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GEOLOGISK EKSPEDITION TIL ØSTGRØNLAND 1936—38
UNDER LEDELSE AF LAUGE KOCH

LIASSIC AND RHAETIC PLANTS COLLECTED IN 1936–38 FROM EAST GREENLAND

BY

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WITH 12 FIGURES IN THE TEXT AND 1 PLATE

KØBENHAVN
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INTRODUCTION

The Liasso-Rhaetic rocks of E. Greenland have already provided a very large flora which was collected along the eastern edge of Jameson Land, which is the part most accessible from the Colony in Scoresby Sound. References to this flora will be found under the names of HARTZ and HARRIS. In the present paper specimens are described from northern and western parts of Jameson Land, and Traill Island further north still. They prove to be of the same age as the floras previously described and are of interest in showing a somewhat different development of the plant-bearing series and in a number of species new to Greenland, but well known from other regions.

When a part only of the present collection had been received (the Mt. Pictet material) it was concluded that this was a Liassic flora rather different from that of Hurry Inlet. This conclusion is confirmed, but as the specimens were worked out a good many more points of resemblance were recognised between the two floras though differences still remain.

The present collection adds a few additional species to the Greenland flora, some of which are well known and indeed were widespread in other parts of the world at their particular period. Certain specimens too which are preserved in an exceptional manner have thrown light on the leaf structure of some Mesozoic ferns about which little was known, and have led to the recognition that one of them is not as was supposed the isolated and earliest member of the fern family now prevalent, but a member of a family prevalent in the Mesozoic.

The specimens described in this paper were obtained on the expedition of 1936—38 to East Greenland led by Dr. LAUGE KOCH, to whom I am grateful for submitting them to me and for help. They were collected by the three Geologists, Dr. HANS STAUBER of Zürich; fil. lic. MALTE ANDERSON of Lund and Dr. WILHELM BIERTHER of Bonn each of whom furnished me with stratigraphic data for which I am grateful. BIERTHER (1941) and STAUBER (1938, 1940, 1942) have described the geology of this area.

PART I
DESCRIPTION OF SPECIES

Cryptogams.

Lycostrobus scotti NATHORST.

Pl. 1, fig. 5.

See HARRIS 1935, P. 153; 1937, P. 12 for references.

Seven more or less perfect specimens of the megaspores of *L. scotti* were obtained from two fragments of shale, J. X. 9 and J. X. 16; all showing sufficient to distinguish them. *L. scotti* was previously known from four localities, one in Sweden, three in E. Greenland, all belonging to the basal Liassic.

Major Paars Dal[1]), Upper Series. Specimens No. J. X. 9; J. X. 16.

Triletes areolatus HARRIS.

Pl. 1, fig. 4.

See HARRIS 1935, P. 158; 1937, P. 12 for references.

A fragment of a megaspore was obtained which agrees perfectly with this species. Although *T. areolatus* is very like *T. rex-argenteus*, certain specimens being almost indistinguishable, the present one is fortunately typical *T. areolatus* in having comparatively thin walls separating the pits on the spore surface.

T. areolatus is a common species in the basal Liassic of E. Greenland.

Major Paars Dal, Upper Series, No. J. X. 16.

Triletes pemphigus sp. nov.

Pl. 1, figs. 1—3.

Diagnosis. Spore spherical, diameter about 800 μ (extremes 550 μ —1000 μ). Triradiate scar rather obscure, its length about two thirds of the spore radius, consisting of narrow, low ridges. Whole surface of spore covered with low, rounded protuberances up to about 50 μ broad, 30 μ high but often lower on the dorsal side; protuberances less developed

[1]) Formerly Palldal.

on ventral side, protuberances typically with a small cavity within and therefore appearing in surface view as thickened rings. Arcuate lamellae not developed, facets not distinguished except by the smaller size of their protuberances. Substance of spore wall finely, but distinctly granular.

This species is represented by about twenty specimens, mostly rather ill preserved; a few cuticle fragments were associated with the spores but none were determinable. The age of the bed where it occurs is given by H. Stauber as '?Lower Liassic' (in which case it would agree with some neighbouring localities).

It differs from all the species previously described in its peculiar hollow protuberances.

N. part of Oswald Heers Klinter (N. of Major Paars Dal), back part, in coal layer. J. 882.

Equisetites sp. A. indet.

Text-fig. 1.

Although the specimens described below may belong to one species, those from the different localities are described separately.

Specimen J. 302; Cape Seaford, Fleming Fjord.

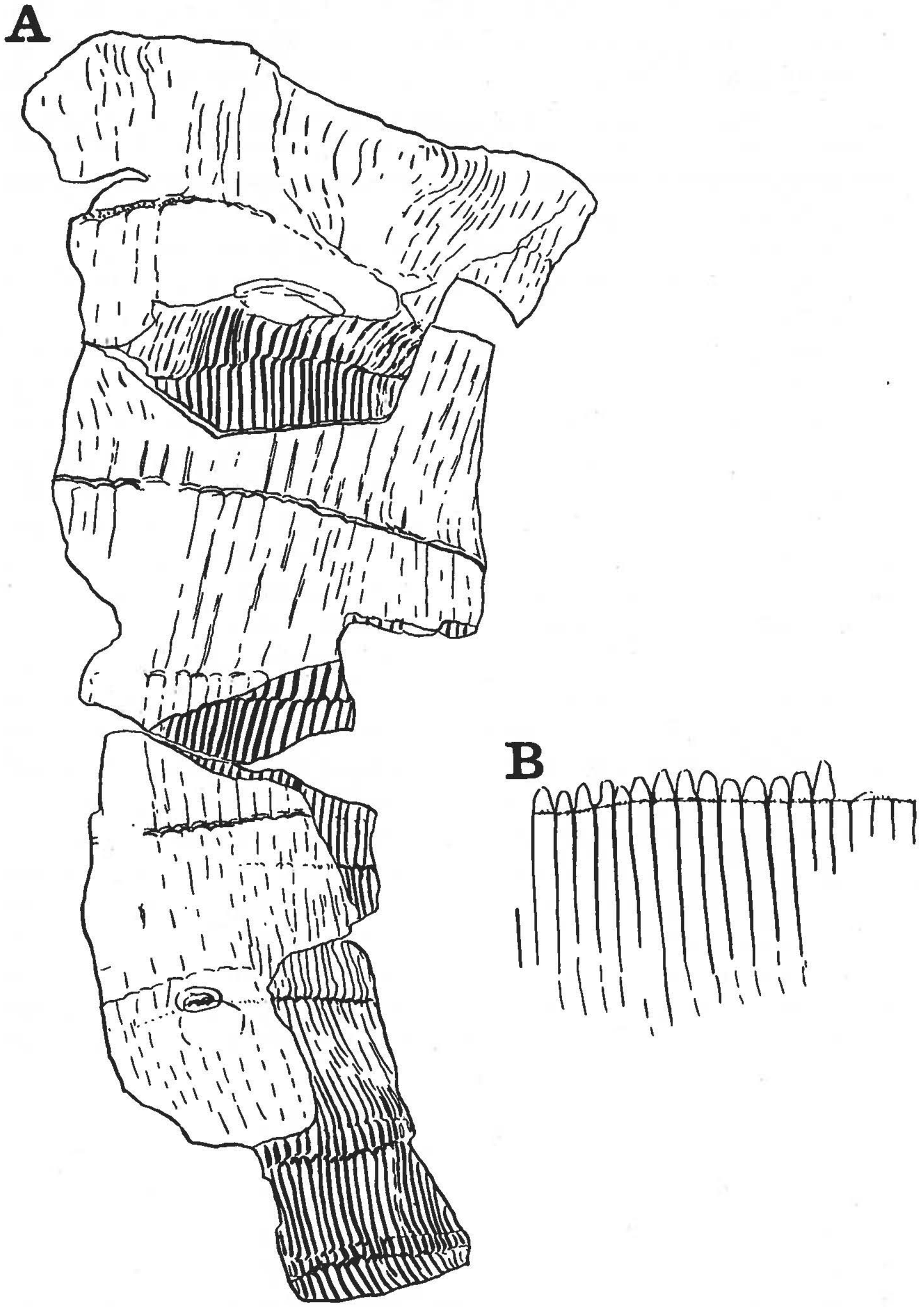
This specimen is the poorly preserved internal cast in sandstone of a stem 15 cm in diameter. It shows one node; the adjacent portion of the internode being over 8 cm long. The stem is marked with ridges representing woody vascular bundles at intervals of slightly over 1 mm, there being about 260 of these ridges on the complete specimen. The node is but slightly constricted and shows no leaves or branches, the vascular bundles appear to alternate as usual at the node. There is a certain amount of disturbance in the course of the vascular bundles at one side of the node, which is perhaps comparable to the puckering of the surface just above the node in some of Schimper's (1869—70) specimens of *E. arenaceus*.

Specimen J. X. 15; Major Paars Dal, Upper Series. (Lias.)

Ill preserved external cast showing two nodes and leaf sheaths with segments 3 mm wide. The free parts of the leaf teeth are missing.

Specimen T. 959; Cape Palander, Mols-Bjerge, N.E. Traill Island.

The best specimen is a stem (Text-fig. 1A) in which the central cavity has been partly filled with sand, and also the space between the woody cylinder and the external surface, so that both are preserved. The leaf sheaths show alternating raised portions and sunken and



Text-fig. 1. *Equisetites* sp. A. *A*. Fragmentary compressed stem; most of the surface is composed of the leaf sheaths, but in places this is broken away to expose the the woody strands. Half natural size. No. T. 959.1. *B*. Fragment of isolated leaf-sheath of another specimen, natural size. No. T. 959.2.

tapering commissiural flanges at intervals of about 3.5 mm; the free portions of the leaf-teeth are missing. The woody bundles, nearly 1 mm thick are at intervals of 1.5—2 mm, so there would appear to be twice as many bundles as leaves. (These measurements were made on limited regions.) At the node there is a woody commissure from which the bundles of the next node originate alternating with those of the first; there is no sign of a nodal diaphragm.

Associated with this is a specimen showing the leaf-teeth; it is too poorly preserved to show whether they are complete or only the bases of leaf-teeth.

This species is of considerable interest, it is a pity it is so poorly preserved. Its pith cast is like that of a Calamite, evidently it differs from many of the *Equisetum* and *Equisetites* species in having woody vascular bundles, cf. Harris 1937 P. 7, instead of mere carinal-canal conducting strands which are completely flattened in preservation. The probable presence of twice as many woody strands as leaf segments is interesting; it is possible that they may only represent metaxylem bundles comparable with those of *Equisetum* in which there are two to each bundle and not complete vascular bundle units.

These large specimens are very like the Keuper species *E. arenaceus*, but they are almost equally like some of the largest Middle Jurassic specimens of *E. beani*; the differences between the two species have never been worked out. Although reference to the literature would suggest that *E. arenaceus* is strictly confined to the Keuper (no specimen worthy of the name occurs in rocks known to be outside its limits) it would seem that many of the determinations are based more on the age of the rock than the morphology of the specimen. Specimens of this type cannot therefore be safely used to determine the age of a rock, except perhaps locally where it is known to occur at a certain horizon. Since one of the present specimens is Liassic, there is some evidence for regarding the other two as Liassic; but it would not be surprising if their age proved older or younger.

Equisetites sp. indet. B.

Specimen 930 E. Gurreholm Mtns.; Peak region, Upper Series.

