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# MESOZOIC PLANTS FROM KITA-OTARI, PROV. SHINANO, JAPAN

By

Saburô ÔISHI

*With 3 Plates and 3 Text-Figures*

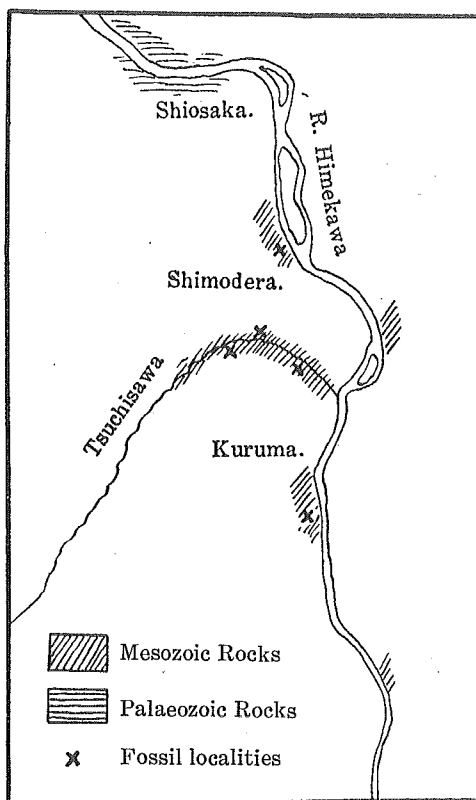
## INTRODUCTION

The collection of fossil plants figured and described in this memoir was made chiefly by the present writer in September, 1930, to which was added a number of specimens kindly submitted by Mr. T. KOBAYASHI of the Geological Institute, Tôkyô Imperial University. It was derived from beds exposed in the neighbourhood of the small village of Kuruma, along the valley of the Himekawa River, Kita-Otari-Gun, Prov. Shinano, and the plant-bearing beds have been called by the writer "the Kuruma Bed"<sup>(1)</sup>. The Kuruma bed consists of sandstones, shales and conglomeratic sandstones in alternation, more than 200 m. in thickness, and contains rich plant remains in certain horizons, chiefly in black coloured shales. The settlement of the stratigraphical sequence of the Mesozoic strata of this region is very difficult or almost impossible, because the strata are elsewhere thickly covered by the volcanic ashes and agglomerates derived from Mt. Kazefuki. The relation of these Mesozoic rocks to the Palaeozoic slates, sandstones and quartzites developed near Shiosaka, 300 m. north of Kuruma, is also obscure.

The plant fossils were collected at three localities, viz., Tsuchisawa, a tributary of the Himekawa River; Shimodera, 100 m. north of Kuruma; and a place 70 m. south of Kuruma. Of these the plant remains are by far the most abundant in the shales exposed in the valley of Tsuchisawa. Mr. T. YAGI<sup>(2)</sup> who visited this region some

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- (1) S. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. Journ. Geol. Soc. Tôkyô, Vol. XXXVIII, No. 449, 1913, p. 45.  
(2) T. YAGI: On the Occurrence of Jurassic plants from Kita-Otari, Prov. Shinano. Journ. Geol. Soc. Tôkyô, Vol. XXV, No. 293, 1918, p. 79 (in Japanese).

fifteen years ago collected a number of plant remains in the valley of Tsuchisawa, which were determined by KRYSHTOFOVICH as follows (the specimens determined by KRYSHTOFOVICH are now preserved in the Nagano Girls' High School in Nagano, and fortunately the writer



Text-fig. 1. Geological sketch-map  
of part of the valley of  
Himekawa. 1/50,000.

happened to possess the opportunity of examining them while on a journey through this district last summer; the names in the right in the following list are those determined by the writer):

KRYSHTOFOVICH	ÔISHI
<i>Equisetites</i> sp. . . . .	= <i>Equisetites</i> sp.
<i>Cladophlebis denticulata</i> (BRONGN.) . . . . .	= <i>Cladophlebis raciborskii</i> ZEILLER

- Clathropteris* sp. . . . . = *Clathropteris* sp.  
*Podozamites lanceolatus*  
 (L. and H.). . . . . = *Podozamites lanceolatus* (L. and H.)  
*Ginkgo* sp. . . . . = *Ginkgoites sibirica* (HR.)  
*Phoenicopsis angustifolia* HR.  
 forma *media* KRASSER . . . = *Phoenicopsis*? sp.  
*Czekanowskia* sp. . . . . = *Czekanowskia rigida* HR.

