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THE RHAETIC PLANTS FROM PROVINCE
NAGATO. A SUPPLEMENT

By

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With 1 Plate and 6 Text-figures

Contribution from the Department of Geology and Mineralogy,
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This paper deals with the description of certain additional material of the Rhaetic plants from the Province of Nagato (Yamaguchi Pref.), collected, after ÔISHI's previous paper⁽¹⁾ was published, by the junior author from the black shales in the Tubuta coal-mine and by the students of our Department from whitish shales developed at the Yamanoi district upon the occasion of a geological excursion led by Mr. Y. SASA in 1934. To these specimens are added some others obtained by Prof. T. NAKASA and Mr. S. WADA of the Hiroshima Higher Normal School, Mr. S. UMEDA of the Asa Girls' High School, and Mr. K. YAMASITA of our Department from the above localities and Momonoki in the Ômine coal-field. To all these donors of specimens the sincere thanks of the authors are due.

The plant-beds at Yamanoi and Tubuta coal-mine belong to the Yamanoi Bed⁽²⁾ of the senior author. The following species are described in this paper:

Yamanoi (Loc. No. 1).

Neocalamites Carrerei (ZEILL.)

Equisetites sp. (a diaphragm)

Cladophlebis denticulata (BRONGN.)

Pterophyllum yamanoiensis sp. nov.

P. sp.

Sagenopteris Nilssoniana PRESL

(1) S. ÔISHI: Rhaetic Plants from Province Nagato (Yamaguchi Prefecture), Japan. This Journal, Ser. IV, Vol. II, No. 1, 1932, pp. 52-67.

(2) S. ÔISHI: The Mesozoic Plants. Iwanami's Manual on Geology and Palaeontology, 1931, p. 6 (in Japanese).

Yamanoi (Loc. No. 13).

Clathropteris obovata ÔISHI ?
Dictyophyllum japonicum YOK.
Cycadocarpidium? sp.

Yamanoi (Loc. No. 16).

Cladophlebis Raciborskii ZEILL. forma *integra* nov.
 Cfr. *Leptostrobis laxiflora* HEER

Yamanoi (Loc. No. 17).

Pterophyllum sp.
Nilssonia simplex ÔISHI
Ctenis? sp.

Yamanoi (Loc. No. 18).

Podozamites sp.

Tubuta (I).

Neocalamites Carrerei (ZEILL.)
Cladophlebis denticulata (BRONGN.)
Clathropteris sp. indet.
Dictyophyllum Nathorsti ZEILL.
Taeniopteris minensis ÔISHI
Pityophyllum longifolium (NATH.)
Elatocladus sp.

Tubuta (II).

Neocalamites Carrerei (ZEILL.)

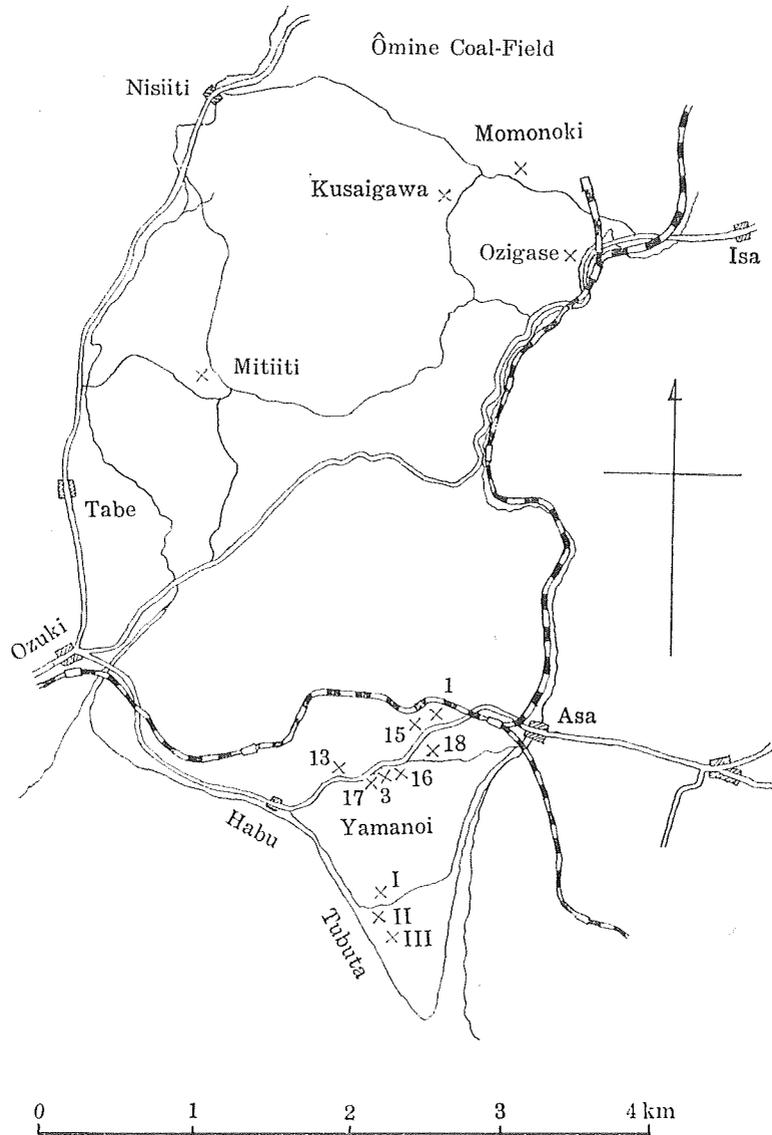
Tubuta (III).

Neocalamites Carrerei (ZEILL.)

Momonoki.

Annulariopsis inopinata ZEILL. ?

Of these, *Neocalamites Carrerei*, *Dictyophyllum japonicum*, *D. Nathorsti*, *Taeniopteris minensis*, and *Pityophyllum longifolium* have already been described in the previous paper of 1932, but they were treated again in the present paper, as more complete specimens are now available.



Text-fig. 1. Map of a part of Prov. Nagato showing the approximate positions of localities of fossil plants described in the present paper and the senior author's Rhaetic Plants from Province Nagato, 1932.