A piece of *Equisetites* apparently about 1.5 cm in diameter. The internode is over 2.5 cm long and bears a leaf sheath divided into tapering segments 2 mm wide at the base, but broken off after 6 mm where they are about 1 mm wide. As this is a much narrower stem its identity with those called *E. sp. A.* is unlikely; it is more like *E. praelongus* from the basal Lias of Sweden and certain specimens of the Rhaetic *E. grosphodon.*

Equisetites grosphodon HARRIS.

See HARRIS 1931(b), P. 18.

This species is represented by two fair-sized stems both preserved as external casts with a sandstone infilling. One is 3.5 cm wide; bears whorls of leaf-teeth at 1 cm intervals with 38 teeth per whorl. The other is 3.2 cm wide, bears 7 whorls of leaf-teeth at intervals of 10—20 mm with about 40 teeth per whorl; they thus agree with the larger specimens previously described.

This species is fairly common in the *Lepidopteris* zone of Jameson Land and appears to be a valuable Rhaetic zone species.

Rhaetic. Major Paars Dal profile 2. Specimen No. 10.

Neocalamites carrerei (ZEILLER) HALLE.

Pl. 1, fig. 8; Text-fig. 2.

1878 *Schizoneura hoerensis* (non HISINGER) NATHORST P. 40; Pl. 7, fig. 5. (This specimen does not appear to have been previously referred to *N. carrerei*).
1903 *Schizoneura carrerei* ZEILLER P. 137; Pl. 36, figs. 1, 2; Pl. 37, fig. 1; Pl. 38, figs. 1—8.
1908 *Neocalamites carrerei* (ZEILLER) HALLE P. 6.
1915 *Neocalamites* cf. *carrerei* (ZEILLER) WALKOM P. 34; Pl. 1, fig. 1; ? fig. 4; perhaps also as *Phyllotheca australis* Pl. 1, fig. 5.
1920 *Neocalamites carrerei* (ZEILLER) YABE Pl. 1, figs. 2, 3.
1923 *Neocalamites carrerei* (ZEILLER) KRYSHTOFOVICH P. 8; figs. 1, 2, 3.
1925 *Neocalamites carrerei* (ZEILLER) KAWASAKI P. 37; Pl. 2, 3, 44, 46, figs. 121, 122. ? non Pl. 43, fig. 117a; Pl. 45, fig. 119b.
1930 *Neocalamites carrerei* (ZEILLER) TURUTANOVA-KETOVA P. 314; Pl. 2, figs. 3, 5, 7; Pl. 5, fig. 5.
1932 *Neocalamites carrerei* (ZEILLER) OISHI P. 269; Pl. 21, figs. 1—4; Pl. 22, figs. 1, 2.
1933(a) *Neocalamites carrerei* (ZEILLER) SZE P. 49; Pl. 8, fig. 6.
1933(b) *Neocalamites carrerei* (ZEILLER) SZE P. 24; Pl. 5, figs. 3, 4.
1933 *Neocalamites carrerei* (ZEILLER) KRYSHTOFOVICH, Pl. 11, fig. 1; also as *N. ferganensis* KRYSH., Pl. 5, fig. 4; Pl. 12, fig. 1.
1938 *Neocalamites carrerei* (ZEILLER) OISHI P. 78, 79. (Age of beds with this species).

The following references are excluded:

"*Schizoneura Krasseri*" SEWARD n. sp , "probably identical with *S. carrerei* ZEILLER". SEWARD 1903, P. 48; Pl. IX, figs. 5,6. Not specifically determinable.
Schizoneura carrerei ZEILLER; SEWARD 1908 P. 85; Pl. 2, fig. 1. Slender stem identified with *S. krasseri*.
Neocalamites carrerei DU TOIT 1927, P. 315; Pl. XVI, figs. 2, 3. (Leaves and also ridges on internode broader than in *N. carrerei*.)

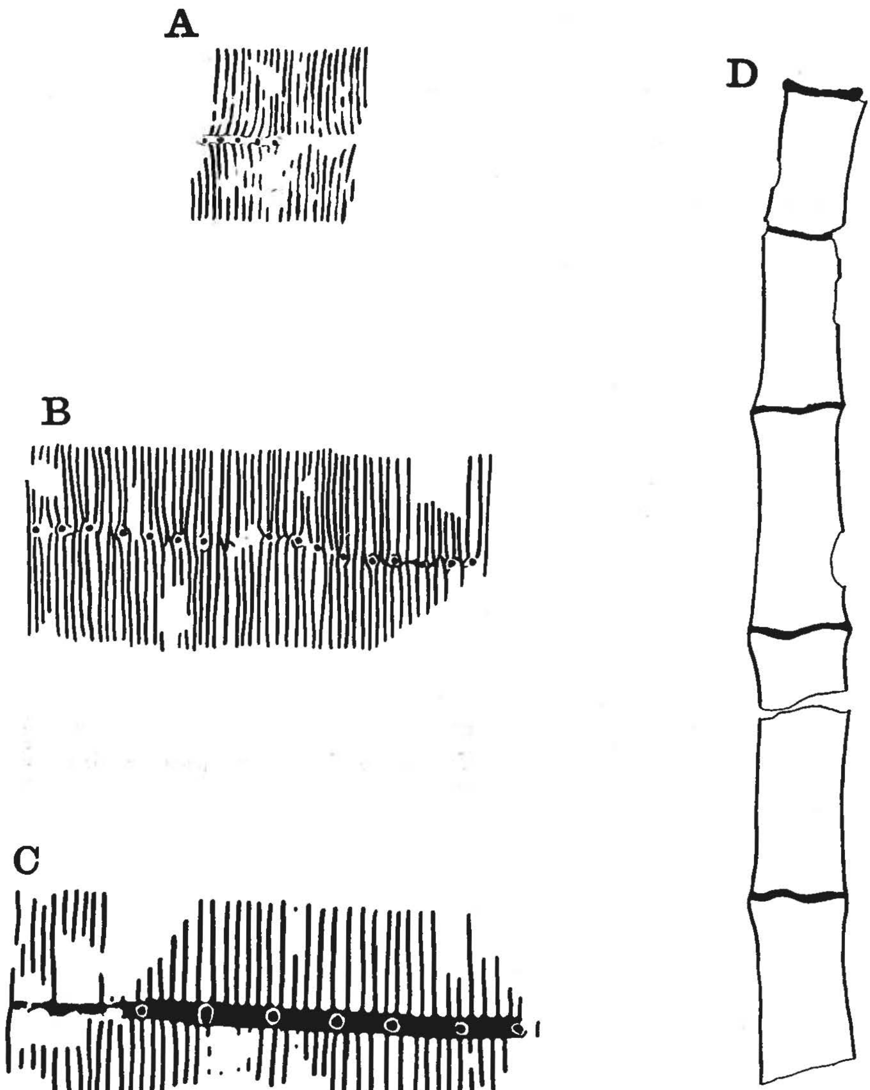
Description. There are many specimens which agree with *N. carrerei*; some being sufficiently characterised for identification, but the majority being equally referable to one of the other species.

The material consists of (1) pith casts; (2) isolated leaves.

Pith-casts. (These might be more accurately described as compressions in which the woody cylinder is prominent). In all the pith-casts the vascular bundles are slender but distinctly recognisable in the internode; at the node they coalesce to form a transverse ridge on which prints of leaf traces are sometimes distinct; sometimes faint, sometimes absent. The following data give the chief particulars of the best specimens:

No. of specimen	Internode length	Internode width	Bundles per cm	Bundles per leaf trace
	1. Pictet Bjærge Profile 7.			
54	over 5 cm	over 6 cm	11	5
48	7.5 cm	over 3 cm	14	2—3
49	over 6 cm	over 6 cm	20	4—6
30	over 11 cm	3.2 cm	14	4
10	over 7 cm	3.2 cm	23	4
	2. Major Paars Dal Profile 1, Zone 5.			
1	10.5 cm	over 7 cm	8—10	not seen
2	5 cm	over 3.5 cm	10	1 or 2
3	over 9 cm	nearly 5 cm	11	not seen
4	5.5 cm	2.2 cm	25	not seen
	3. Major Paars Dal Upper Series.			
J. X. 16	over 3 cm	over 2.5 cm	18	3—4
J. X. 1	over 10 cm	over 3 cm	17	not seen
J. 991	?	over 3.5 cm	12	3
	4. Major Paars Dal; loose-lying blocks.			
12	11, 10, 9 cm (successively)	5 cm	15	leaf traces not seen
5	3, 2.5, 2 cm (successively)	1.9 cm	18	leaf traces not seen
	5. N.E. part of Gurreholm Bjærge.			
J. 924	3.2, 2.4, 1.9 cm (successive internodes)	1 cm	25	2

Most of these specimens as will be seen are rather large stems with long internodes. It is rather striking that leaf traces are not seen in Nos. 3, 4, 12 which appear fairly well preserved; they are very minute and faint in J. 924.



Text-fig. 2. *Neocalamites carrerei* (ZEILLER) Halle, pith casts. *A*. Part of a node, Pictet Bjærge 10, × 2. *B*. Node, Pictet Bjærge 52, × 2. *C*. Node, Pictet Bjærge 30, × 2. *D*. Rather slender stem. *E*. Gurreholm Bjærg, J 924, × 1.

Leaves. Leaves referred to this species are known from Pictet Bjærge alone, no specimen shows them attached. Isolated leaf fragments, however, are present in numbers on nearly every block from this locality. Their length exceeds 10 cm and they appear to have attained their full width near the base and then tapered exceedingly gradually. The midrib is occasionally apparent and is relatively broad occupying half the width of the leaf; it sometimes appears to consist of two separate strands but this effect may have been caused by bad preservation. The margins of the leaf are straight and the lamina gives a suggestion of fine longitudinal striation, but no clearly marked transverse striation. The following figures give the range of width of the leaf fragments. All the specimens exposed on certain rich blocks were measured.

Width of leaf	Number of specimens
0.2—0.3 mm	1
0.3—0.4 mm	2
0.4—0.5 mm	6
0.5—0.6 mm	16
0.6—0.7 mm	19
0.7—0.8 mm	26
0.8—0.9 mm	18
0.9—1.0 mm	16
1.0—1.1 mm	1

As these figures refer to fragments, it will no doubt be true that many of the narrower ones represent distal portions of leaves which were of normal breadth below.

Discussion. *N. carrerei* is by no means an easy species to distinguish. particularly from *N. hoerensis* though certain specimens of the two are different enough. The following comparison brings out their salient points:

N. carrerei	*N. hoerensis*
(See ZEILLER 1903, KAWASAKI 1925, OISHI 1932)	(See HALLE 1908, HARRIS 1926, 1931, OISHI 1932).
Leaf usually under 1.0 mm wide at widest point; never over 1.5 mm.	Leaf always over 1.0 mm wide at widest; often over 1.5 mm; widest known 2.5 mm.
No details available.	Substance of lamina showing coarse striae.

The leaves are of similar shape, attaining their maximum breadth just above the base and then tapering very gradually. Their lengths may be similar.

Main stems often over 4 cm wide; widest known 12 cm. May have 50—100 leaves per node.	Main stems seldom over 4 cm; widest known 5 cm. Number of leaves not over 50 per node.
Frequent small leafy stems about 2 cm wide in which internodes are almost as broad as long. (Long internodes of this width also occur).	Smaller leafy stems have internodes distinctly longer than broad, usually at least twice as long.

Such stems often have only 2 bundles per leaf trace.	Stems of this width seldom have 2, but usually 3 or 4 bundles per leaf trace.
Leaf trace often small and indistinct.	Leaf trace nearly always obvious.

In both the internode length varies greatly being frequently very long. The concentration of bundles ranges from 10—25 cm, there are 2—5 bundles per leaf trace, 3 or 4 being most usual. In both, very slender leafy stems are occasionally produced. No differences are known in the finer details of the pith-cast.

