

Psilophyton forbesii, a New Devonian Plant from Northern Maine

Author(s): Henry N. Andrews, Andrew Kasper and Ely Mencher

Source: *Bulletin of the Torrey Botanical Club*, Jan. - Feb., 1968, Vol. 95, No. 1 (Jan. - Feb., 1968), pp. 1-11

Published by: Torrey Botanical Society

Stable URL: <https://www.jstor.org/stable/2483801>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <https://about.jstor.org/terms>



JSTOR

Torrey Botanical Society is collaborating with JSTOR to digitize, preserve and extend access to *Bulletin of the Torrey Botanical Club*

Psilophyton forbesii, a new Devonian plant from northern Maine¹

Henry N. Andrews, Andrew Kasper and Ely Mencher²

Department of Botany
University of Connecticut, Storrs

ANDREWS, H. N., and KASPER, A. (University of Connecticut, Storrs, Conn.) and MENCHER, E. (Geology Dept., City College of City Univ. of N.Y.) *Psilophyton forbesii*, a new Devonian plant from northern Maine. Bull. Torrey Bot. Club 95: 1-11. 1968.—A new species of *Psilophyton*, *P. forbesii*, is reported from upper Lower Devonian deposits in northern Maine. The plant is characterized by a strong central (monopodial) stem up to 9 mm in diameter with dichotomously forking side branches; spines or emergences are lacking; the ovoid sporangia were borne in terminal pairs and measure approximately 3.5 to 4.0 mm long and 1.3 to 1.8 mm in greatest diameter. A brief account is given of other early Devonian plants from Maine that are under study in the authors' laboratory and a review is given of two recent studies by H. P. Banks and F. M. Hueber bearing on the classification of the psilophytes and the status of the genus *Psilophyton*.

Until quite recently northern Maine has been regarded as an area that was unlikely to yield significant results to paleobotanical investigations, at least in any abundance. However, intensive explorations of the sedimentary rocks have revealed numerous horizons and localities at which fossil plants occur; in some of these the macrofossils are very fragmentary but in others the preservation is quite good. We have already found several new species or genera and continued field work promises to turn up more and to add to our knowledge of some of the fragmentary plants. It is the purpose of this study to describe an interesting and new Devonian plant and to mention something of the work that is in progress.

In two publications, on fossil plants of the area we are concerned with, there is some suggestion of the paleobotanical potential. In 1962 Dorf and Rankin described a few fossils from certain localities in the northern part of Baxter Park, and in 1964 Schopf reported a flora from a private quarry near Presque Isle. During the course of a comprehensive study of the sedimentary rocks in certain parts of northern Maine being conducted by one of us (E.M.) several new plant localities have been located and paleobotanical investigations were initiated in the summer of 1964.

The present study describes a collection of a single species of a new psilophyte from the Trout Valley Formation of the Traveler Mountain quadrangle, Maine; this formation was established by Dorf and Rankin,

¹ This project was done under Grant B 16793 from the National Science Foundation.

² Geology Dept., City College of City Univ. of N.Y.
Received for publication June 18, 1967.