KRYSHTOFOVICH ascribed the plant bed to the Jurassic age.

In 1927, Mr. T. KOBAYASHI<sup>(3)</sup> also made a collection of some fossil plants in the valley of Tsuchisawa and at the upper course of the Dairagawa River<sup>(4)</sup> and determined them as follows (the names in the right are those determined by the writer):

- | KOBAYASHI                              | ÔISHI                                     |
|--|---|
| <i>Equisetites sarrani</i> . . . . .   | = <i>Equisetites</i> sp.                  |
| <i>Cladophlebis haiburnensis</i> . . . | = <i>Cladophlebis raciborskii</i> ZEILLER |
| <i>C. raciborskii</i> . . . . .        | = <i>C. raciborskii</i> ZEILLER           |
| <i>Taeniopteris</i> sp. . . . .        | = <i>Taeniopteris</i> sp.                 |
| <i>T. cfr. virgulata</i> . . . . .     | = <i>Marattiopsis muensteri</i> (GOEPP.)  |
| <i>Ptilophyllum</i> sp. . . . .        | = <i>Pterophyllum propinquum</i> GOEPP.   |
| <i>Dictyophyllum</i> sp. . . . .       | = <i>Dictyophyllum</i> sp.                |
| <i>Pagiophyllum</i> sp. . . . .        | = <i>Elatocladus</i> sp.                  |

Mr. KOBAYASHI compared the plant beds with those in his Miné Formation<sup>(5)</sup> which according to him, is Upper Triassic in age.

Recently the present writer<sup>(6)</sup> enumerated the species of fossil plants derived from the Kuruma Bed, together with a brief geological note of this region, after a provisional determination; the following is the list of species here described with slight alteration of the specific names of the previous determination:

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- (3) T. KOBAYASHI: On the Tetori Series. Ibid., Vol. XXXIV, No. 401, 1927, p. 63 (in Japanese).  
 (4) The River Dairagawa is a small river originating from Mt. Inu, 1593 m., about 20 km. N. W. of Kuruma, and empties into the Japan Sea. Mr. KOBAYASHI kindly informed me that the plant fossils were found in a block of rock at the place about 1 km. upstream from a small village, Daira, Prov. Etchû.  
 (5) T. KOBAYASHI: Note on the Mesozoic Formation in Prov. Nagato, Chûgoku, Japan. Journ. Geol. Soc. Tôkyô, Vol. XXXIII, No. 398, 1926, p. 1.  
 (6) S. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. L.c., p. 48.

Species	Localities			
	Valley of Tsuchisawa	Shimodera	South of Kuruma	R. Dairagawa
1. <i>Equisetites</i> sp.	×	×	×	
2. <i>Neocalamites hoerensis</i> (SCHIMP.)	×			
3. <i>Cladophlebis nebbensis</i> (BRONGN.)	×			
4. <i>C. denticulata</i> (BRONGN.)	×		×	
5. <i>C. cfr. raciborski</i> ZEILLER	×			
6. <i>C. haiburnensis</i> (L. and H.)	×			
7. <i>C. sp. a.</i>	×			
8. <i>C. sp. b.</i>	×			
9. <i>Thaumatopteris schenki</i> NATH.			×	
10. <i>Clathropteris</i> sp.	×			
11. <i>Dictyophyllum</i> sp.				×
12. <i>Marattiopsis muensteri</i> (GOEPP.)	×			
13. <i>Taeniopteris</i> sp.	×			
14. <i>Pterophyllum propinquum</i> GOEPP.	×			
15. <i>P. jaegeri</i> BRONGN.	×			
16. <i>Ginkgoites digitata</i> (BRONGN.) var. <i>huttoni</i> SEWARD	×			
17. <i>Czekanowskia rigida</i> HEER	×	×	×	
18. <i>Phoenicopsis</i> ? sp.	×			
19. <i>Pityophyllum longifolium</i> (NATH.)	×	×	×	
20. <i>Elatocladus</i> sp.				×
21. <i>Podozamites lanceolatus</i> (L. and H.)	×	×	×	
22. <i>Carpolithus</i> sp.	×			