It will be seen that leafy stems of the two are fairly well distinguished by their foliage; and in addition very wide stems and stems with short internodes can be recognised as *N. carrerei*; the ranges of the two overlap to such an extent, however, that many specimens are indistinguishable.

Another species with some resemblance is *Lobatannularia carcinoides* Harris (1937 P. 11) in which though the foliage is very different similar large pith-casts are produced. It is possible that some of the less perfect pith-casts previously regarded as belonging to that species may have belonged to *N. carrerei* (i. e. this species may not really be absent from E. Jameson Land) but it is unlikely that any of the described specimens were really *N. carrerei*.

On these criteria it will be seen that the Pictet Bjærge leaves if rightly placed in *Neocalamites* are like *N. carrerei* rather than *N. hoerensis* as also are the two stems over 6 cm wide; the others may in the absence of evidence to the contrary be placed here too. The specimens from Major Paars Dal Profile 1 are doubtful; but the crowded leaf traces of the one and the obscure ones of the others suggest *N. carrerei*; this applies equally to the loose-lying No. 12. The specimen from Gurreholm Bjærge is typical *N. carrerei*.

Occurrence. *N. carrerei* has not been previously found in Greenland. It is a widespread species, especially in Asia. Its occurrence is as follows.

1. Localities which cannot be more precisely correlated than Upper Trias to Lower Lias. Tonkin (Zeiller 1903). Australia Ipswich Series (Walkom 1915). E. Siberia (Kryshtofovich 1923). China (Sze 1933 a, b). Angara Land (Kryshtofovich 1933).

2. Localities which are definitely Lower Liassic rather than Rhaetic. Sweden (Nathorst 1878). Korea (Kawasaki 1925). Central Asia (Upper plant Series of Turutanova-Ketova 1930). Japan (locality 49 of Oishi 1932, 1938, age of locality uncertain). In Greenland it has now been found in association with Liassic species.

It will be seen that *N. carrerei* occurs in rocks of Liassic age; whether it really occurs in the Rhaetic at all must remain doubtful until the age of certain floras can be more precisely dated. One of the largest of these imperfectly dated floras, the Tonkin flora, was originally regarded as Rhaetic on what seemed good evidence, and it may well be that it includes true Rhaetic in its lower horizons, but it certainly contains a number of species which are now known to be more typical of the Lower Lias than the Rhaetic. Possibly therefore the original specimens of *N. carrerei* may have come from a basal Liassic rather than a Rhaetic horizon.

N. carrerei, when clearly distinguished from the Rhaetic *N. hoerensis*, may thus prove a zone fossil of the Lower Liassic.

Specimens (all regarded as Lower Liassic).

Pictet Bjærge, profile 7. Nos. 1, 2, 10, 30, 49 and many others.
Major Paars Dal, profile 1, zone 5. Nos. 1, 2, 3, 4.
Major Paars Dal, loose blocks. Nos. 5, 12.
Major Paars Dal, Upper Series. No. J. 991, J. X. 16, J. X. 1.
N. E. Gurreholm Bjærge., Peak region, Upper Series. J. 924.

Schizoneura sp. indet. A.

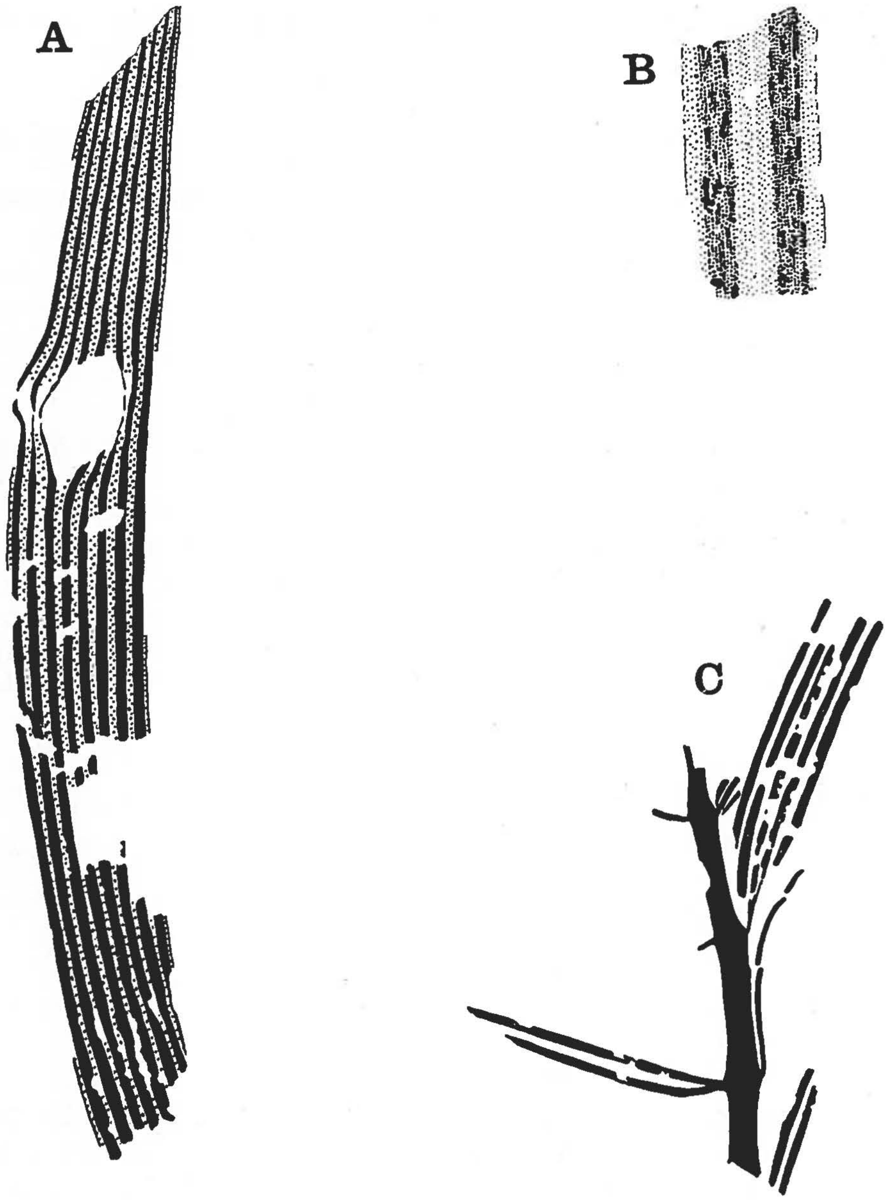
Text-fig. 3.

The fossils described here are a slender stem bearing fused leaves of the *Schizoneura* type and isolated fragments of fused leaves.

The only stem is shown in Text-fig. 3 C. It is preserved as a compression without infilling of the pith cavity but it shows some indistinct ridges like vascular bundles at intervals of about 0.6 mm. The attachment of leaves at each of the three nodes is shown unmistakably, at the middle node, only one of the group of five on the right was traced to it; the others seem to arise at slightly different planes, no doubt from the front and back of the stem. Of these five parallel leaves the two lower ones and the three upper appear to be united by their margins (which are not shown in the Text-figure), but between these two sets is a break, though this may well have been caused in preservation. The leaves on the left of the lower node are separate, though this too may result from bad preservation.

There are plenty of fragments of this type of foliage. The best (shown in Text-fig. 3 A) consists of eight leaf units which gradually grow a little broader and then a good deal narrower, while the midribs are at first very broad and afterwards become narrow.

The leaf-units vary in width from 1—2 mm, the midrib which is marked by many coarse longitudinal striae may itself be over 1 mm



Text-fig. 3. *Schizoneura* sp. A. *A*. Large leaf sheath (veins black, lamina stippled), Pictet Bjærge 52, × 1. *B*. Part of C, × 5. *C*. Shoot with three nodes (lamina not indicated here), Pictet Bjærge 44, × 1.

wide. The lamina is very delicate; thinner than that of the leaf referred to *N. carrerei*; it shows some traces both of longitudinal cells and of transverse striation. The margins of the individual leaves are quite distinct and appear as though separated by a narrow gap of uniform width (about 25 μ) doubtless this was occupied by a delicate layer of cells holding the leaves together.

Discussion. *Schizoneura* sp. A is associated with *N. carrerei* in this collection. It is distinguished by the considerably greater width of the leaf units, and by some differences in their structure but it does nevertheless seem possible that they may belong to the same species. *Neocalamites carrerei* might well have been a plant like a large bamboo producing stems with sheathing leaves in the shade, and a very different type of foliage in the exposed upper parts; this is almost certainly the case in *Lobatannularia* (or *Neocalamites*) *carcinoides* Harris which was a plant of similar size. In *N. carrerei*, however, there are no specimens transitional in character or showing both types of foliage together. Another reason against identifying them is the absence of any *Schizonera*-like specimens in the fine Asiatic collections of *N. carrerei.*

Schizoneura sp. A. indet. is indistinguishable from the specimens called '*Neocalamites carcinoides* stem type C' Harris 1931, P. 26 (a lower Liassic type) but in the absence of any typical shoots or leaves in the type 'B', it is regarded for the present as distinct. As the identification of types 'B' and 'C' rests on not quite conclusive evidence the matter is open.

Specimens Pictet Bjærge, profile 7 (Lias).

Nos. 17, 28, 44, 52 and fragments on others.

Cladophlebis ingens Harris.

Text-fig. 4, 5, 6 C, D.

1931 b *Cladophlebis ingens* Harris P. 55; Text-fig. 17.
1931 b *Cladophlebis* sp. A Harris P. 56; Text-fig. 19.
1937 *Cladophlebis ingens* Harris P. 18.

This species is very well represented in the Pictet Bjærg material. The specimen shown in Text-fig. 4, 5 is typical, but there are fragments of what must have been still larger leaves; the widest piece of pinna-bearing rachis is 12 mm wide. The pinnules in the figured specimen are of typical size but the largest measure 3.7 cm × 1.1 cm; some very small ones also occur.

It will be noticed that the pinnules overlap regularly; in this specimen the surface of the pinnules is distinctly curved. On the assumption that the concave surface faced down as in most leaves, it can be worked out which pinnule was above which. From this the way they were originally tilted out of the perfect horizontal plane can be inferred;

(Text-fig. 6 D) and it is interesting that in this it agrees fully with most living ferns and with shoot systems resembling fern leaves seen in *Selaginella* and many flowering plants.

In other specimens the overlap is similar, except that the degree of crowding differs, being sometimes even greater and sometimes barely occurring at all.

The pinnules have entire margins but in some they are distinctly undulating, though the lobes so formed are very obscure. The surface of the pinnules is sometimes undulating; the area traversed by the branches of a lateral vein being raised in the middle.

The venation is constant (apart from differences related to the size of the pinnules). In large pinnules each vein divides ultimately into about eight branches which meet the margin at a concentration of about 16 per cm; in smaller ones the veins divide into four or more branches, reaching the margin at a concentration of 20—24 per cm.