It has been elsewhere mentioned by the senior author that the florula of the Yamanoi Bed is closely akin to that of the Nariwa

Bed⁽¹⁾ in the Nariwa district, the following species being common or closely allied to each other in both florulas: ⁽²⁾

Yamanoi Bed	Nariwa Bed
<i>Annulariopsis inopinata</i> ZEILL.?	<i>A. inopinata</i> ZEILL.?
<i>Neocalamites Carrerei</i> (ZEILL.)	<i>N. Carrerei</i> (ZEILL.)
<i>Cladophlebis denticulata</i> (BRONGN.)	<i>C. denticulata</i> (BRONGN.)
<i>Cladophlebis haiburnensis</i> (L. and H.)	<i>C. haiburnensis</i> (L. and H.)
<i>C. nebbensis</i> (BRONGN.)	<i>C. nebbensis</i> (BRONGN.)
<i>C. Raciborskii</i> ZEILL. forma <i>integra</i> nov.	<i>C. cfr. Raciborskii</i> ZEILL.
Cfr. <i>Tacnopteris nabaensis</i> ÔISHI	<i>T. nabaensis</i> ÔISHI
<i>Nilssonia simplex</i> ÔISHI	<i>N. simplex</i> ÔISHI
<i>Baiera paucipartita</i> NATHORST	<i>B. paucipartita</i> NATHORST
<i>Stenorachis elegans</i> ÔISHI	<i>S. elegans</i> ÔISHI
<i>Pityophyllum longifolium</i> NATHORST	<i>P. longifolium</i> NATHORST
<i>Podozamites lanceolatus</i> (L. and H.)	<i>P. lanceolatus</i> (L. and H.)
<i>P. Schenki</i> HEER	<i>P. Schenki</i> HEER

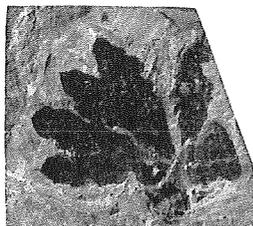
DESCRIPTION OF THE SPECIMENS

GENUS *Annulariopsis* ZEILLER

Annulariopsis inopinata ZEILLER?

Text-fig. 2.

An imperfect specimen in text-fig. 2 has been provisionally assigned to *Annulariopsis inopinata* ZEILLER as it seems to represent an imperfect leaf whorl of ZEILLER's species described by ZEILLER from the Rhaetic of Tonkin. In the text-figure, six leaves are radially disposed from a supposed center; they are spatulate, 18 mm. long, 5 mm. broad in their broadest portion and traversed by a midnerve.



Text-fig. 2. *Annulariopsis inopinata* ZEILLER? $\times 1$.
Loc. Mononoki.

Though fragmentary, the present specimen resembles in its size and form leaf whorls shown by ZEILLER⁽³⁾ in his Pl. XXXV, figs. 5-7. Similar leaf whorls have been figured by the senior author⁽⁴⁾

(1) S. ÔISHI: The Rhaetic Plants from the Nariwa District. This Journal, Ser. IV, Vol. I, Nos. 3-4, 1932, p. 258.

(2) S. ÔISHI: Rhaetic Plants from Province Nagato, 1932, p. 55.

(3) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin, 1903.

(4) S. ÔISHI: The Rhaetic Plants from the Nariwa District, p. 271, Pl. III, fig. 5; Pl. IV, fig. 3.

from the Rhaetic bed of the Nariwa district. Therefore, the occurrence of this species in the Yamaguti Prefecture is of special interest.

Locality: Momonoki.

GENUS *Neocalamites* HALLE

Neocalamites Carrerei (ZEILLER)

Pl. X (I), Fig. 1.

(An addition to the synonym table given in ÔISHI's The Rhaetic Plants from the Nariwa District, p. 269).

- ?1931. *Neocalamites* cf. *hoerensis* SZE: Beitrage zur liasischen Flora von China. Acad. Sinica, No. XII, p. 51, Pl. IX, fig. 4.
1932. *Neocalamites Carrerei* ÔISHI: Rhaetic Plants from Province Nagato (Yamaguchi Prefecture), Japan, p. 56.
1933. *Neocalamites Carrerei* SZE: Beitrage zur mesozoischen Flora von China. Pal. Sinica, Ser. A, Vol. IV, Fasc. 1, p. 49, Pl. VIII, fig. 6.
1933. *Neocalamites Carrerei* SZE: Fossile Pflanzen aus Shensi, Szechuan und Kueichow. Ibid., Ser. A, Vol. I, Fasc. 3, p. 24, Pl. V, figs. 3-4.

In 1932, the senior author⁽¹⁾ reported the occurrence of this well known species from several localities in Yamaguti Prefecture without illustration.

The figured specimen (Pl. X (I), fig. 1) is derived from the 1st pit of the Tubuta Coal mine (I): it is a pith-cast more than 12 cm. long and 3.5 cm. broad and shows two nodes, the internode between being 5.5 cm. The surface is ornamented by ridges and furrows in alternation, which correspond to the relief on the real surface of the stem; the ridges are 14 in number per cm. Associated with the stems, there are several detached needle-like leaves about 0.7 cm. broad, each provided with a midnerve.

In 1931 SZE⁽²⁾ figured two stem-fragments from Mentoukou as *N.* cfr. *hoerensis*, which he, however, renamed *C. Carrerei* in his later paper⁽³⁾, on the ground that the internode in the Mentoukou specimen is short and much related to *C. Carrerei*. Judging from the illustration of SZE's *N.* cf. *hoerensis* from Mentoukou, however, the internode seems to be very long compared with the breadth of the stem, and the specimen appears to be more closely related to *N. hoerensis*, to which SZE first compared the specimen. Unfortunate-

(1) S. ÔISHI: Rhaetic Plants from Province Nagato, p. 56.

(2) H. C. SZE: Op. cit., 1931.

(3) H. C. SZE: Fossile Pflanzen aus Shensi, etc., 1933.

ly, not being aware of the morphology of the branches of *N. Carrerei*, the writers find it difficult to distinguish specifically the remains of such branches or very small specimens of stems on the basis of the external morphology only, unless they are not associated with leaves, through which it is possible, to some extent, to differentiate between *N. hoerensis* and *N. Carrerei*.

Localities: Yamanoi (Loc. No. 1); Tubuta (I, II & III).

GENUS *Equisetites* STERNBERG

Equisetites sp.

A fragmental specimen of an isolated diaphragm of *Equisetites*. It is a circular disk 2 mm. diameter consisting of small central circular area of tissue and nine radiating bands separated by slightly broader spaces. Specifically not determinable.

Locality: Yamanoi (Loc. No. 1).

GENUS *Cladophlebis* BRONGNIART

Cladophlebis denticulata (BRONGNIART)

Pl. X (I), Fig. 2.