## ON THE GEOLOGICAL AGE OF THE KURUMA BED

The flora of the Kuruma Bed numbers 22 different forms, of which 12 are probably referable to already known definite species, only one other form is doubtfully compared with other known species, and the remaining 9 are specifically indeterminable. It is remarkable from the above list that the present flora shows an intimate relation with the Rhaetic Nariwa flora,<sup>(7)</sup> bearing the following important species in common between them, viz. :

- Neocalamites hoerensis* (SCHIMP.)  
*Cladophlebis nebbensis* (BRONGN.)  
*C. denticulata* (BRONGN.)  
*C. cfr. raciborskii* ZEILLER  
*C. haiburnensis* (L. and H.)  
*Marattiopsis muensteri* (GOEPP.)  
*Pterophyllum jaegeri* BRONGN.  
*Podozamites lanceolatus* (L. and H.)

Of these, *N. hoerensis*, *C. nebbensis*, *Marattiopsis muensteri* and *P. jaegeri* are the characteristic elements of the Rhaeto-Liassic strata of the world and *C. cfr. raciborskii* is closely allied to *C. raciborskii* from the Rhaetic of Tonkin. The most remarkable thing is the occurrence of *Thaumatopteris schenki* NATH. : this species has hitherto been known only from the Rhaetic or lower Liassic rocks of Sweden, Bornholm, Poland, Germany and Franconia and its occurrence in this flora is most valuable in determining the geological age of the plant beds. Under these considerations, it cannot be denied that the flora of the Kuruma Bed is closely allied to the Rhaetic Nariwa flora and its geological age may accordingly represent the Rhaetic.

At this place, the writer wishes to put on record his sincere thanks to Prof. H. YABE of the Institute of Geology and Palaeontology in Sendai and to Prof. T. NAGAO of our Department for their valuable suggestions on many matters. Further the writer wishes to express his thanks to Mr. T. KOBAYASHI of the Geological Institute in Tôkyô who kindly sent his material for the writer's use, and to Mr. T. YAGI of the Ina Girls' High School at Ina from whom the writer received much facilities in collecting fossils.

(7) S. ÔISHI: On the Upper Triassic Formation in Nariwa District, Bitchû. Journ. Geol. Soc. Tôkyô, Vol. XXXVIII, No. 448, p. 5 (in Japanese).

## DESCRIPTION OF THE SPECIES

*Equisetales*GENUS *Equisetites* STERNBERG*Equisetites* sp.

Pl. XVI, Fig. 1.

1918. *Equisetites* sp. KRYSHTOFOVICH: in T. Yagi's On the Occurrence of Jurassic Plants in Kita-Otari, Prov. Shinano. L.c., p. 80.
1927. *Equisetites sarrani* KOBAYASHI: On the Tetori Series. L.c., p. 63.
1931. *Equisetites* sp. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

*Equisetites* is the commonest plant in the collection, but none of the specimens can be attributed to any definite species being represented always in the fragmental state of stems and leaf-sheaths. All specimens are the impressions of the outer surface of the plant, and consequently the commissure between adjacent teeth is elevated as ridges, which is originally represented as a deep furrow.

Pl. XVI, fig. 1 shows a part of leaf-sheath obtained from Tsuchisawa, but its whole length is unknown because the commissural furrows die away below. It is more than 2.5 cm. in breadth and the upper margin frayed out into teeth which are at least 15 in number and about 3 mm. in length ending in an obtuse apex. There is fine granular ornamentation covering the whole surface of the leaf-sheath, probably indicating siliceous deposits as can be seen in some species of the living *Equisetum*.

Our specimens may belong to either *E. sarrani* (ZEILLER)<sup>(8)</sup> or *E. muensteri* STERNB.<sup>(9)</sup>

Localities: Tsuchisawa; south of Kuruma; and Shimodera.