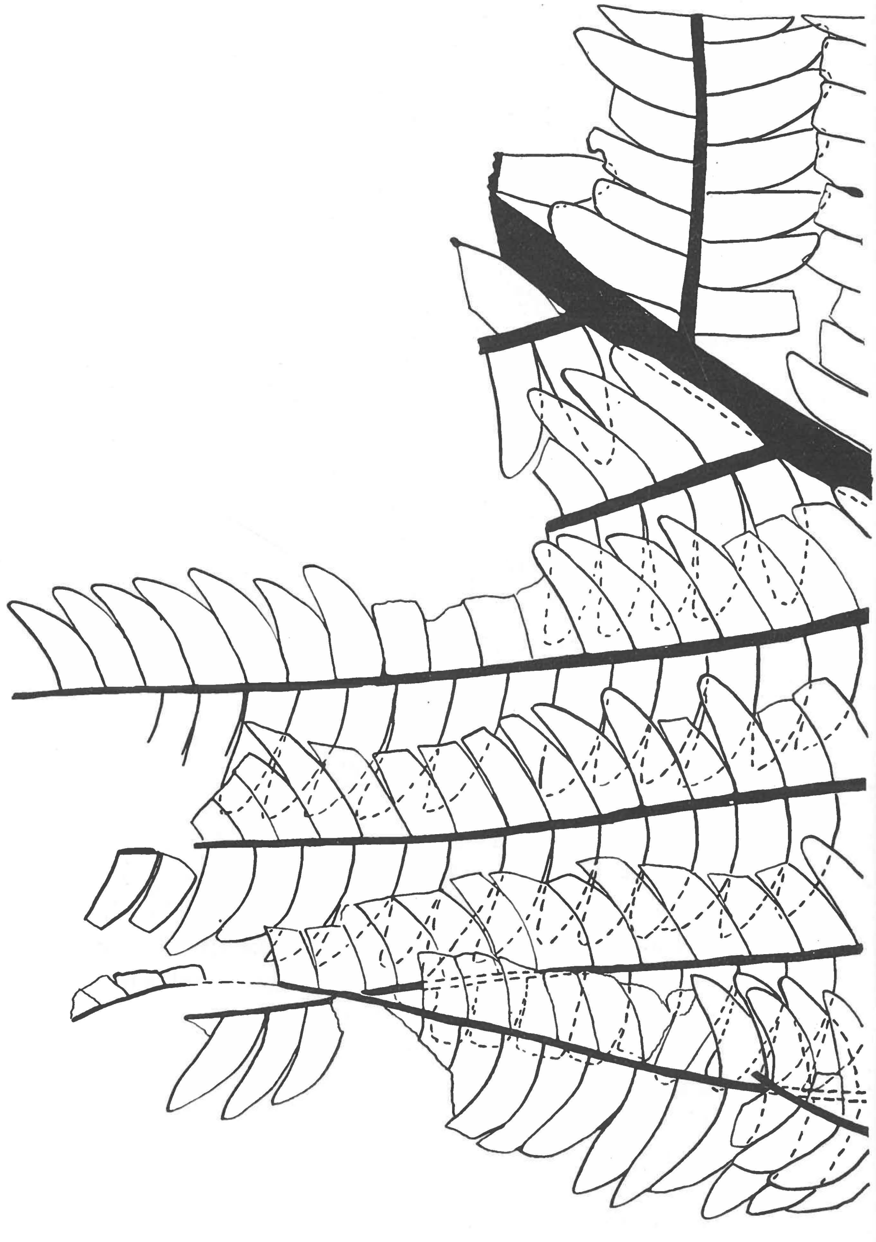
Comparison. The present specimens are just like *C. ingens* HARRIS, but are better preserved and extend our knowledge of that species. They also agree well with *C. halleiana* SZE (1931) P. 32 from the Lias of China; *C. fukienensis* SZE (1933a) P. 49 both of which seem to match one or another part of particular specimens of *C. ingens* perfectly. Very similar also is *C. haiburensis* of OISHI (1932) in which the pinnules are, however, blunter than is usual in *C. ingens* and *C. raciborskii* of OISHI (1932) P. 286, later named *C. raciborskii* former *integra* by OISHI and TAKAHASI (1936) P. 119, in which the pinnules are rather narrower than is usual in *C. ingens.* The original specimens of *C. raciborskii* of ZEILLER (1903) are distinguished by their dentate margins.

C. ingens was previously known from the Greenland basal Liassic. The above mentioned similar specimens are all Lower Liassic (or Rhaetic) but the stratigraphic value of the agreement with the Asiatic specimens is lessened by the difficulty which exists in determining the species of *Cladophlebis. C. haiburnensis* is based on a specimen from the Lower Oolites but a number of Liassic specimens have been identified with it; the original *C. haiburnensis* differs from *C. ingens* in having smaller pinnules.

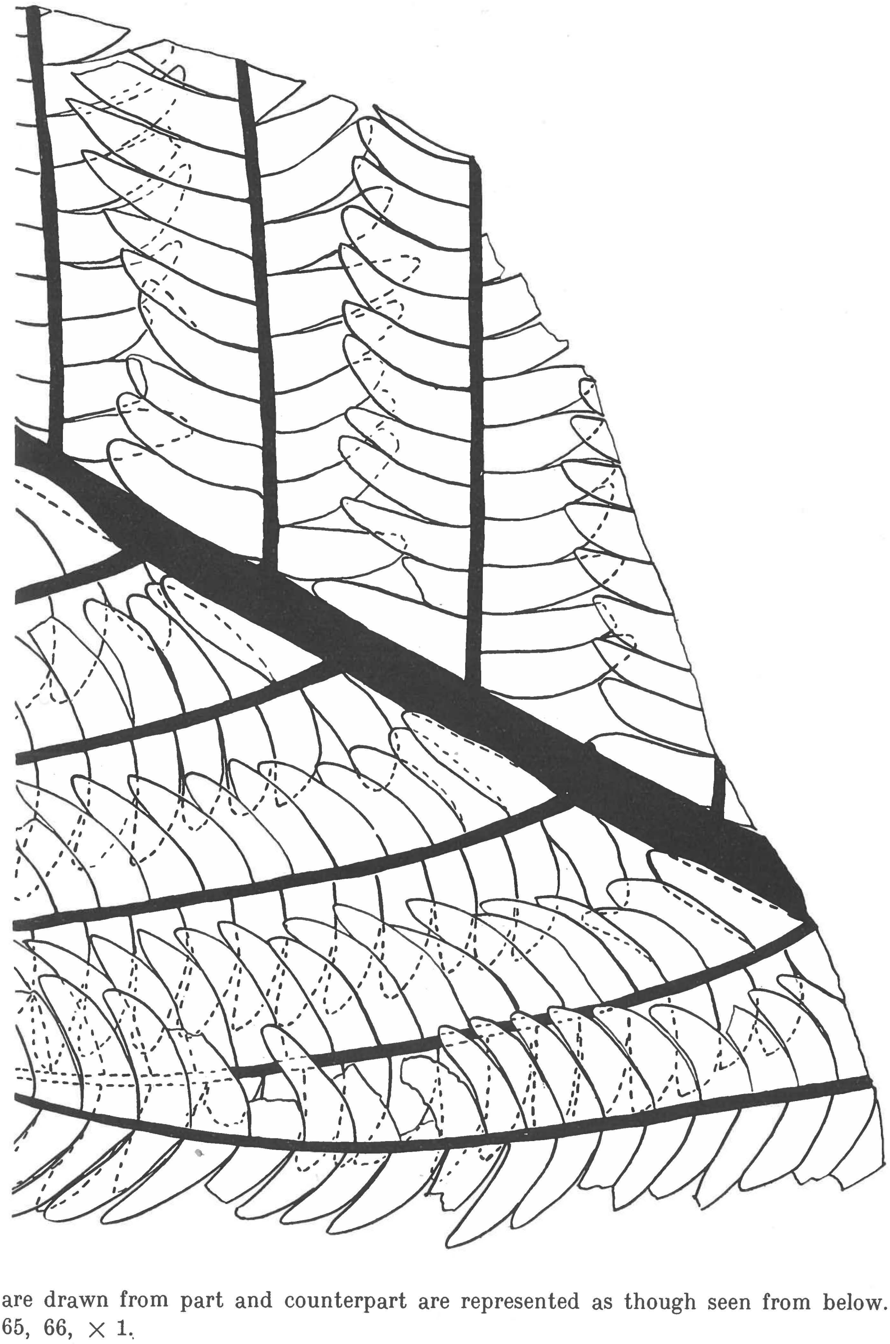
Specimens (Liassic).

Pictet Bjærge, Profile 7. Nos. 32, 33, 37, 40, 42, 54, 58, 59, 65, 66 and others.

Pictet Bjærge Tal C No. Pf 5, Pf 6.



Text-figs. 4 and 5. *Cladophlebis ingens*; middle portion of a leaf. The pinnules, which
Pictet Bjærge



are drawn from part and counterpart are represented as though seen from below.
65, 66, × 1.

Cf. *Osmundopsis plectrophora* Harris.

Text-fig. 6 A, B.

See Harris 1931 b, P. 49.

There are two small fragments of the *Cladophlebis*-type of leaf in which the pinnules agree in size, shape and venation with those from the sterile leaf of *O. plectrophora*, but with no other species known from Greenland. They might, however, belong equally well to other species of other lands, so that their stratigraphic value is uncertain. *O. plectrophora* occurs in the basal Liassic of Jameson Land.

Specimens (Liassic). Pictet Bjærge, Profile 7. Nos. 32, 63.

Hausmannia sp. indet.

Pl. 1, Fig. 6.

The only fragment shows the veins very clearly, but none of the margins and is thus quite indeterminable. The genus is represented by one or two ill-known species in the Lower Lias of W. Jameson Land (see Harris 1931b, P. 97) and is known throughout the Mesozoic from the Upper Trias onwards.

Locality. Liassic. Behind W. Ørsteddal, S.E. Gurreholm Bjærg, Clay-shale, Upper Series. No. J. 908.

Thaumatopteris schenki Nathorst.

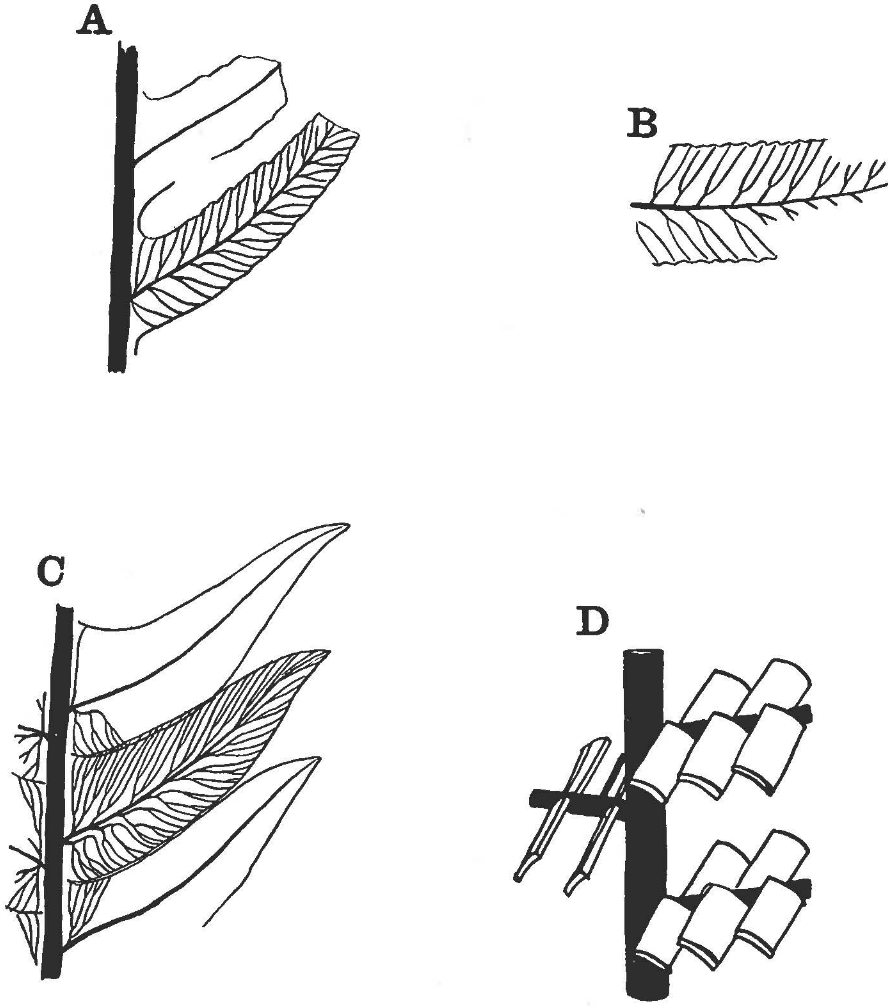
Text-fig. 7.