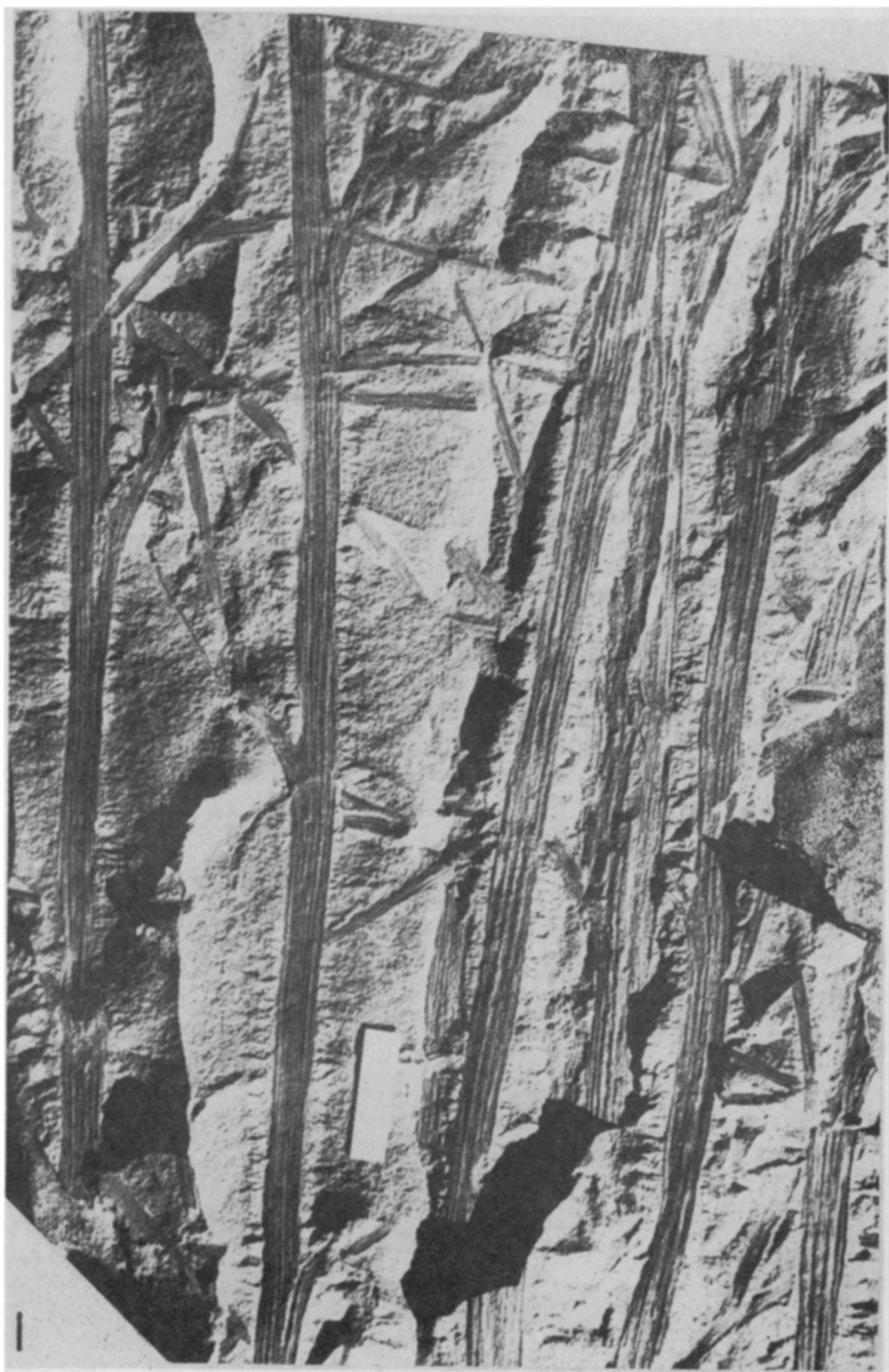


Fig. 1. The several specimens shown here are interpreted as the central axis of the plant; the characteristic longitudinal ridging is evident. Specimen No. USNM42819.
.9x.

1962, and was considered to be of Early Devonian age. Plants occur at several localities along Trout Brook and South Branch Ponds Brook.

Psilophyton forbesii n. sp.