1928. *Cladophlebis denticulata* YABE and ÔISHI: Jurassic Plants from the Fang-tzu coal-field, Shantung. Jap. Journ. Geol. Geogr., Vol. VI, Nos. 1-2, p. 5, Pl. I, figs. 3-4.
1931. *Cladophlebis denticulata* SZE: Beitrage zur liasischen Flora von China, p. 2, Pl. I, fig. 1; p. 30, Pl. IV, fig. 4.
1931. *Cladophlebis denticulata* ÔISHI: Mesozoic Plants from Kita-Otari, Prov. Shinano, Japan. This Journal, Ser. IV, Vol. I, No. 2, p. 233, Pl. XVI, figs. 5, 5a.
1932. *Cladophlebis denticulata* KRYSHTOFOVICH and PRYNADA: Contribution to the Mesozoic Flora of Ussuriland. Bull. U. Geol. Pros. Serv. U. S. S. R., LI, Fasc. 22, p. 365.
1932. *Cladophlebis denticulata* ÔISHI: The Jurassic Plants from Shitaka (the Maizuru Coal-field), Prov. Tango (Kyôto Prefecture), Japan. This Journal, Ser. IV, Vol. II, No. 1, p. 6.
1932. *Cladophlebis denticulata* ÔISHI: The Rhaetic Plants from the Nariwa District, Prov. Bitchû, Japan, p. 288, Pl. XI, fig. 2.
1933. *Cladophlebis denticulata* YABE and ÔISHI: Mesozoic Plants from Manchuria. Sci. Rep., Tôhoku Imp. Univ., 2nd Ser., Vol. XII, No. 2B, p. 12, Pl. I, fig. 8.

(For further references, see YABE: Notes on Some Fossil Plants from Japan, Korea and China. Sci. Rep., Tôhoku Imp. Univ., 2nd Ser., Vol. VII, No. 2, 1922, p. 9).

The incomplete specimen in Pl. X (I), fig. 2 shows a distal portion of a sterile pinna more than 6.5 cm. long consisting of a delicate axis to which pinnules are attached suboppositely. The pinnules are closely set, triangular in shape, slightly falcate, tapering towards the obtusely pointed apex and attached to the axis by the whole base at an angle of approximately 45°. The midnerve sending off once forking secondary nerves at an angle of about 45° to it, is distinct, persisting to the tip and decurrent at the base. The distal margin of a pinnule is toothed, each tooth receiving a single secondary nerve.

There are at hand a considerable number of specimens of this species derived from the Tubuta coal mine, but none of them are complete, all being represented by fragments of pinnae. The pinnules on the left hand side of the figured specimen are attached to the axis at a more acute angle than those in the right hand side, but this is obviously due to the distorsion.

Localities: Yamanoi (Loc. No. 1); Tubuta (I).

Cladophlebis Raciborskii ZEILLER forma *integra* nov.

1906. *Todites Williamsoni* YOKOYAMA (pars): Mesozoic Plants from China. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. XXI, Art. 9, p. 18, Pl. III; p. 20, Pl. V, fig. 1a.
- ?1911. *Cladophlebis kamenkensis* THOMAS: The Jurassic Flora of Kamenka. Mém. Com. Géol., N. S., Liv. 71, p. 66, Pl. III, figs. 1-3.
1922. *Cladophlebis Raciborskii* YABE: Atlas of Fossils, Pl. V, fig. 3.
1931. *Cladophlebis* cfr. *Raciborskii* ÔISHI: Mesozoic Plants from Kita-Otari, p. 234, Pl. XVI, figs. 6-6a; Pl. XVII, fig. 1.
1932. *Cladophlebis* cfr. *Raciborskii* ÔISHI: The Jurassic Plants from Shitaka (the Maizuru Coal-field), p. 7, Pl. II, fig. 1.
1932. *Cladophlebis* cfr. *Raciborskii* ÔISHI: The Rhaetic Plants from the Nariwa District, p. 287, Pl. VIII, fig. 3; Pl. X, figs. 3-4.
1933. *Cladophlebis* sp. SZE: Fossile Pflanzen aus Shensi, Szechuan und Kueichow, p. 13, Pl. VI, fig. 8.

The senior author⁽¹⁾ has elsewhere described fern-fronds closely related to a Rhaetic species *Cladophlebis Raciborskii* ZEILLER under the name "*C. cfr. Raciborskii* ZEILLER" without referring them directly to ZEILLER's species. The fern-fronds in question, as mentioned in ÔISHI's previous papers on the fossil plants from Kita-Otari, Nariwa, etc., are characterised by bearing pinnules which are long and narrow in shape, slightly falcate, possessing twice forking

(1) See the references cited in the synonym table.

secondary nerves which are generally arching, differing from the original specimens of ZEILLER⁽¹⁾ only in the entire margin of the pinnules. As mentioned by KAWASAKI⁽²⁾, it is indeed possible that the pinnules appear to be entire all round when the margin is rolled down, and the similar view was also expressed by SEWARD⁽³⁾ in regard to the pinnules of *C. denticulata*. However, so far as the Japanese specimens are concerned, there exist two types of fronds of *C. Raciborskii*-type in respect to the margin of pinnules, one those with entire margin and the other the toothed one. These types seldom occur on the same frond. All these facts render it appropriate to hold them as distinct forms, at least as one being in the rank of a "variety" or "forma" of the other. Under these reasons the present authors prefer to apply the original specific name to those specimens as figured by ZEILLER which are characterised by having toothed margin, and "forma" *integra* to those elsewhere described by the senior author as "*C. cfr. Raciborskii* ZEILLER".

This separation, however, is by no means a valid one. It is tentatively made only for the sake of convenience, as the fronds of *integra*-type occur frequently in the older Mesozoic rocks of the Japanese Islands rather than those of the original type. The references cited in the synonym table show the specimens which should be included in forma *integra*.

We have a single imperfect specimen of this form derived from Yamanoi (Loc. No. 16).

Cladophlebis sp. figured by SZE⁽⁴⁾ from Szechuan may be referable to the present form.

HARRIS⁽⁵⁾ figured some imperfect specimens of *Cladophlebis*-fronds from the *Thaumatopteris*-Zone of Eastern Greenland under the name *Cladophlebis ingens*, which is in the form of pinnules and, because of having twice forking secondary nerves very much resembles the present form.

Locality: Yamanoi (Loc. No. 16).

(1) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin, 1903, p. 49, Pl. V, fig. 1.

(2) S. KAWASAKI: Some Older Mesozoic Plants in Korea. Bull. Geol. Surv. Korea, Vol. IV, Pt. 1, 1925, p. 17.

(3) A. C. SEWARD: Jurassic Flora, Pt. I, 1900, p. 138.

(4) H. C. SZE: Fossile Pflanzen aus Shensi, Szechuan, etc., 1933, p. 13, Pl. VI, fig. 8.

(5) T. M. HARRIS: The Fossil Flora of Scoresby Sound, East Greenland. Medd. om Grønland, Bd. LXXXV, No. 2, 1931, p. 55, Text-fig. 17 A-D.

GENUS *Clathropteris* BRONGNIART

Clathropteris obovata ÔISHI?

Pl. X (I), Fig. 4.