See Harris 1937, P. 24; also Harris 1931, P. 93 for references.

This species is represented by a few fragments of pinnae which although small are determinable with certainty because no other plant appears to have similar rounded lobes and similar veins. The fragments yielded good celloidin casts of the upper or lower epidermis on which the course of the veins could be seen by the elongation of the cells along them. The stomates are confined to the areas between the veins on the lower surface.

This species was previously known from five localities in Greenland where it occurs at various levels in the *Thaumatopteris* zone from the base upwards. It is a characteristic fossil of the Lower Lias of Germany, Poland and Sweden.

Locality. Behind W. Ørsteddal, S. E. Gurreholm Bjærge, shaly clay, Upper Series. No. J. 908.



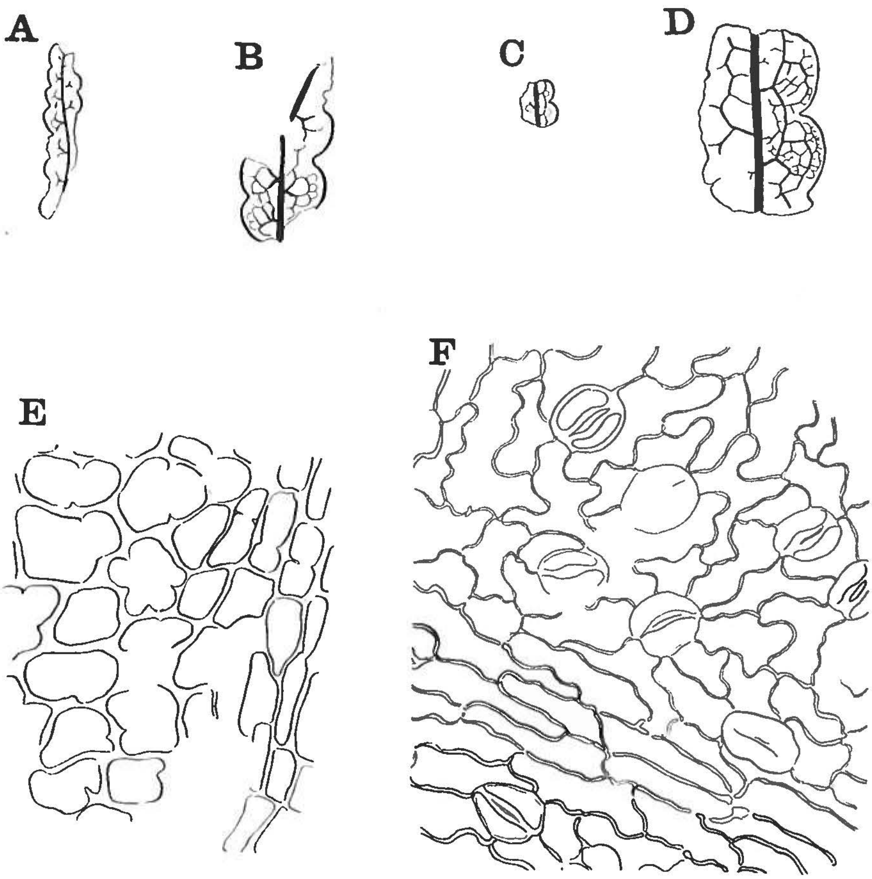
Text-fig. 6. *A*. Cf. *Osmundopsis plectrophora*, fragment of a pinna, Pictet Bjærge 32, × 2. *B*. Cf. *Osmundopsis plectrophora*, fragment of a pinnule, Pictet Bjærge 63, × 2. *C*. *Cladophlebis ingens*, pinnules of rather small size, showing the veins, Pictet Bjærge 40, × 2. *D*. *Cladophlebis ingens*, purely diagrammatic representation of the orientation of the pinnules, seen from above.

Phlebopteris angustoloba (Presl) Hirmer and Hörhammer.

Text-fig. 8.

See Harris 1937. P. 22; 1931 b, P. 74 (as *Laccopteris angustiloba*).

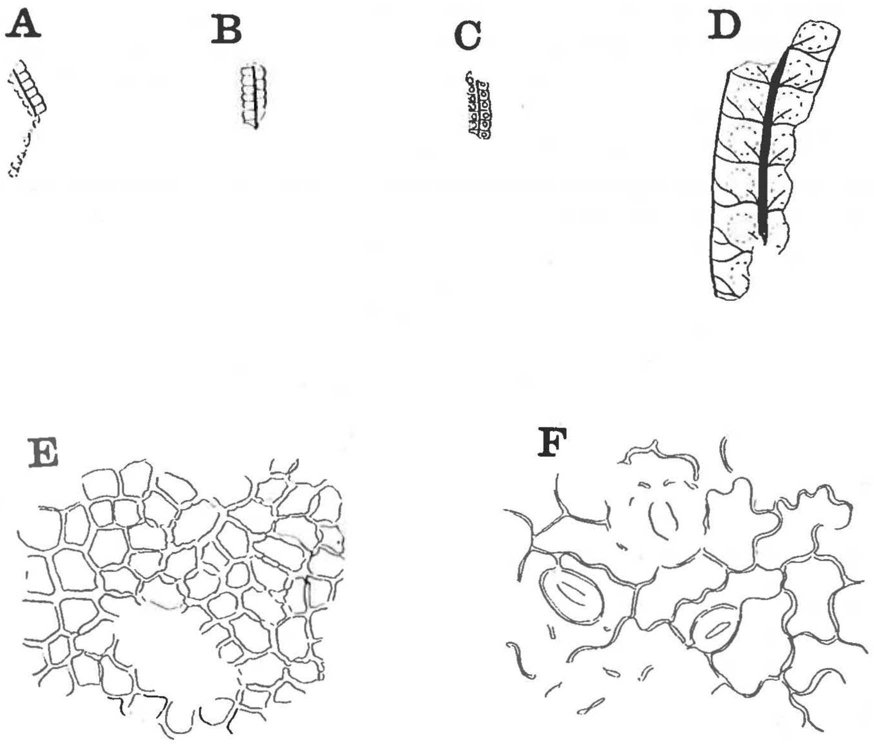
Although the three fragments are minute this fern has such characteristic pinnules and venation that its determination is certain. In all three specimens the surface of the pinnules shows strongly convex



Text-fig. 7. *Thaumatopteris schenki*. *A*, *B*, *C*. Pinnule fragments, Nos. J 908.11; J 908.10; J 908.12, all × 1. *D*. Same as *C*., from a celloidin pull, × 4. *E*. Upper epidermis, celloidin pull from *B*., × 300. *F*. Lower epidermis, celloidin pull from *A*., × 300.

areas (*Gutbiera* form); in one, Text-fig. 8 C, D they are so rounded as to suggest a sorus, but no sporangia or placenta were found.

The specimens gave moderately good celloidin casts showing the upper and lower epidermis separated by a considerable thickness of badly preserved mesophyll cells. Both epidermises show the veins, but while on the upper side lateral veins are only indicated by one or two rows of narrower cells, they are more strongly shown on the lower side. The upper epidermis shows polygonal cells with moderately thick walls and no stomates, the lower sinuous cells and rather crowded stomates which appear to be raised. The stomates are confined to the concavities in the lower surface.



Text-fig. 8. *Phlebopteris angustiloba.* *A*, *B*, *C*. Pinnule fragments, × 2. Nos. J 908.8; J 908.9; J 908.2. *D*. Celloidin pull from *C*. showing the veins, × 10. *E*. Upper epidermis, celloidin pull from *A*., × 300. *F*. Lower epidermis, celloidin pull from *C*., × 300.

This species has only been found in one other locality in Greenland, but is a well known fossil of the Lower Lias of Germany, Sweden and Poland. Specimens identified with it have been recorded from rocks of other ages than the Lower Lias but none of these specimens appear convincing.

Locality. Behind W. Ørsteddal, S. E. Gurreholm Bjærge, Clay-shales, Upper Series. No. J. 908.

Genus **Goeppertella** OISHI and YAMASITA.

OISHI and YAMASITA (1936) have recently placed this fern, long known as *Woodwardites microlobus* SCHENK, in the new genus *Goeppertella* and have assigned it to the Dipteridaceae. The present account gives details of the finest venation which supports this conclusion. Unfortunately the leaf base is still unknown, it might be constructed just as in

Thaumatopteris in which case it would be closely related to the rest of the alliance, or it might be constructed on the ordinary pinnate plan in which case it would stand apart from the rest as HIRMER (1937) suggests.

The name *Woodwardites* was rightly abandoned. GOEPPERT first used it for a Carboniferous leaf apparently as a synonym of *Lonchopteris* BRONGN., it was later used for Tertiary leaves, later still for this species by SCHENK (see ZEILLER 1903 P. 89). There are profound differences between the present fern and *Woodwardia* both in venation and sorus and it was only mistakenly regarded as the oldest member of the Polypodiaceae.

Goeppertella microlobus (SCHENK) YABE and YAMASITA.

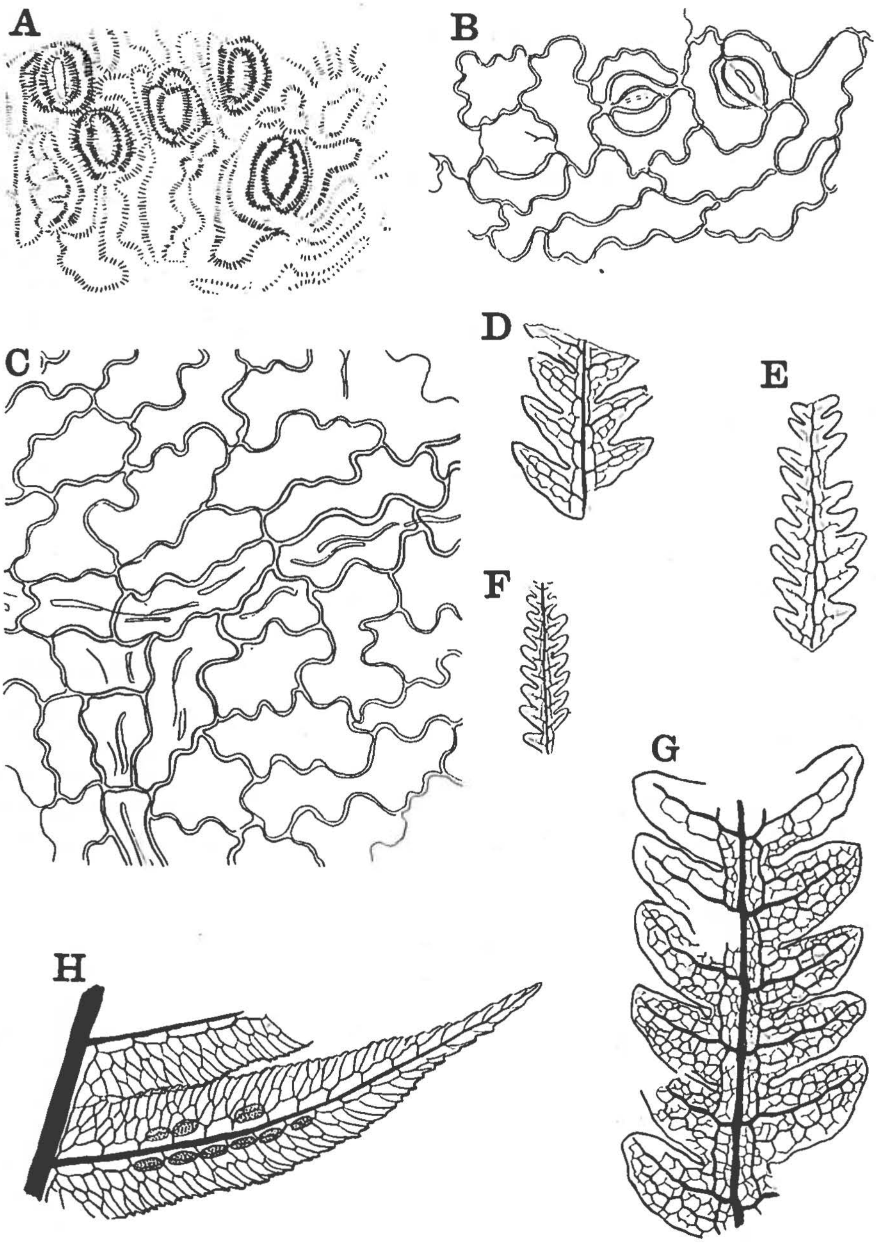
Text-fig. 9.