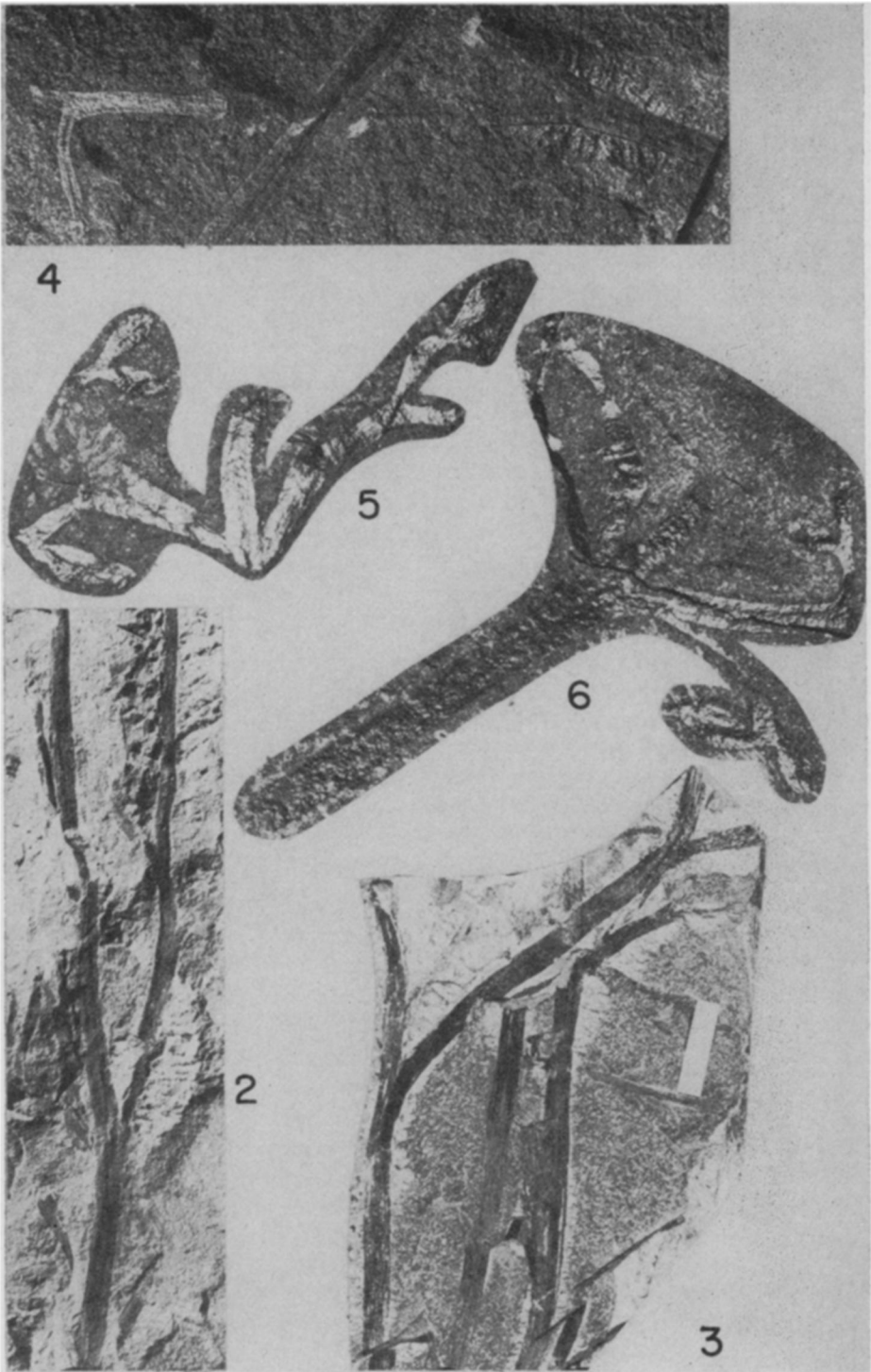
The specimens attributed to this species were obtained from an outcrop on the east bank of South Branch Ponds Brook located about 500 yards downstream from the junction with Gifford Brook. The locality was discovered by D. W. Rankin (Rankin's locality No. 14, in Caldwell, 1966); later collections were made by William Forbes of Washburn, Maine, and by Dr. Bradford Hall of the University of Maine both of whom have kindly placed their specimens in our hands for study; the present writers have visited the locality several times during the past two years.

The best specimens have been obtained from a very restricted site extending some six or seven feet along the bank and through a vertical thickness of about six inches. The fossils appear as rather colorful reddish-brown impressions against the dark grey of the shale. Unfortunately black-and-white photography does not convey the attractiveness of their appearance. The plants also occur through another eight to ten inches above the better zone and at several places along the bank to the south (upstream), but the rock is quite coarse-grained and the preservation is poor. It is possible that additional material will be discovered as our digging continues but, since the plant seems to constitute a distinct and interesting new species, and no other fossils are immediately associated with it, it is appropriate to deal with it separately.