Compare:

1932. *Clathropteris obovata* ÔISHI: The Rhaetic Plants from the Nariwa District, p. 29, Pl. XII, fig. 2; Pl. XIV, fig. 1.
1932. *Dictyophyllum* sp. indet. ÔISHI: Rhaetic Plants from Province Nagato, p. 60, Pl. I, figs. 7-8.

The imperfect specimen in Pl. X (I), fig. 4 shows a portion of a pinna certainly of a fern of the Dipteridaceae; it attains more than 8 cm. in breadth with the margin obviously lobed, but the general outline of the pinna cannot be made out. It is traversed by a delicate midnerve sending off secondary nerves at an angle of about 50°. The secondary nerves are opposite or subopposite, slightly curved and occasionally undulating. The tertiary nerves are at a wide angle to the secondaries and unite with each other to form polygonal meshes. The quaternary nerves are obscure.

The specimen is closely allied to *C. obovata* ÔISHI⁽¹⁾ described from the Nariwa district, differing only in the former's having a more or less straight midnerve; moreover, the secondary nerves are at a more acute angle to the midnerve than in the latter. In this specimen, the reticulum made by the tertiary nerves differs somewhat from the characteristic rectangular meshes of *Clathropteris*-type, thus rather resembling the reticulum of *Dictyophyllum*. Therefore, the assignment of the present specimen to *Clathropteris*, particularly to *C. obovata*, is only provisional taking into consideration the available general features of the present specimen.

The imperfect pinnae described by the senior author⁽²⁾ from the same locality as *Dictyophyllum* sp. indet. belong to the present form.

Locality: Yamanoi (Loc. No. 13).

Clathropteris sp. indet.

Pl. X (I), Fig. 5.

Pl. X (I), fig. 5 shows an imperfect specimen of a fern reminding one of a portion of a pinna of *Clathropteris*. It is more than

(1) S. ÔISHI: The Rhaetic Plants from the Nariwa District, p. 29, Pl. XII, fig. 2; Pl. XIV, fig. 1.

(2) S. ÔISHI: Rhaetic Plants from Province Nagato, p. 60, Pl. I, figs. 7-8.

5 cm. long and 4 cm. broad and the midnerve sends off secondary nerves oppositely at an angle of approximately 45°. The outline of the pinna (?) is obscure, the margin being quite imperfect all round. The tertiary nerves spring off from the midnerve at a wide angle or nearly at a right angle and form polygonal to rectangular meshes characteristic to the genus *Clathropteris*, and each mesh is filled by the quaternary nerves which form a finer reticulum.

The present specimen is specifically not determinable, though its close affinity is to *Clathropteris meniscoides* BRONGNIART.

Locality: Tubuta (I).

GENUS *Dictyophyllum* BRONGNIART

Dictyophyllum Nathorsti ZEILLER

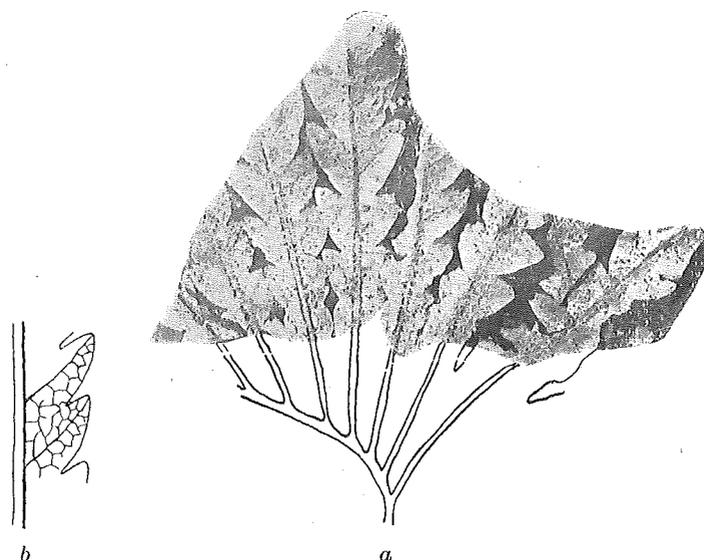
Text-fig. 3.

1891. *Dictyophyllum* cfr. *acutilobum* YOKOYAMA: On Some Fossil Plants from the Coal-bearing Series of Nagato. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. IV, Art. 2, p. 242, Pl. XXXII, fig. 6.
1903. *Dictyophyllum Nathorsti* ZEILLER: Flore fossile des gîtes du charbon de Tonkin, p. 109, Pl. XXIII, fig. 1; Pl. XXIV, fig. 1; Pl. XXV, figs. 1-6; Pl. XXVII, fig. 1; Pl. XXVIII, fig. 3.
1905. *Dictyophyllum Nathorsti* YOKOYAMA: Mesozoic Plants from Nagato and Bitchû. Ibid., Vol. XX, Art. 5, p. 6.
1905. *Dictyophyllum japonicum* YOKOYAMA: Ibid., p. 5, Pl. II, fig. 3 (non YOKOYAMA, 1891).
- ?1931. *Dictyophyllum* cf. *Nathorsti* SZE: Beitrage zur liasischen Flora von China, p. 3, Pl. I, fig. 2.
1932. *Dictyophyllum Nathorsti?* ÔISHI: Rhaetic Plants from Province Nagato, p. 57.
1932. *Dictyophyllum Nathorsti* ÔISHI: Some Fossil Plants from the Tubuta Coal-mine, Asa-gun, Yamaguti Prefecture. Journ. Geol. Soc. Tôkyô, Vol. XL, No. 480, p. 610, Text-figs.
- ?1933. *Dictyophyllum Nathorsti* SZE: Fossile Pflanzen aus Shensi, Szechuan und Kueichow, p. 20, Pl. II, fig. 9; p. 25, Pl. V, fig. 2.

Though this species has already been described in YOKOYAMA⁽¹⁾ and OISHI's⁽²⁾ previous papers on the Rhaetic plants from Nagato, the present writers wish to describe it again here as better specimens are available from the subsequent collection of the junior author at the Tubuta coal mine.

(1) M. YOKOYAMA: On Some Fossil Plants from the Coal-bearing Series of Nagato, p. 242; Mesozoic Plants from Nagato and Bitchû, p. 6.

(2) S. ÔISHI: Rhaetic Plants from Province Nagato, p. 57.



Text-fig. 3. *Dictyophyllum Nathorsti* ZEILLER. *a*, $\times 1$. *b*, enlarged to show the nervation. Loc. Tubuta (I).