1867 *Woodwardites microlobus* SCHENK, P. 68; Pl. 13, figs. 11—13.
1882 *W. microlobus* SCHENK, ZEILLER, P. 308; Pl. 12, figs. 3, 4.
1892 *W. microlobus* SCHENK, RACIBORSKI, P. 347; Pl. 2, fig. 17.
1903 *W. microlobus* SCHENK, ZEILLER, P. 91; Pl. 17, figs. 1—5.
1913 *W. microlobus* SCHENK, MÖLLER and HALLE, P. 9; Pl. 1, figs. 7—16.
1919 *W. microlobus* SCHENK, ANTEVS, P. 14; Pl. 1, figs. 5, 6, 6a.
1936 *Goeppertella microlobus* (SCHENK) OISHI and YAMASITA, P. 146.
1937 *Goeppertella* HIRMER, PP. 83, 86.

Description. There are many fragments of this species, all sterile, but preserved in very fine grained shale and showing microscopic features very well. The best of these are figured.

The midribs of the leaf segments are sunken on the upper side and very prominent indeed on the lower; the stronger lateral veins which form a mesh share this feature, so that the leaf surface is marked out into little areas with sunken borders. The finer veins do not as a rule influence either surface of the lamina, and as they are therefore less obvious they had been entirely overlooked. Careful examination without any special treatment does, however, always show them, and in celloidin casts showing epidermal cells they are striking owing to the elongation of the cells along them while between the cells are polygonal or sinuous. The cells along the margins on both surfaces are narrow like those along veins; there may perhaps be a marginal vein.

Locality. Behind W. Ørsteddal, S.E. Gurreholm Bjærge, Clay-shale, Upper Series. No. J. 908.



Text-fig. 9. *Goeppertella microlobus*; *Woodwardia* (recent). *A*, *B*. Celloidin pulls of lower epidermis, *A*. showing the contour of the cell surface, *B*. the cell walls, from adjacent parts of same preparation, No. J 908.1, × 300. *C*. Celloidin pull of upper epidermis, No. J 908.2, × 300. *D*, *E*, *F*. Pinnules, Nos. J 908.4; J 908.7; J 908.5, all × 2. *G*. Celloidin pull showing most of the veins (the smaller veins are omitted where obscure), No. J 908.2, × 4. *H*. *Woodwardia radicans* (recent); fertile pinnule for comparison, × 2.

Gymnospermae.

Stachyotaxus elegans NATHORST.

See HARRIS 1935, P. 52 for references.

There are five poor but determinable specimens of leafy shoots which are undoubtedly referable to this species which is abundant throughout the Rhaetic of Greenland. With one shoot is associated a very poorly preserved cone-scale with a seed. This genus is one of the very few of those common to Greenland and Sweden but not yet found elsewhere.

Rhaetic. Major Paars Dal, Profile 2. No. 8.

Podozamites sp. Type 2 HARRIS.

Text-fig. 10 A, B.

1935 *Podozamites* sp. indet. Type 2 HARRIS 1935, P. 92.

This is like the leaves figured in HARTZ (1896) as *P. lanceolatus* and *P. schenki* and by HARRIS (1935) as Type 2; Pl. 18, Fig. 7 and Text-fig. 38. The leaves are as a rule slender and reach their widest point just below the middle; though in some they are of moderate breadth (about 1 cm). The specimen shown in the Text-figure is typical; the veins are sometimes more numerous than in the leaf base figured.

Podozamites leaves of this shape are common in the *Thaumatopteris* zone of Greenland but have not been noted in the *Lepidopteris* zone. Elsewhere, however, similar leaves are known from rocks of Rhaetic age onwards.

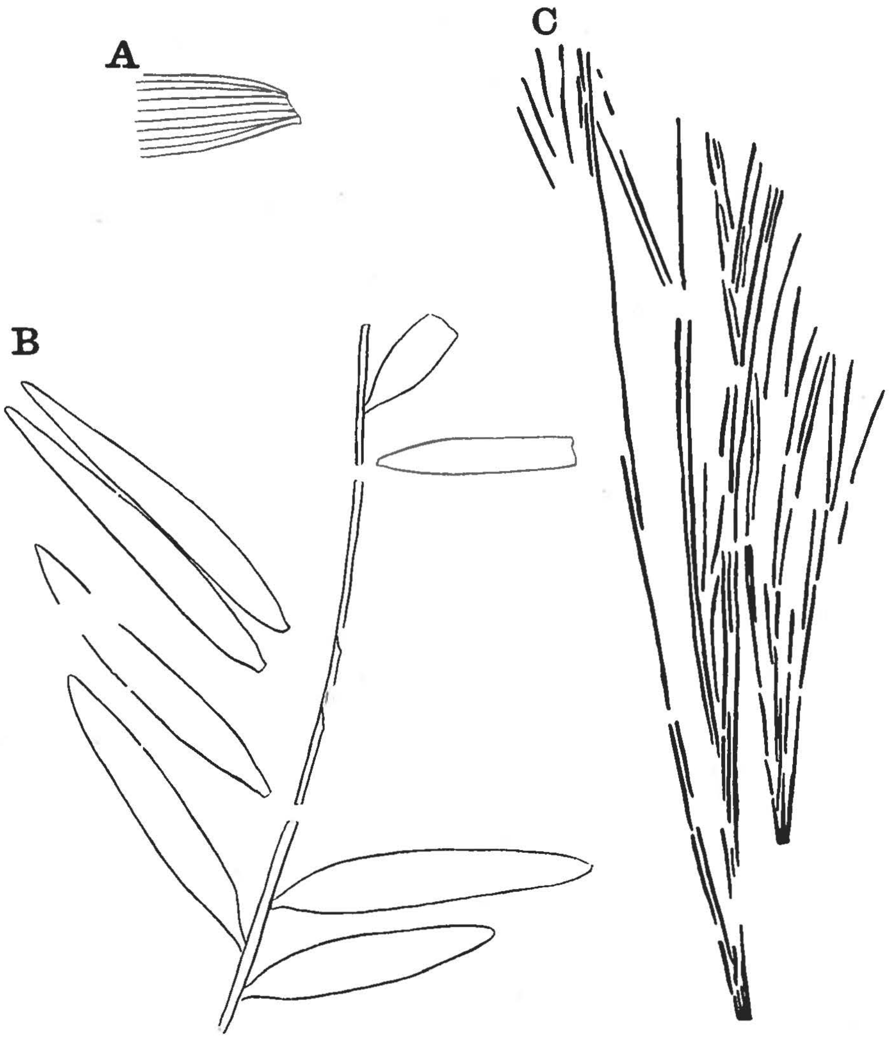
Liassic. Pictet Bjærg Tal C, Pf. 5, 6; Pictet Bjærg, Profile 7, Nos. 36, 71 and others.

Podozamites sp. Type 4 HARRIS.

1926 (b) *Podozamites schenki* (? NATHORST) HARRIS P. 115.
1935 *Podozamites* sp. Type 4, HARRIS P. 92.

These are a few fairly good shoots with very slender leaves agreeing exactly with those figured by HARRIS (1926b) as *Podozamites schenki.* Specimens resembling *P. schenki* occur in both *Lepidopteris* and *Thaumatopteris* zones.

Rhaetic. Major Paars Dal, Profile, No. 6.



Text-fig. 10. *Podozamites*; *Czekanowskia*. *A*. *Podozamites* sp. fragment from base of leaf, Pictet Bjærge 36, × 2. *B*. *Podozamites* sp. shoot, Pictet Bjærge 71, × 1. *C*. *Czekanowskia* sp., two leaf bundles, Pictet Bjærge Tal C, Pf 1, × 1.

"*Desmiophyllum* Type 2" Harris.

Text-fig. 11.

1935 *Desmiophyllum* Type 2, Harris P. 98 (description).
1937 *D*. Type 2, Harris P. 66 (mention only).

The leaves figured here which are all preserved on one block agree closely with those previously described, but not figured. No specimen is complete; but the length may well have been at least 20—30 cm as in the previous specimens. The base and apex of the leaf have now been recognised; the apex proves to be acute and shows several fine veins ending in it; the base is gradually tapering. In most of the present leaves there are four veins.

It has been previously pointed out (Harris 1935) that no trace of a cuticle is preserved even where that of the associated Ginkgoalean leaves is preserved to perfection; its absence thus appears to be an original feature and it is evident that this is quite different from the thickly cutinised Ginkgoalean leaves of the *Phoenicopsis*-type.

D. Type 2 is common in the upper half of the *Thaumatopteris* zone of Greenland.

Lower Liassic. Pictet Bjærge, No. 71.

Czekanowskia sp. indet.

Text-fig. 10 C.

Two specimens show bundles of stiff leaves diverging from a point. The leaves are about 1 mm wide and the longest are incomplete and over 10 cm long; they fork occasionally. The general form of the foliage indicates that they belong to *Czekanowskia* but in the absence of any preserved cuticle it is impossible to identify them further.

Two species of *Czekanowskia* are already known from the Lower Liassic of E. Greenland, and there are others from various stages in the Lias and Oolite of other regions, but no specimens have yet been found in rocks known to be as old as Rhaetic. The genus thus appears to have some zonal significance even in the absence of a specific determination.

Lower Liassic. Pictet Bjærge, Profile 7, 495—525 m, No. Pf. 6. Pictet Bjærge Tal C at 725, No. Pf. 1.