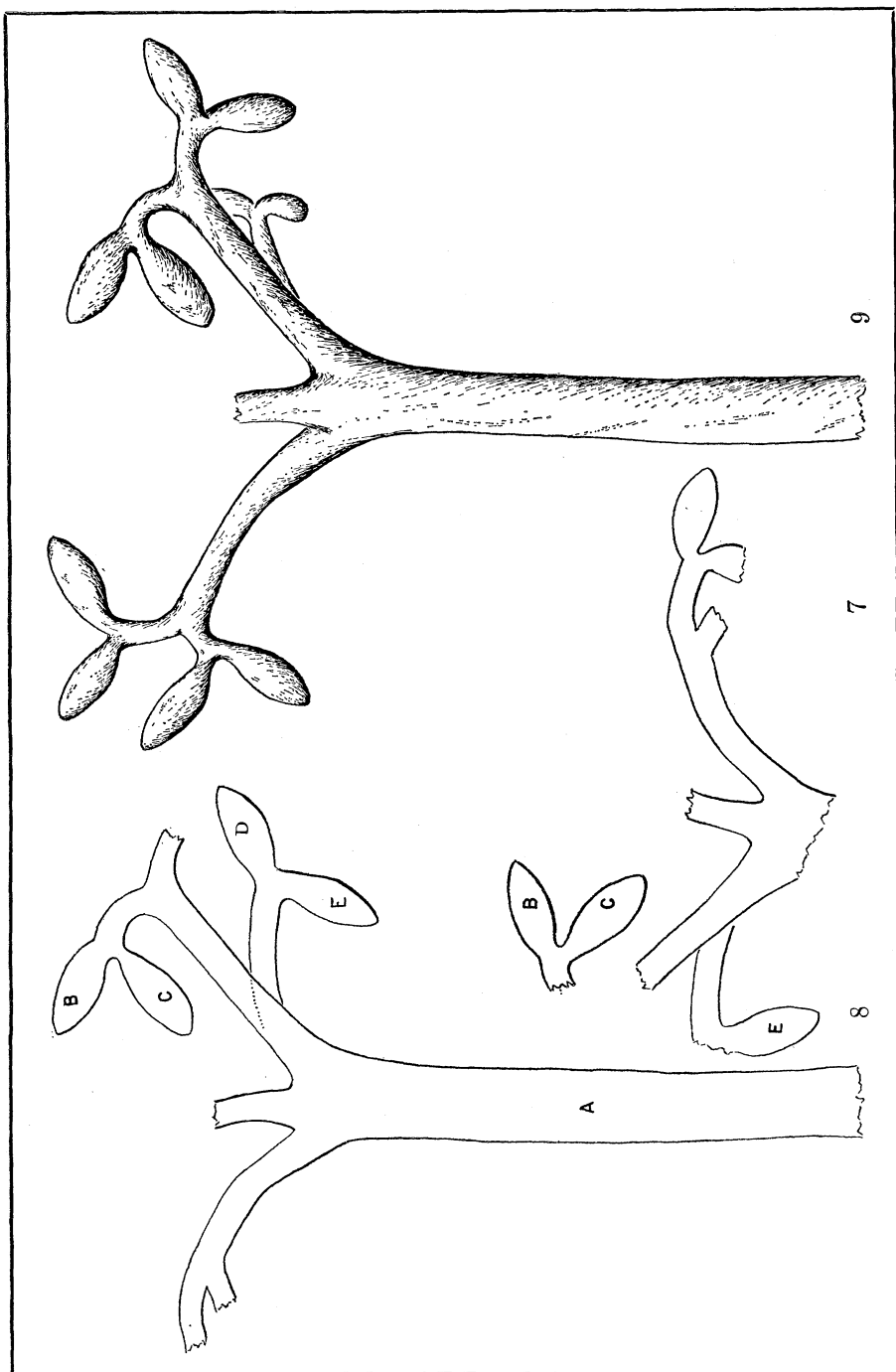
The plant is distinctly monopodial in its habit, consisting of a central axis with side branches that divide with more or less equal dichotomies. The term "pseudomonopodial" is preferred by some investigators for such an axis since it is evident that the apical meristem must have divided unequally for the most part with one branch dominating (overtopping) the other to a degree that produced an essentially vertical stem. The largest of the axes, considered to be the main stem of the plant, is 9 mm in diameter; the branches show a gradated series down to a minimum of about .5 mm.

The axes bear distinctive longitudinal striations, a feature that has been noted by other investigators who have dealt with apparently comparable psilophyte remains. It is possible that they reflect anatomical features such as strong cortical fiber strands or the ridges of an actinostele; the former seems more likely since the striations extend through the entire breadth of the axis.