One of the specimens is shown in Text-fig. 3. It is a basal part of an arm, consisting of seven pinnae disposed palmately; the pinnae are 4.5 cm. long, but, as the outer margin is broken, the whole length of the pinnae is not clear. The pinna-rachis is prominent and 0.9 mm. across at the basal part. The lamina tapers gradually towards the proximal portion of each pinna, and fuses laterally at the base, the fused portion being estimated to be about 2 cm. long and is lobed at the margin. The lobes are triangular in form, their apices being obtusely pointed and directed forwards. The secondary nerves, one entering into each lobe, are at an angle of about 45° to the pinna-rachis, and distinct, persisting to the tip of the lobe. The tertiary nerves form a reticulum consisting of polygonal meshes.

As mentioned by ZEILLER⁽¹⁾, *D. Nathorsti* is characterised by the basal part of the laminae which are confluent or fused laterally for a part of their length instead of being free as in an allied species *D. exile* (BRAUNS). Therefore, some imperfect specimens from China which SZE⁽²⁾ assigned to ZEILLER's species have little claim to be

(1) R. ZEILLER: Op. cit., p. 109.

(2) H. C. SZE: Op. cit., 1931, p. 3; Fossile Pflanzen aus Shensi, etc., 1933, pp. 20, 25.

assigned to that species, though the general features do remind one of *D. Nathorsti*.

Locality: Tubuta (I).

Dictyophyllum japonicum YOKOYAMA

Pl. X (I), Fig. 3.

In the previous paper of the senior author⁽¹⁾, resemblance was pointed out between the pinnae of *D. japonicum* and *Camptopteris spiralis* NATHORST, in respect to the gradual reduction of lamina of pinnae towards the proximal end. The probable specific identity of both species was suggested, though the axes or arms to which pinnae are attached in peculiar manner as in *Camptopteris* are unfortunately lacked in the Japanese specimens.

The present authors have recently secured an additional specimen of *D. japonicum* derived from Yamanoi (Loc. No. 13), from where YOKOYAMA first described it, and in which it was found that the pinnae of *D. japonicum*, which have hitherto been known only as isolated pinnae, are disposed in the usual manner as in *Dictyophyllum*. Pl. X (I), fig. 3 shows the specimen: two arms about 2 mm. across are obviously seen, each bearing more than nine pinnae disposed outwards. Here the laminae are entirely reduced at the basal parts of the pinnae as is characteristic to YOKOYAMA's species, and only a single pinna bears a less reduced lamina lobed at the margin. In this specimen, the basal parts of the pinnae without lamina are more than 2.5 cm. long.

The reduction of lamina towards the proximal portion occurs also in *D. exile* (BRAUNS)⁽²⁾; but since there is no trace of the existence of the well-defined specimens of the latter species in the plant-bed of Yamanoi (Loc. No. 13), the present authors as yet prefer to treat the specimen as *D. japonicum*.

KRYSHTOFOVICH and PRYNADA⁽³⁾ reported the occurrence of this species in the Mongugai Series of Ussuriland with neither figure nor description.

Locality: Yamanoi (Loc. No. 13).

(1) S. ÔISHI: Rhaetic Plants from Province Nagato, p. 58.

(2) A. G. NATHORST: Ueber *Dictyophyllum* und *Camptopteris spiralis*. Kgl. Svensk. Vet.-Akad. Handl., Vol. XLI, No. 5, 1906, p. 7, Pls. IV-V; Pl. VI, figs. 1-22; Pl. VII, figs. 2-11.

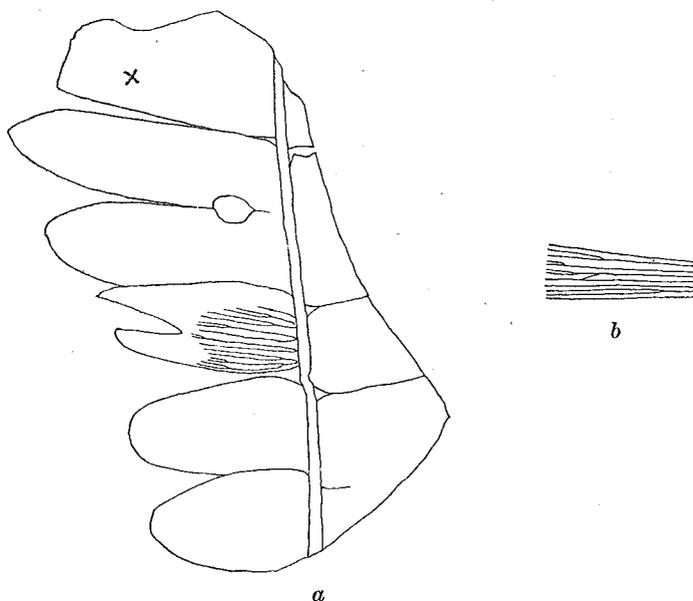
(3) A. KRYSHTOFOVICH and V. PRYNADA: Op. cit., p. 367.

GENUS *Pterophyllum* BRONGNIART

Pterophyllum yamanoiensis sp. nov.

Pl. X (I), Fig. 6; Text-fig. 4.

Several specimens were examined. One specimen in Pl. X (I), fig. 6 shows the following characters:



Text-fig. 4. *Pterophyllum yamanoiensis* sp. nov. ; *a*, a sketch of the specimen in Pl. II, fig. 6, somewhat magnified ; *b*, nerves in the pinna marked *x*, showing a cross-connection.

Frond of unknown size and form, being more than 7 cm. in length and 4 cm. in breadth. Rachis 2 mm. across in the proximal broken end narrowing upwards, the surface with longitudinal striations. Pinnae into which the lateral lamina is dissected are ovate to obovate, ± 1 cm. in breadth, closely set laterally or lightly overlapping, and attached by the whole or slightly contracted base to the lateral side of the rachis at a wide angle or almost perpendicularly. Nerves nearly parallel or slightly diverging, they fork in most cases close to, or at variable distances from their origin, and number approximately 15–20 at the distal part. Only in a single case is there a cross connection of the nerves (Text-fig. 4b).

In respect to the form of the pinnae, *P. yamanoiensis* recalls somewhat *Nilssonia bindrabunensis* SEWARD and SAHNI⁽¹⁾ from India. But the nerves in the present specimen fork more frequently than in the Indian species, and moreover there is no essential character for referring it to the genus *Nilssonia*.

The nearest alliance of the present specimen is no doubt to a Greenland Rhaetic specimen which HARRIS⁽²⁾ called by the name *Pterophyllum astartense*, and so great is the resemblance that the present authors were inclined even to assign the specimen to the Greenland species. But a careful comparison of both specimens showed that there was a considerable difference in the strength of the rachis so as to admit the inclusion of our specimen under HARRIS' species, the rachis in *P. astartense* being very thick and strong and moreover the nerves in the Greenland species being more crowded than in ours. These differences led the present authors to separate the Japanese specimen specifically from the Greenland ones; but, at any rate, our species is closely related to *P. astartense*.