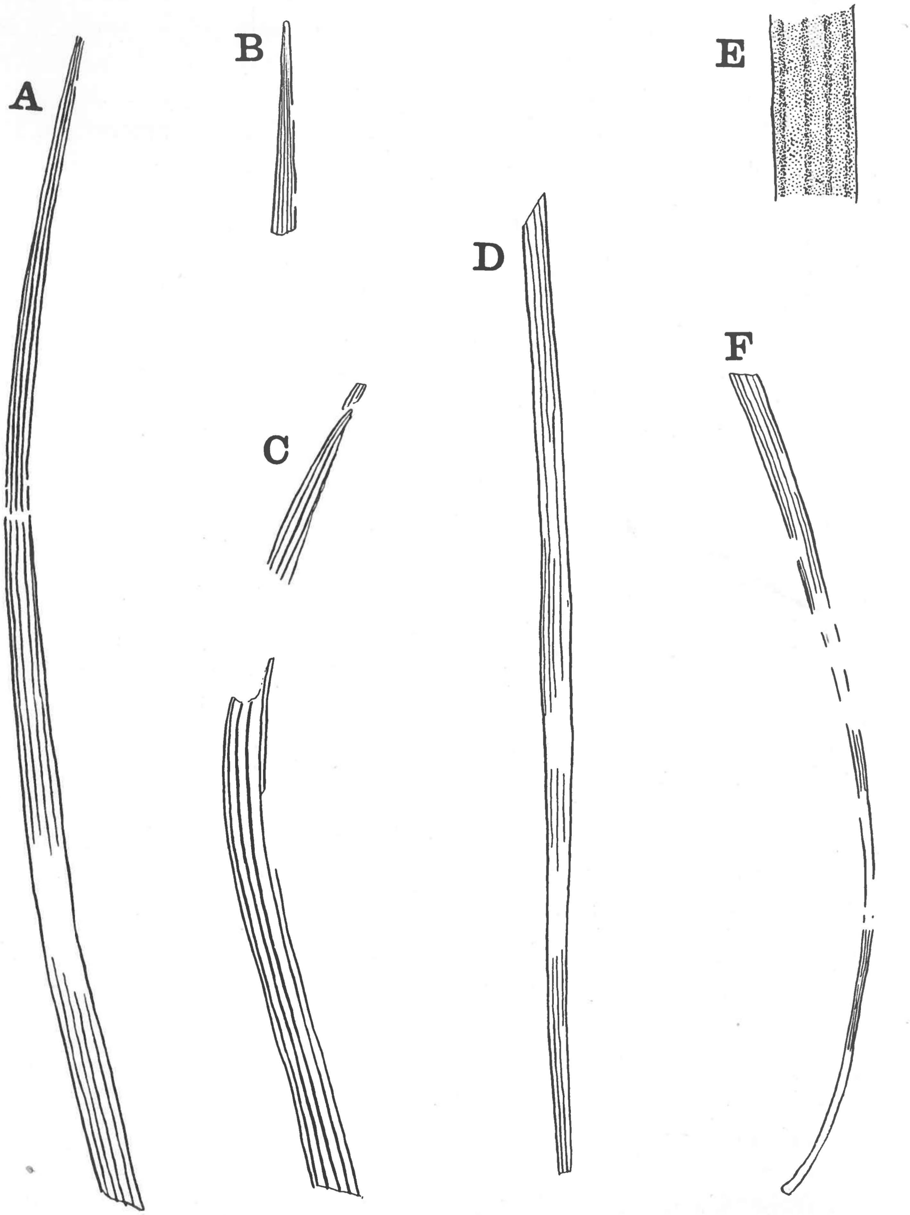
Ixostrobus groenlandicus Harris.

Text-fig. 12 E, F, G.

See Harris 1935, P. 147; Harris 1937, P. 66.

The specimen figured is poorly preserved as a mere shining film on a coarse shale and no details beyond those shown could be made out. It is, however, possible to make out the essential features of the axis and its microsporophylls and these agree well with *I. groenlandicus*.

It shows rather clearly that the appendages are in whorls. A reexamination of the original specimens shows that there too the microsporophylls are whorled, though occasionally they are crowded and one



Text-fig. 11. *Desmiophyllum*, Type 2, HARRIS. *A*, *C*, *D*. Middle portions of leaf. *B*. Apex. *F*. Base. *E*. Veins. *E*. × 4, rest natural size. All from Pictet Bjærge 71.

microsporophyll may be slightly displaced so as to make the whorled arrangement less obvious. The number of microsporophylls in a whorl seems to vary; in some it would appear to be four but in others it is almost certainly as many as six. The microsporophylls of successive whorls were clearly seen to alternate.

The present specimen is associated with "*Desmiophyllum* sp. 2" and with a *Podozamites* of the *agardhianus* type, thus affording some additional support to the suggestion (Harris 1935, P. 147) that it is the male organ of a tree with that type of leaf. It may be noted that there is similar evidence of association suggesting that *Swedenborgia* is the female organ of the same species of *Podozamites*.

I. groenlandicus is an uncommon fossil of the *Thaumatopteris* zone of Greenland. The very similar *I. siemiradzkii* Raciborski occurs in a flora of Liassic type in Poland.

Pictet Bjærge, Profile 7, No. 68.

Cf. *Stenorrhachis dubius* Antevs.

Text-fig. 12 D.

1919 *Stenorrhachis dubius* Antevs, P. 38; Pl. 5, figs. 8—15.

A very poorly preserved cone showing appendages which appear to agree with those of *S. dubius* in consisting of a short stalk bearing two oval bodies about 4 mm long. The oval bodies show 3 or 4 indistinct longitudinal striae.

S. scanicus is a cone of uncertain morphology from the Swedish Liassic. No cone comparable with this has been previously found in Greenland.

Locality. Pictet Bjærge, Profile, No. 53.

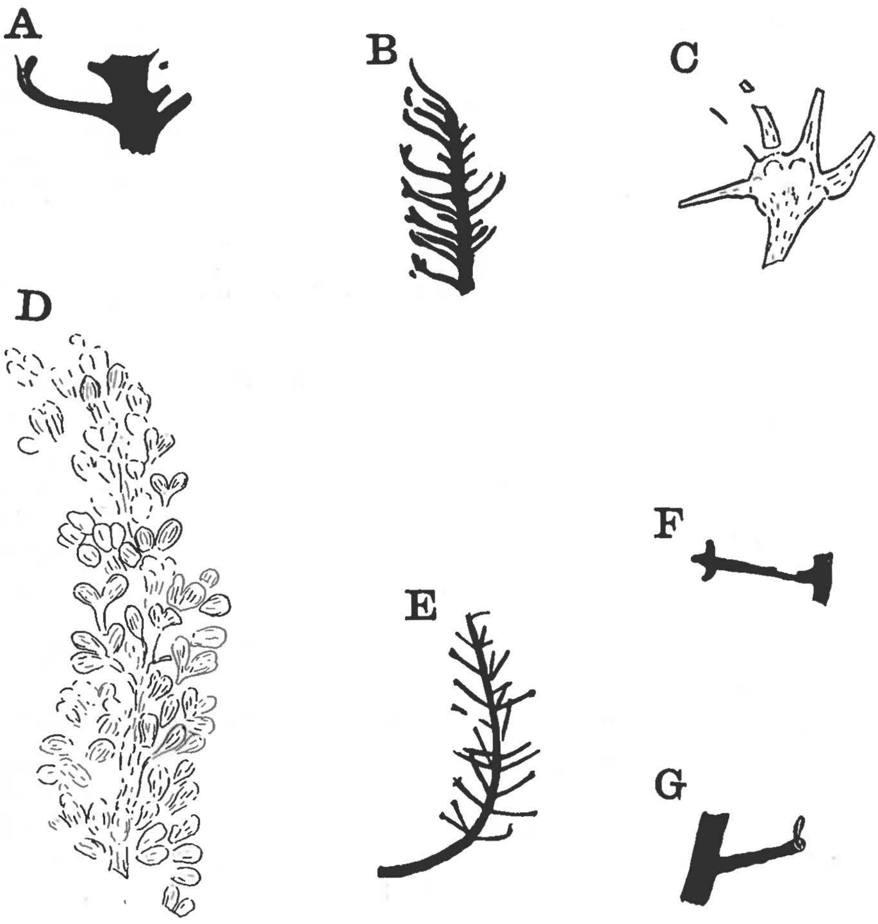
Swedenborgia cryptomeriodes Nathorst.

Text-fig. 12 C.

See Harris 1935, P. 108; 1937, P. 64 for references.

A single cone scale, which is imperfect but definitely determinable was the only specimen recognised. *S. cryptomerioides* has been found in four or five localities in the Greenland Lower Liassic of which it is a zone fossil. In each Greenland locality (including the present) it is associated with a narrow leaved *Podozamites*. In Japan (Oishi and Yamasita 1935, Oishi 1938) it is of *Thaumatopteris* zone (presumably basal Liassic) age.

Lower Lias. Pictet Bjærge, Profile, No. 36.



Text-fig. 12. Gymosperm fructifications. *A*, *B*. Cone sp. indet. A; *A*. × 2; *B*. natural size. Pictet Bjærge 53. *C*. ***Swedenborgia cryptomerioides***, cone scale, Pictet Bjærge 36, × 2. *D*. Cf. ***Stenorrhachis dubius***, cone, Pictet Bjærge 53, × 1. *E*, *F*, *G*. ***Ixostrobus groenlandicus***, Pictet Bjærge 68, *E*. natural size, *F*, *G*. × 2.

Conites sp. indet.

Text-fig. 12 A, B.

The specimen is distinct from anything previously found in Greenland, and is probably a new species, though not well enough known to be characterised as one. It appears to have some resemblance to *Ixostrobus*, but differs from *I. groenlandicus*, in its shorter axis and stouter, more crowded appendages. It is possible that the appendages agree in essential structure, and there is a suggestion that they may form whorls.

Lower Liassic. Pictet Bjærge, Profile 7, No. 55.

PART II
DISCUSSION OF LOCALITIES

It will be seen from the analysis given below that the localities from which determinable plants were obtained fall into two groups; one with Rhaetic, one with Lower Liassic species. The Rhaetic species come from one locality in Major Paars Dal which provides three only, these being widespread in the Rhaetic exposure in Hurry Inlet. The poverty of the Rhaetic in W. Jameson Land is in marked contrast with the condition in the east, along Hurry Inlet, where almost every section provides at least one bed with a dozen or more species. No determinable plants of Rhaetic age have yet been found north of Major Paars Dal.

The Liassic localities are more numerous but only three are moderately rich and these barely come up in number of species to the average for the plant beds of the Hurry Inlet Lias; there are also some localities with only one or two determinable species and many of roughly similar age in which some obscure impression, doubtfully of plant nature was all that was found. Here again it is evident that the plant bearing series, which is so productive of beautiful specimens in the east of Jameson Land, becomes comparatively barren in the north and west.

It is difficult to compare the flora of these new localities with those along Hurry Inlet because each locality has its own assemblage of species. It can be stated without reservation that these new floras resemble those of Hurry Inlet more closely than those of anywhere else. The differences concern about five species which were not previously found in Hurry Inlet, and two species *Lobatannularia carcinoides* and *Sphenobaiera spectabilis* common in Hurry Inlet, but absent here. It seems likely that this difference is rather too great for mere chance because in the later stages of the investigation of the Lias of Hurry Inlet it was very rare for a new locality to provide even one new species, but instead species were found that had been met several times before. Here, however, three localities though by no means rich in species have provided five new ones for Greenland.

Of these new ones the two definitely and one tentatively identified are all found in the basal Liassic of other lands. Plainly therefore they do not point to any difference of age between the floras, but rather confirm their agreement. The differences must then be due to other causes, possibly slight local differences in the environment due to a difference of situation.