The specimens shown in fig. 1 are typical of those that are regarded as main stems. For the most part the branches are smaller than the main axis; the latter may, however, dichotomize equally as is apparently the case in fig. 2. The specimen shown in fig. 2 is either a strong branch or the distal part of a main axis. One of the smallest specimens found is shown in fig. 4;



Figs. 2-6.—Fig. 2. This is probably the dichotomizing distal part of a main axis. Specimen No. USNM 42820.—Fig. 3. A large branch with two dichotomies. Specimen No. USNM 42821.—Fig. 4. A distal branchlet; the subdivision at the extreme left is 1 mm in diameter. Specimen No. USNM 42822.—Figs. 5, 6. The two surfaces (part and counterpart) of the fertile specimen. Compare with drawings (figs. 7, 8, 9). Specimen No. USNM 42823, A, B. Fig. 2, .9 $\times$; Fig. 3, .6 $\times$; Fig. 4, 2 $\times$; Figs. 5, 6, 3 $\times$.



Figs. 7-9. Fig. 7 (center), Fig. 8 (left), Fig. 9 (right).—Figs. 7, 8. Drawings of the adjoining surfaces of the fertile specimen. The axis (A) is present on only one side; the distal end is missing from both sides; for correlation of other parts compare sporangia B, C, D, E.—Fig. 9. A restoration of the fertile specimen. The main axis of the specimen is 2 mm in diameter.

at the left end this is only 1 mm wide and probably represents a termination or a region very close to it.

No spines or emergences have been observed on the axes. In the course of our excavation hundreds of specimens have been observed and the preservation is sufficiently good as to leave no doubt that the axes were quite smooth.

Only one fertile specimen has been discovered, both faces of the fossil as it was broken open being shown in the illustrations. It consists of an axis fragment 19 mm long and 2 mm broad with two fertile side branches. The terminal part of the branch either aborted or was broken off prior to fossilization. Since the specimen does not occur in a flat plane some of the branches and sporangia appear on only one side of the specimen. To illustrate all that is present both sides ("part and counterpart") are shown in the photos (figs. 5, 6); since the sporangia do not show to the best advantage in a photograph they are supplemented with drawings (figs. 7, 8) and a restoration (fig. 9).

Referring to the restoration (fig. 9), the right branch divides almost immediately and one division, which dipped down into the rock matrix, terminates in a pair of sporangia; the other division dichotomizes and each of the secondary divisions bears a pair of sporangia. The left branch dichotomizes once and each subdivision bears a pair of sporangia. The sporangia are approximately 3.5 to 4 mm long and 1.3 to 1.8 mm in greatest diameter. Spores have not been observed.

The terminal portion of this specimen is lost but the remaining part is only 1.5 mm in diameter; the number of sporangia that it bore was probably not great.

Psilophyton forbesii Andrews, n. sp.

Diagnosis. Plants of monopodial habit with a central axis up to 9 mm in diameter. Side branches fork equally or unequally. Most of the larger axes are strongly ridged longitudinally. Apparently naked, there being no evidence of emergences. Sporangia ellipsoidal, 3.5 to 4 mm long and 1.3 to 1.8 mm broad, borne in terminal pairs. The specimens shown in figures 1, 5, 6 are designated as the types. The figured specimens will be deposited in the U. S. National Museum, Washington, D.C.

Horizon. Trout Valley Formation of Dorf and Rankin, 1962; probably upper Lower Devonian.

Locality. East side of South Branch Ponds Brook, 500 yards below (north) junction with Gifford Brook; Traveler Mt. quadrangle, Maine.

The plant is named for Mr. William Forbes of Washburn, Maine, in recognition of his knowledge of Maine geology and his generosity in sharing this knowledge and his collections with us.

