** (Dn.), Penh. Lower Erian of Gaspé. (*Bell.*)
6. **N. Storriei**, Barb. Silurian (Wenlock Age) of Cardiff, Wales. (*Storrie.*)
7. **N. dechenianum**, Solms-Laub. Upper Devonian of Gräfrath, Germany. (*Solms-Laubach.*)
8. **N. Ortoni**, n. sp. Upper Erian of Ohio. (*Orton.*)

EXPLANATION OF FIGURES IN PLATE V.

Illustrating Prof. Penhallow's paper on *Nematophyton Ortoni*, n. sp.

Description of Figures.

Fig. 1. Transverse section showing the general character of the structure. ×45.

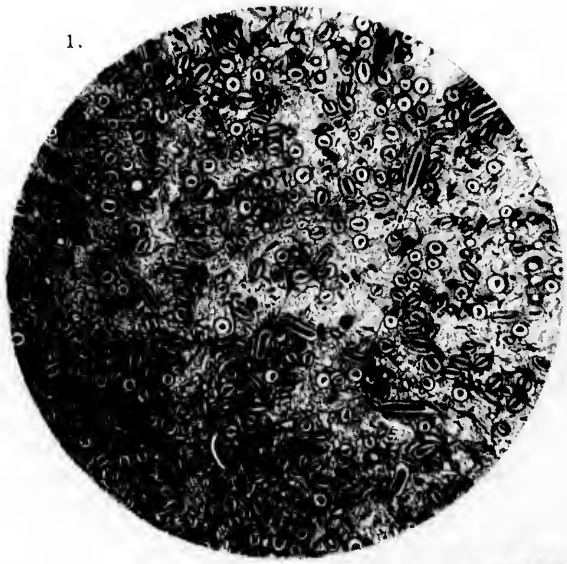
Fig. 2. Longitudinal section showing the general character of the medulla, with trumpet-hyphae, and on the extreme left of the field a portion of a medullary spot. ×45.

Fig. 3. Longitudinal section showing the occasional exposure of the tubular cells for a great length, trumpet-hyphae, and two medullary spots on the left. ×45.

Fig. 4. Transverse section showing a cell of the medulla with, at the centre of the figure, three branches. The darker area of the field on the upper side is the side of a medullary spot. ×170.

Fig. 5. Longitudinal section showing trumpet-hyphae at centre and left side, with crystals of silica occupying the spaces between the large tubular cells. ×170.

1.



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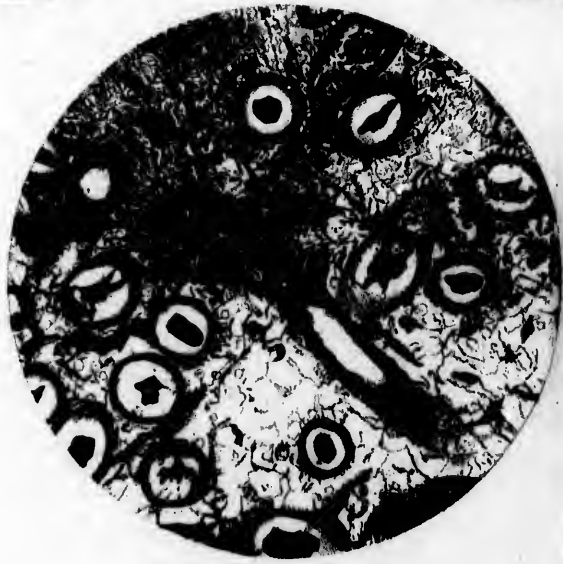

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3.

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