The comparative barrenness of the plant bearing Liasso-Rhaetic of N. and W. Jameson Land is a fact from which conclusions might perhaps be drawn. Nearly all the localities provide merely Equisetaceous stems; sometimes preserved in position of growth, but no fern leaves, or even upper parts of Equisetaceae; two localities, however, provide plenty of fern and other leaves. Though not always sharply contrasted, the two types of flora may be regarded—the one as an *Equisetum* reed swamp preserved more or less in the position of growth in sandy material; the other as a lagoon into which leaves fall or were occasionally washed from the surrounding forest and preserved in very fine silt. In N. and W. Jameson Land the *Equisetum* swamp growing presumably on mud flats predominates, but in E. Jameson Land it is the lagoon type of flora which is the commoner.

In addition to the specimens described here, there is some material of petrified wood of conifer-type, some of which appears to be fairly well preserved. This undescribed wood is at present with the other material; its age where known is largely Dogger. There were also a number of specimens with obscure impressions which proved to be indeterminable and so without scientific interest from rocks of various ages in the Jurassic. These were broken up in searching for better specimens. There was also some bituminous coal composed of compressed conifer wood.

Preservation. Much of the material is very like that already described from E. Greenland and calls for no comment. Two types of preservation are, however, shown which are of interest.

1. Pictet Bjærge, Profile 7. The fossils are preserved in a shale which has become intensely hard; the plant matter has been altered to a thin, shining black layer in the substance of which the plane of cleavage occurs. No fine features are preserved and no technique showed anything more than was obvious to the naked eye. This rock appears to have undergone slight metamorphosis, and the plant material has the appearance of anthracite, but proves on roasting to contain a great deal of iron.

2. W. Ørsteddal, S. E. Gurreholm Bjærge. The fossils are preserved in a very fine black shale. The cellular substance of the plant is often partly replaced by a white mineral, and partly remains carbonaceous, but no cuticles are preserved. Excellent celloidin pulls are yielded by certain

specimens; in some, repeated pulls showed first epidermis and then mesophyll cells.

Localities from which plants described in this paper have been obtained.

Rhaetic. Major Paars Dal, Profile 2.

Equisetites grosphodon Harris; *Stachyotaxus elegans* Nathorst. Both indicate a Rhaetic age. (The associated *Podozamites* does not indicate any precise age).

Lower Liassic (Probably basal Liassic).
Major Paars Dal, Upper series.

Lycostrobus scotti Nathorst; *Triletes areolatus* Harris; *Neocalamites carrerei* (Zeiller) Halle. These three species, particularly the first two indicate a Lower Liassic age. The associated *Equisetites* sp. A is not used as evidence in determining the age of this locality.

Major Paars Dal, Profile 1, Zone 5.

Neocalamites carrerei (Zeiller) Halle indicates a Lower Liassic age. *Equisetites* sp. A. is associated but is not used as evidence for this locality.

Major Paars Dal, back part (?Lower Lias, H. Stauber).

Triletes pemphigus.

N.E. Gurreholm Bjærge, Peak region, Upper series.

Neocalamites carrerei indicates a Lower Liassic age. *Equisetites* sp. B. is associated but provides no indication of age.

Behind W. Ørsteddal, S. E. Gurreholm Bjærge, Clay shale, Upper Series.

Coeppertella microlobus, *Phlebopteris angustiloba*, *Thaumatopteris schenki* indicate a Lower Liassic age. The associated fragments of *Hausmannia*, *Neocalamites*, *Podozamites* do not provide any precise indication of age.

Pictet Bjærge, Profile 7.

Neocalamites carrerei (Zeiller) Halle; *Cladophlebis ingens* Harris; *Ixostrobus groenlandicus* Harris; *Swedenborgia cryptomerioides* Nath.; *Czekanowskia* sp.; *Desmiophyllum* Type 2 Harris all indicate a Lower Liassic age. Cf. *Stenorrhachis dubius* Antevs, Cf. *Osmundopsis plectrophora* Harris would also provide evidence for this age if correctly determined. No evidence is provided by the associated *Podozamites* species or by *Schizoneura* sp. indet.

Pictet Bjærge, Tal C at 725 m.

Cladophlebis ingens and *Czekanowskia* sp. indicate a Lower Liassic age. No evidence is provided by the associated *Podozamites* leaves.

Fleming Fjord, Cape Seaford.

Equisetites sp. A. is the only species: the evidence is the same as for Traill Island.

NE. Traill Island, Kap Palander, Mols Bjærge.

The only species is *Equisetites* sp. A. which agrees with that from Major Paars Dal, upper series and Profile 1, which are correlated as Lower Liassic. If correctly identified the specimens would thus provide evidence that this locality is Lower Liassic.

Analysis of the floras described here.

1. Rhaetic Flora.

Species	Previous localities
Equisetites grosphodon	Greenland. Rhaetic.
Stachyotaxus elegans	Greenland, Sweden. Rhaetic.
Podozamites sp. 4	Similar in many Mesozoic floras.

2. Lower Liassic Floras.

Lycostrobus scotti	Greenland, Sweden. Lias.
Triletes areolatus	Greenland. Lias.
Triletes pemphigus	—
Equisetites sp. , sp. B	Similar in many Mesozoic floras.
Neocalamites carrerei	Lower Lias, Liasso-Rhaetic, many regions.
Schizoneura sp.	Similar in older Mesozoic floras.
Cladophlebis ingens	Greenland. Lias.
Cf. *Osmundopsis plectrophora*	Greenland. Lias.
Hausmannia sp.	Mesozoic of most lands.
Thaumatopteris schenki	Greenland and Europe. Lias.
Phlebopteris angustiloba	Greenland and Europe. Lias.
Goeppertella microlobus	Europe, Liassic. Tonkin, Liasso-Rhaetic.
Podozamites sp. 2	Similar in many Mesozoic floras.
Desmiophyllum sp. 2	Greenland. Lias.
Czekanowskia sp.	Lias and Oolite, many regions.
Ixostrobus groenlandicus	Greenland. Lias.
Cf. *Stenorrhachis dubius*	Sweden. Lias.
Swedenborgia cryptomerioides	Greenland, Sweden, Japan. Lias.
Conites sp.	—

Summary.

The floras of a number of Liasso-Rhaetic localities in N. and W. Jameson Land and Traill Island are described. The following species are determined.

Rhaetic: *Equisetites grosphodon*, *Stachyotaxus elegans*. Lower Liassic: *Lycostrobus scotti*, *Triletes areolatus*, *T. pemphigus* sp. nov., *Neocalamites carrerei*, *Cladophlebis ingens*, *Thaumatopteris schenki*, *Phlebopteris angustiloba*, *Goeppertella microlobus* (Schenk), *Swedenborgia cryptomerioides*.

New morphological data are provided in the case of *Cladophlebis ingens*, *Thaumatopteris schenki*, *Phlebopteris angustiloba*, *Goeppertella microlobus*, *Ixostrobus groenlandicus*.

The present floras are compared with those previously known from E. Greenland.

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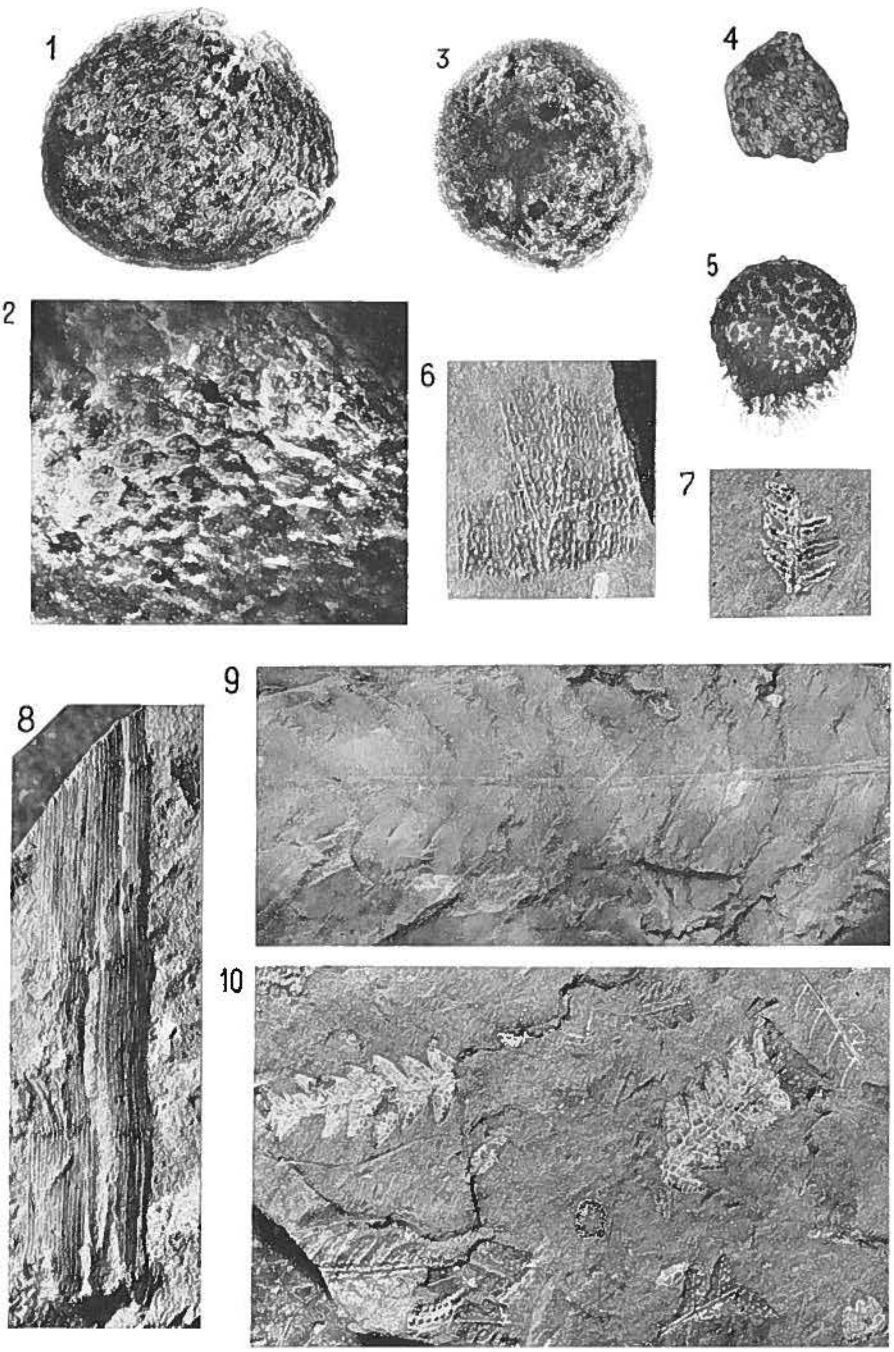
Færdig fra Trykkeriet den 21. Juni 1946.

Plate 1.

Fig. 1. *Triletes pemphigus*, slide J 882, × 50.
Fig. 2. Part of same specimen, showing the protuberances in surface view, × 100.
Fig. 3. *T. pemphigus* type-specimen, showing the triradiate scar, J 882, × 50.
Fig. 4. *Triletes areolatus* fragment of spore, J X 16, × 50.
Fig. 5. *Lycostrobus scotti*, spore, J X 16, × 50.
Fig. 6. *Hausmannia sp. indet.*, J 908.3, × 2.
Fig. 7. *Goeppertella microlobus*, pinnule, J 908.1, × 2.
Fig. 8. *Neocalamites carrerei*, pith cast. Major Paars Dal, profile 1, Zone 5, No. 5. × 1.
Fig. 9. *Cladophlebis ingens*, pinna coated with NH_4Cl to show the undulating surface, Pictetbergen 65.
Fig. 10. *Goeppertella microlobus*; *Phlebopteris angustiloba* (near base) slab covered with fragments in which the leaf substance is replaced by mineral. No. J 908.2, × 2.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