The habit of the plant as depicted in the restoration (fig. 10) is based

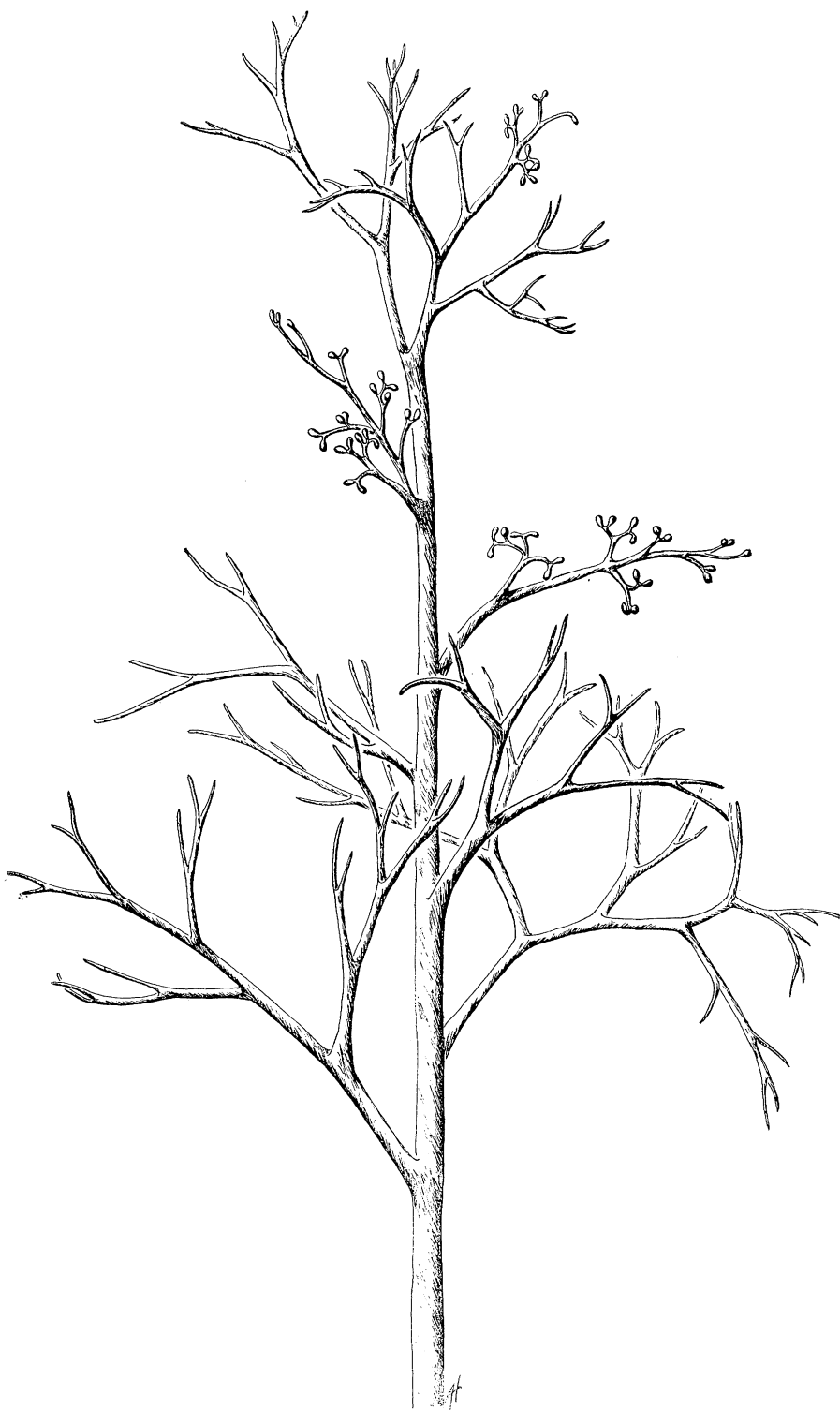


Fig. 10. A restoration of the plant based on many vegetative specimens and one fertile one. The plant probably attained a height of about two-thirds of a meter. Size: the basal portion of the main axis is 9 mm in diameter.

on specimens found on the larger slabs, such as the one illustrated in fig. 1. Judging from the general form of the largest specimens and the rather slight degree of taper of the main stem, we believe the plant attained a height of about two-thirds of a meter. We have no information on the base of the plant nor do we know just how the fertile branches were borne or how abundant they were. The sporangia as shown are, proportionally, a little larger than they should be.

In their general aspect the more complete specimens suggest that the plant was rather rigid in its habit, perhaps even more so than is indicated. Several of the larger rock specimens bear the presumed main axes aligned more or less parallel. It seems likely that the plant grew in rather dense stands comparable to the way that the living *Equisetum hyemale* or *Typha* grows. If dense stands of these plants were overwhelmed by a stream carrying abundant quantities of sediment a similar type of fossilization might be expected. There is of course no implication of a close relationship with either of those genera.

Discoveries of new Devonian plants in recent years have added much to our knowledge of the earlier types of vascular plants. Evolutionary patterns are becoming more complex but significant progress is being made in dealing with them and in establishing a more satisfactory classification. H. P. Banks and F. M. Hueber have made two recent and important contributions; since the information that they present has been used in our classification of the fossils described here it is necessary to refer to them at least briefly.