Locality: Yamanoi (Loc. No. 1).

Pterophyllum sp.

Pl. X (I), Fig. 7.

In association with *Pterophyllum yamanoiensis* described above, there occur some fragments of *Pterophyllum*-fronds which externally differ from the named species. One of the specimens is shown in Pl. X (I), fig. 7. It is a portion of a frond more than 4 cm. in length and 6 cm. in breadth traversed by a slender rachis about 1.2 mm. across to which are attached pinnae at a right angle. There are faint longitudinal striations on the surface of the rachis. The pinnae are set closely at the base about 6 mm. broad and taper gradually to the acuminate apex. The nerves are parallel to each other, fork first at their origin and then at variable distances from the base; the number is approximately 15 at the middle portion of each pinna.

The external feature of the figured specimen remind one strongly of a Middle Jurassic species of *Nilssonia*, *N. tenuicaulis* (PHILLIPS).

(1) A. C. SEWARD and B. SAHNI: Indian Gondwana Plants: A Revision. Pal. Indica, N. S., Vol. VII, Mem. No. 1, 1920, p. 31, Pl. III, figs. 31-32.

(2) T. M. HARRIS: The Fossil Flora of Scoresby Sound, East Greenland. Medd. om Grønland, Bd. LXXXV, No. 5, 1932, p. 44, Pl. IV, fig. 10; Text-figs. 19-21.

But, in the latter species the nerves are mostly simple as is usually the case in *Nilssonina*, and moreover there is no evidence for including the present specimens in that genus.

It is highly probable that this specimen may belong to a different part of the same frond to which a new specific name *Pterophyllum yamanoiensis* was given above. But as there is no evidence of an organic connection between them, it is proposed tentatively to hold the present specimen as a form distinct from the preceding one. There is at hand another fragmental specimen of *Pterophyllum* derived from Yamanoi (Loc. No. 17), but it is too imperfect to deserve description.

Locality: Yamanoi (Loc. Nos. 1 & 17).

GENUS *Taeniopteris* BRONGNIART

Taeniopteris minensis ÔISHI

1932. *Taeniopteris minensis* ÔISHI: Rhaetic Plants from Province Nagato, p. 60, Pl. II, figs. 1-5.

There are a good number of specimens of this species derived from the Tubuta coal-mine. Though they are somewhat fragmental, they agree essentially with the type specimens of this species figured and described by the senior author⁽¹⁾ from Nagato in 1932. Therefore it is not needed to describe them here again.

Locality: Tubuta (I).

GENUS *Nilssonina* BRONGNIART

Nilssonina simplex ÔISHI

Pl. X (I), Fig. 9.

1932. *Nilssonina simplex* ÔISHI: The Rhaetic Plants from the Nariwa District, p. 334, Pl. XXVI, figs. 7-9; Pl. XXVII, figs. 1-4.

The specimen shown in Pl. X (I), fig. 9, though it is imperfect, may most probably be specifically identical with *Nilssonina simplex*. It is a portion of a frond more than 3 cm. long and 2 cm. broad. The rachis is narrow but rigid, about 1-1.5 mm. across, with a median longitudinal groove on the upper surface. The nerves are simple or fork close to the rachis or sometimes at some distance from their

(1) S. ÔISHI: Rhaetic Plants from Province Nagato, p. 60.

origin, parallel, at a right angle to the rachis, at their origin running obliquely downwards in the median groove of the rachis, and number about 23 at the margin. The margin is entire or slightly wavy.

The occurrence of this species in Nagato is particularly interesting, because it is one of the characteristic elements of the Nariwa flora of the Nariwa district.

Locality: Yamanoi (Loc. No. 17).

GENUS *Ctenis* LINDLEY and HUTTON

Ctenis ? sp.

Pl. X (I), Fig. 8.

The specimen in Pl. X (I), fig. 8 shows an incomplete frond with a nervation of *Ctenis*-type? It consists of a slender rachis to which are attached some pinnae ovate in outline about 3 cm. in their longer axis and 1.7 cm. in the shorter, by a slightly contracted base. The nervation is very coarse; about five nerves are given off from the rachis, then they fork repeatedly at variable distances from their origin; the nerves are ± 1.5 mm. apart. In some cases, such a cross connection of the nerves can be seen; but it is not clear owing to the bad preservation of the specimen.

If this specimen be really *Ctenis*, it is a peculiar form of this genus never yet described. There is a probability that the present specimen is a young frond of *Ctenis japonica* ÔISHI⁽¹⁾, the nervation of both being resembling strikingly.

Locality: Yamanoi (Loc. No. 17).

GENUS *Pityophyllum* NATHORST

Pityophyllum longifolium (NATHORST)

The specimen shows some long and narrow leaves more than 8 cm. long and 2-5 mm. broad at the middle portion, thence narrowing very gradually towards both ends. The midnerve is prominent and elevated as a ridge. Other surface features are not recognisable.

Locality: Tubuta (I).

(1) S. ÔISHI: The Rhaetic Plants from the Nariwa District, p. 343, Pl. XXIX, figs. 5-7; Pl. XXX; Pl. XXXI, fig. 1.

GENUS *Elatocladus* HALLE

Elatocladus sp.

Pl. X (I), Fig. 11.

Pl. X (I), fig. 11 shows a sterile coniferous shoot. It consists of a rachis from which linear leaves are disposed spirally at an acute angle. The leaves are linear lanceolate, 6 mm. long, 1 mm. broad, crowded around the rachis, and decurrent at the base. The midnerve is prominent.

Locality: Tubuta (I).

GENUS *Podozamites* F. W. BRAUN

Podozamites sp.

Pl. X (I), Fig. 10.

Pl. X (I), fig. 10 shows an imperfect *Podozamites*-shoot consisting of a slender axis 1 mm. across to which two leaves are attached oppositely. The leaves are obovate, 2.7 cm. long, 1.2 cm. broad, and provided with a rounded apex. The nerves are prominent, parallel to each other and to the lateral margin of the leaves, fork near the base and converge at the apex; there are 17 nerves at the middle portion of a leaf.

The present specimen differs from any species of *Podozamites* hitherto described in respect to the number of nerves and the characteristic obovate form of the leaves. It may represent a new form of the genus *Podozamites*; but as the specimen is too imperfect to institute a new specific name for it, the present authors prefer for the present to call it *Podozamites* sp. awaiting a further supply of material from the same locality.

Locality: Yamanoi (Loc. No. 18).

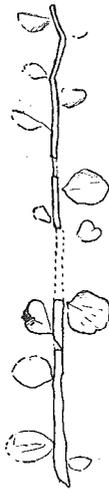
GENUS *Leptostrobus* HEER

This generic name was established by HEER⁽¹⁾ in 1876 for some strobili from the Jurassic rocks of Siberia agreeing closely in general

(1) O. HEER: Beitrage zur Jura-Flora Ostsibiriens und des Amurlandes. Mém. l'Acad. Imp. Sci. St.-Petersbourg, Ser. VII, Vol. XXII, No. 12, 1876, p. 72. See also HEER: Nachtraege zur Jura-Flora Sibiriens. Ibid., Vol. XXVII, No. 10, 1880, p. 23.

habit and in the form of the megasporophylls with those of *Voltzia*, a conifer with Araucarian affinities. As to the probable generic identity of these two genera, *Leptostrobus* and *Voltzia*, a view was already expressed by SEWARD⁽¹⁾ in 1919. *Leptostrobus* as defined by HEER is characterised by lax strobili consisting of a slender axis to which are attached shortly stalked cone-scales with a lobed outer margin, each bearing a two-winged seed of *Samaropsis*-type.

There are now at hand two imperfect specimens of lax strobili derived from Yamanoi agreeing closely with the Siberian specimens but they show no indication of seed. It is unfortunate that the present specimens are too imperfect to allow one to form an opinion on the relation between *Leptostrobus* and a related genus *Voltzia* (including *Voltziopsis* POTONIE); while on the other hand, it is undeniable that these specimens are closely allied to *Leptostrobus*, especially to *L. laxiflora*⁽²⁾ from Siberia. All these facts led the present authors to refer the Japanese specimens to *L. laxiflora*, though it is only provisionally. The description of one of the specimens runs as follows:



Text-fig. 5. Cfr. *Leptostrobus laxiflora* HEER. $\times 1$. Loc. Yamanoi (16).

Cfr. *Leptostrobus laxiflora* HEER*

Text-fig. 5.

Lax strobili more than 6 cm. long; axis thin, slender, straight, slightly more than 1 mm. across in its proximal broken end, narrowing upwards, with faint longitudinal striations on the surface; cone-scales short stalked, 3–5 mm. long, ovate or orbicular in outline, shallowly divided by furrows, lightly crenulated at the outer margin, and arranged in a very loose spiral (possibly) on the axis; no indication of seed; foliage shoots are also not known.

(1) A. C. SEWARD: Fossil Plants, Vol. IV, 1919, p. 295.

(2) O. HEER: Op. cit., 1876, p. 72; 1880, p. 23.

* After the manuscript of this note was ready for print, the present authors receipt the paper by HARRIS: The Fossil Flora of Scoresby Sound, East Greenland. Pt. 4, 1935. In this paper he described *Leptostrobus longus* sp. nov. which resembles externally *L. Laxiflora* from Siberia. The Japanese specimens may be more closely related to the Greenland specimens in bearing slender axis, but, unfortunately, the cuticular preparations are not available in ours.

The above diagnosis is given based on the specimen in Text-fig. 5. We have another specimen of a lax strobilius derived also from the same locality, belonging possibly to the same species.

Locality: Yamanoi (Loc. No. 16).

GENUS *Cycadocarpidium* NATHORST

Cycadocarpidium ? sp.

Pl. X (I), Figs. 12, 12a.

Among the collection of fossil plants from Yamanoi, the authors found a single specimen of a small leaf which differs somewhat from an ordinary type of *Podozamites*-leaf but rather resembling a sporophyll of *Cycadocarpidium*. It is shown in Pl. X (I), fig. 12. It consists of an oval lamina 0.7 cm. long and 0.4 cm. broad in its broadest middle portion, with rounded apex; it is short stalked, the stalk being 1 mm. long at least. The nerves are prominent, parallel, unbranched, numbering 5, and converge to the apex. An appendage seems to occur at the base of the lamina but the actual evidence of seeds is obscure.

There is no decisive evidence upon which the present specimen should be referred to the genus *Cycadocarpidium*. But the unusually suggestive of small lamina, coarse nerves and the presence of an object (appendage?) at the base of the lamina seem to warrant the reference of this specimen to *Cycadocarpidium* rather than to *Podozamites*.

There are now five known species of *Cycadocarpidium*, namely, *C. Erdmanni* NATH., *C. Swabii* NATH., *C. redivivum* NATH., *C. macrozamioides* SCHUSTER and *C. parvum* KRYSHT. and PRYNADA, of which *C. Erdmanni* NATH. seems to be a species to which the present specimen is more or less comparable, especially in respect to the presence of an appendage?

It has been noted by several authors⁽¹⁾ that *Cycadocarpidium* occurs in close association with *Podozamites*-leaves; this is also the case in the Asiatic specimens. This fact often leads one to the consideration that *Cycadocarpidium* is a sporophyll borne on a *Podozamites*-shoot, and it seems that this supposition is appropriate to a

(1) A. G. NATHORST: Ueber die Gattung *Cycadocarpidium* NATHORST nebst einigen Bemerkungen ueber *Podozamites*. Palaeobot. Mitt., 10. Kgl. Svensk., Vet.-Akad. Handl., Bd. XLVI, No. 8, 1911. H. COUNILLON: Flore fossile des gites de charbon de l'Annan. Bull. Serv. Géol. l'Indochine, Vol. I, Fasc. 2, 1914. H. C. SZE: Fossile Pflanzen aus Shensi, Szechuan und Kueichow, 1933, p. 22.

certain extent. However, there is a fact which seems to have been overlooked by several authors that while the occurrence of *Cycadocarpidium* is confined to the Rhaetic or Liassic strata of the world, the *Podozamites* occurs in particular abundance throughout various horizons of the Mesozoic rocks. This notable contrast may be accidental, but is a matter considerably worthy of note.

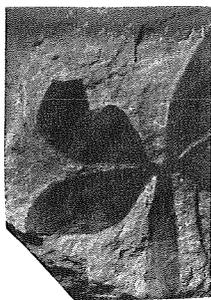
Locality: Yamanoi (Loc. No. 13).

GENUS *Sagenopteris* PRESL

Decisive evidence as to the systematic position in the plant kingdom of this genus has long been lacking. Several authors suggested of its affinity to Hydropterideae. However, THOMAS⁽¹⁾ pointed out the intimate association of *Sagenopteris* with some reproductive organs which verify the angiospermous affinity, and instituted a family Caytoniales including *Sagenopteris*. Recently, *Sagenopteris* was again found in association with *Caytonia* in eastern Greenland; HARRIS⁽²⁾ discussed on the affinity of these plants, and suggested rather gymnospermous affinity of *Caytonia*, though it is not yet arrived at a decisive opinion.

Sagenopteris Nilssoniana (BRONGN.)

Text-fig. 6.



Text-fig. 6. *Sagenopteris Nilssoniana* PRESL. $\times 1$.
Loc. Yamanoi (1).