At the occasion of the Centennial Celebration of the Peabody Museum at Yale University in October, 1966, Banks presented a comprehensive and critical study of Devonian plants and evolutionary trends under the title "The Origin and Early Evolution of Land Plants"; and in a recent issue of *Taxon* Hueber and Banks (1967) have resolved in a very helpful fashion the identity of the problematical *Psilophyton princeps*.

The earlier and more primitive Devonian plants are classified by Banks into three subdivisions of the Tracheophyta, the Rhyniophytina, Zosterophyllophytina and the Trimerophytina.

The Rhyniophytina, typified by *Rhynia*, include plants with naked (lacking emergences), dichotomizing axes bearing sporangia that are terminal, usually fusiform and may dehisce longitudinally; they are diminutive plants and, in so far as is known, have a small terete xylem strand with a central protoxylem. The following plants are assigned to the group: *Rhynia*, *Horneophyton*, *Hicklingia*, *Eogaspesia*, *Taenioocrada*, *Hedeia*, *Yarravia* and *Hostimella*.

The Zosterophyllophytina include plants with laterally borne, globose or reniform sporangia which dehisce along the distal edge; they were naked, spiny or toothed and probably were predominantly dichotomous;

plants classified in the group include *Zosterophyllum*, *Bucheria*, *Gosslingia* and "*Psilophyton ornatum*."

The Trimerophytina include plants of monopodial habit; that is, they have a strong central axis with side branches that dichotomize equally and bear terminal masses of paired fusiform sporangia. The genera included are *Trimerophyton*, *Dawsonites*, and *Psilophyton*.

The second study that we wish to refer to is Hueber and Banks' (1967) revised concept of *Psilophyton princeps*. The plant was originally described by Dawson in 1859 but in later publications his concept of it changed somewhat; it is now apparent that several different plants entered into the much-copied restoration and, in spite of its interest and importance, it has been a focal point for a good deal of misunderstanding about the nature of early land vascular plants. It therefore seems pertinent to repeat Hueber and Banks' (1967, p. 84) revised diagnosis of *Psilophyton* Dawson:

"Stems branched pseudomonopodially and dichotomously, naked or spinous, ridged or unridged, compressions may be marked by punctiform scars; sporangia elongate-elliptical, pendulous, paired, and borne terminally on repeatedly dichotomized lateral branches, total number per lateral branch system large; dehiscence longitudinal along facing surfaces of paired sporangia; xylem a solid strand, centrarch or mesarch; outer cortex collenchymatous."

Psilophyton forbesii fits into the concept of Banks' Trimerophytina and particularly *Psilophyton* with the exception of the number of sporangia. It is possible that the one fertile specimen that we have is misleading in this respect in that it may be only a part of a fertile branch; however, judging from the size of the axis (fig. 6) and the branching pattern of the portion preserved it seems likely that the number of sporangia was small by comparison with some other species of *Psilophyton* (or *Dawsonites*). It is reasonable to suppose that species of *Psilophyton* varied somewhat in this feature.

It is perhaps pertinent to point out that some of the spiny fossils previously placed in *Psilophyton* are known to have had their sporangia borne laterally. Detailed descriptions have not been published but this development in our knowledge has been reported briefly on several occasions (Hueber, 1962, 1964; Banks, 1965).

The sporangial portion of *P. forbesii* could be compared with fragmentary specimens of *Dawsonites* and the vegetative system could be compared with a number of sterile axes found described in the literature. There would be little to gain from a detailed comparison with such fossils. The specimens at our disposal seem adequate to allow a reasonably accurate restoration of the plant and as such it does not compare closely with previously described fossils.

Studies are in progress of other collections that we have made during the past two years and they indicate the presence of a diverse flora. One of the most productive localities in the Traveler Mountain quadrangle is a site, also

in the Trout Valley Formation, along the south bank of Trout Brook about 200 yards upstream from the bridge at "The Crossing" (Locality No. 1 of Dorf and Rankin, 1962 and locality No. 16 of Rankin, in Caldwell, 1966). This is an outcrop that extends for some 40 yards along the stream bank, and the beds, which slope gently toward the north, rise vertically above the brook for about 8 to 10 yards. Although much work remains to be done, this locality has yielded several different plants some of which are probably new species or genera.

One of the most abundant and complete plants is a psilophyte, referable to the genus *Psilophyton* as redefined by Hueber and Banks. It is a small plant and transistional in habit between pseudomonopodial and dichotomous; the largest specimens that we have are 8.5 cm long with a maximum diameter of 2 mm. The axes are smooth, lacking appendages or longitudinal striations. The larger ones are monopodial while the smaller ones bearing sporangia tend to be dichotomous. The distal parts of the shoot system branch quite freely, ultimately bearing pairs of sporangia in considerable abundance.

The same outcrop has also yielded numerous specimens of another spineless psilophyte that is somewhat larger than the one noted above. It is monopodial, with a strong central, longitudinally ridged axis up to 23 cm long and 3 mm in diameter; the lateral divisions dichotomize and terminate in very fine branchlets. The fertile parts have not been found thus far.

The flora also contains two kinds of spiny axes, probably referable to the *Zosterophyllophytina*, and several other fossils tentatively assigned to *Taeniocrada*, *Trimerophytina* and *Drepanophycus*.

Several other sites, in the St. Froid Lake area, also are under study. As our investigations of the megafossils and spores of this region continue we expect to contribute to our knowledge of Lower and Middle Devonian floras and, hopefully, to supply information that will aid with age determinations.

Acknowledgements. This study has been aided in large part by funds received from the National Science Foundation. We are also grateful to Mr. William Forbes, Washburn, Maine, and Prof. Bradford Hall, the University of Maine, for specimens donated from their collections. The drawings and restoration have been prepared by Mary Hubbard, the University of Connecticut.

Literature Cited

- BANKS, H. P. 1965. Some recent additions to the knowledge of the early land flora. *Phytomorphology* 15: 235-245.
- BANKS, H. P. 1968. The origin and early evolution of land plants. Centennial Celebration of the Peabody Museum, Yale University, Symposium on the origins of major groups. New Haven, Conn., U.S.A., Oct. 1966.
- CALDWELL, D. W. 1966. (editor). Guidebook for field trips in the Mount Katahdin region, Maine. New England Intercollegiate Geological Conference, Sept. 29-Oct. 1, 1966. 61 p.

- DORF, E. and D. W. RANKIN. 1962. Early Devonian plants from the Traveler Mountain area, Maine. *Journ. Paleont.* 36: 999-1004.
- HUEBER, F. M. 1962. The psilophytes and their relationship to the origin of ferns. *Amer. Journ. Bot.* 49: 670.
- . 1964. The psilophytes and their relationship to the origin of ferns. *Torrey Bot. Club Mem.* 21: 5-9.
- HUEBER, F. M. and H. P. BANKS. 1967. *Psilophyton princeps*: the search for organic connection. *Taxon* 16: 81-85.
- SCHOPF, J. M. 1964. Middle Devonian plant fossils from northern Maine. U.S. Geol. Survey Prof. Paper 501D: 43-49.

Scenedesmus wall ornamentation. IV. Apical openings and membranes.¹

F. R. Trainor and F. G. Roskosky

Biological Sciences
University of Connecticut
Storrs, Connecticut, 06268

TRAINOR, FRANCIS R. and FRANCES G. ROSKOSKY (Univ. of Conn., Storrs, Conn. 06268) *Scenedesmus* wall ornamentation. IV. Apical openings and membranes. *Bull. Torrey Bot. Club* 95: 11-15. 1968.—*Scenedesmus protuberans*, isolated from an Austin, Texas, pond, was grown in laboratory culture in 4-week studies in 3 defined media. The organism typically produced 2-celled or 4-celled colonies with 4 long corner spines. Apical openings, which could be confused with short spines, were the site of bristle insertion. Delicate membranes were observed connecting cell apices in most colonies. Unicells were not produced in media useful for unicell production with other *Scenedesmus* species.

Although Chodat (1926) in his monograph of *Scenedesmus* introduced some physiological characteristics, e.g. response of organisms to various media and macroscopic appearance when grown on various kinds of agar, he based most of his classification on the wall ornamentation of individual cells or colonies. Others dealing with the genus also relied on wall structure (Smith, 1916; Uherkovich, 1966). Bisalputra and Weier (1963), Bisalputra, Weier, Risley and Engelbrecht (1964) and Bisalputra (1965) examined the cell wall of *Scenedesmus quadricauda* (Turp.) de Breb. (strain 614) using electron microscopy. Burg and Trainor (1967) pointed out the site of bristle insertion in the same strain. The long delicate appendages called bristles were first reported by Petersen (1912), but had long been ignored in observations of *Scenedesmus* species.

¹ This study was aided by funds from NIH grant WP 00850-03.
Received for publication July 28, 1967.