Text-fig. 6 shows a petiolate leaf consisting of a petiole 4 mm. broad at the lowest broken end and narrowing to 2 mm. at the top where are attached four leaflets oval-lanceolate in outline, ± 2 cm. long and 0.8 cm. broad. Each leaflet has a midnerve which is distinct in its proximal portion and gradually vanishing towards the distal portion. The characteristic anastomosing nerves are almost invisible owing to the coarseness of the matrix on which the leaf is impressed; but in some places they are faintly visible.

(1) H. H. THOMAS: The Caytoniales, A New Group of Angiospermous Plants from the Jurassic Rocks of Yorkshire. Phil. Trans. Roy. Soc. London, Ser. B, Vol. CCXIII, 1925.

(2) T. M. HARRIS: Op. cit., 1932, p. 5.

The assignment of the present specimen to *S. Nilssoniana* is only provisionally, because of its agreement with specimens figured under this name. This species has been reported from the Rhaetic and the Liassic strata of various countries and is described under the well-known name *S. rhoifolia* PRESL which is synonymous to *S. Nilssoniana*.

S. Nilssoniana differs little in its external features from *S. Phillipsi* (BRONGN.) widely distributed in the Jurassic strata of the world. In many cases, it is impossible to separate the both species specifically.

Locality: Yamanoi (1).

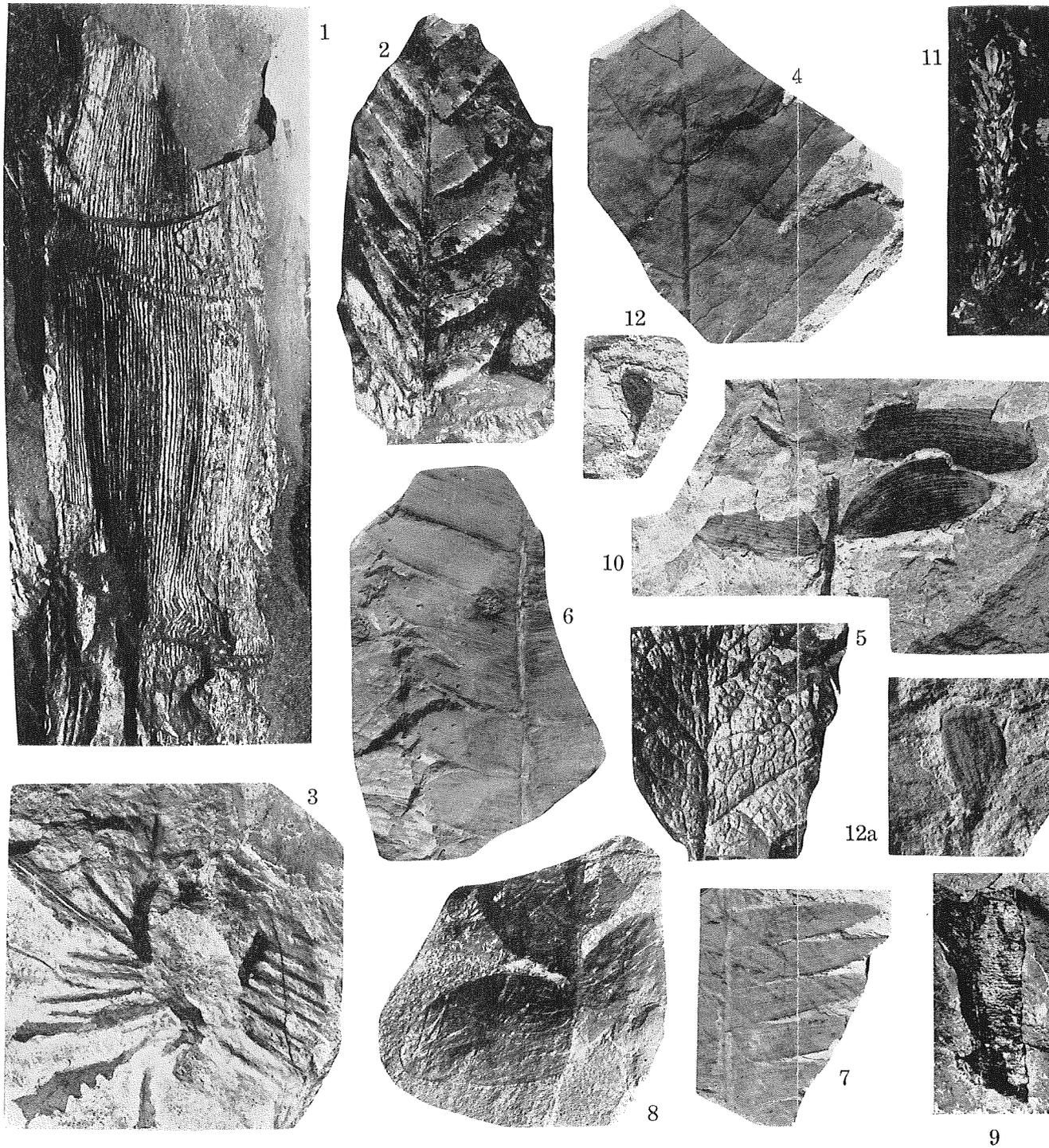
September, 1935.

PLATE X (I)

PLATE X (I)

(The figures are natural size unless otherwise stated).

- Fig. 1. *N^eocalamites Carrerei* (ZEILLER). Loc. Tubuta (I). P. 117.
Fig. 2. *Cladophlebis denticulata* (BRONGN.). Loc. Tubuta (I). P. 118.
Fig. 3. *Dictyophyllum japonicum* YOKOYAMA. Loc. Yamanoi (13). P. 124.
Fig. 4. *Clathropteris obovata* ÔISHI? Loc. Yamanoi (13). P. 121.
Fig. 5. *Clathropteris* sp. indet. Loc. Tubuta (I). P. 121.
Fig. 6. *Pterophyllum yamanoiensis* sp. nov. Loc. Yamanoi (1). P. 125.
Fig. 7. *Pterophyllum* sp. Loc. Yamanoi (1). P. 126.
Fig. 8. *Ctenis?* sp. Loc. Yamanoi (17). P. 128.
Fig. 9. *Nilssonia simplex* ÔISHI. Loc. Yamanoi (17). P. 127.
Fig. 10. *Podozamites* sp. Loc. Yamanoi (18). P. 129.
Fig. 11. *Elatocladus* sp. Loc. Tubuta (I). P. 129.
Figs. 12-12a. *Cycadocarpidium?* sp. 12a \times 2. Loc. Yamanoi (13). P. 131.



Takeda photo.

S. Ôishi and E. Takahasi: Rhaetic Plants from Nagato.