- (8) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin, 1903, p. 114, Pl. XXXIX, figs. 1-13. Cfr. T. M. HARRIS: The Rhaetic Flora of Scoresby Sound, East Greenland. Medd. om Grønland, LXVIII, 1926, p. 54, Pl. II, figs. 2 and 3.
- (9) W. PH. SHIMPER: Traité de Paléontologie Végétale, Vol. I, 1896, p. 269, Pl. 8, figs. 3, 3b, 4, 6 and 7. M. de SAPORTA: Plantes Jurassiques, Vol. I, p. 232, Pl. 27; Pl. 28, figs. 1; Pl. 29, figs. 1-8. A. G. NATHORST: Bidrag till Sveriges Fossila Flora. II. Floran vid Hoeganaes och Helsingborg. K. Svensk. Vet.-Akad. Handl. Vol. 16, No. 7, 1878, p. 40, Pl. 5, figs. 1-5; Pl. 7, figs. 1-4. C. T. BARTHOLIN: Nogle i den bornholmske Jura-formation forekommende Planteforsteninger. I. Bot. Tidsskr., Vol. 18, No. 1, 1892, p. 13. Pl. 5, figs. 1-6. N. HARTZ: Planteforstenieger fra Cap Stewart i Ostgrønland.

GENUS *Neocalamites* HALLE*Neocalamites hoerensis* (SCHIMPER)

Pl. XVI, Figs. 2, 3.

1869. *Schizoneura hoerensis* SCHIMPER: *Traité de paléontologie Végétale*, Vol. I, 1869, p. 283.
1878. *Schizoneura hoerensis* NATHORST: *Bidrag till Sveriges fossila flora. II. Floran vid Hoeganaes och Helsingborg*. L.c., p. 9, Pl. I, figs. 1-4.
- ?1906. *Schizoneura hoerensis* YOKOYAMA: *Mesozoic Plants from China*. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. XXI, Art. 9, p. 29, Pl. VII, fig. 10.
1908. *Neocalamites hoerensis* HALLE: *Zur Kenntnis der mesozoischen Equisetales Schwedens*. L.c., p. 6, Pls. I, II.
1915. *Neocalamites hoerensis* WALKOM: *Mesozoic Flora of Queensland. Pt. I. The Flora of the Ipswich and Walloon Series*. Queensland Geol. Surv. Publ. No. 252, p. 33, Pl. II, fig. 1.
1926. *Neocalamites hoerensis* HARRIS: *The Rhaetic Flora of Scoresby Sound, East Greenland*. L.c., p. 51, Pl. IV, fig. 8; Pl. IX, figs. 2, 5; Text-fig. 1A.
1931. *Neocalamites hoerensis* ÔISHI: *On the Mesozoic Plant-bearing Beds of Kita-Otari*. L.c., p. 48.

There are at hand a considerable number of specimens of this plant, among these the best two are illustrated in Pl. XVI, figs. 2 and 3. Only a single specimen in fig. 2 shows the attachment of leaves to the nodes, though there are many isolated leaves in association with the stems. In this specimen, the internode is more than 7.5 cm. long and 2 cm. across measured on the impression and it is slightly swollen at the nodal region. The surface of the stem is ornamented by longitudinal ridges and furrows in alternation and the breadth of a ridge does not exceed 1 mm. A few of the linear leaves are more than 5 cm. in length and 1.5-2 mm. in breadth and traversed by a single nerve.

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Medd. om Gönland, XIX, 1896, p. 223, Pl. 6. H. MOELLER: *Bidrag till Bornholms Fossila Flora. Pteridofyter*. Lund. Univ. Årsskr. Bd. 38, Af. 2, No. 5, 1902, p. 53, pl. 6, figs. 13-15. A. C. SEWARD: *Jurassic Flora*, Pt. II, 1904, p. 12, Pl. I, fig. 4. T. G. HALLE: *Zur Kenntnis der Mesozoischen Equisetales Schwedens*. K. Svensk. Vet.-Akad. Handl. Vol. 43, No. 1, 1908, p. 18, Pl. IV, figs. 17 and 18. T. M. HARRIS: *The Rhaetic Flora of Scoresby Sound, East Greenland*. L.c., p. 52, Pl. II, figs. 1, 6 and 7. H. YABE: *Geographical Research in Chiha, 1911-1916. Atlas of Fossils*, 1920, Pl. II, figs. 3 and 5.



Fig. 3 shows a pith-cast possibly of the same species; it is about 7 cm. in length and 2.5 cm. in breadth and there is also a slight elevation at the node. The surface shows also longitudinal ridges and furrows in alternation, and besides this there are fine longitudinal striations on the ridges.

It is often very difficult to distinguish *N. hoerensis* from *N. carrerei* (ZEILLER) or almost impossible to settle even generically when the indication of leaves are absent. In *N. carrerei*, however, as HALLE says, the leaves are mostly shorter, narrower, and more in number, and the internode is generally shorter in comparison with the breadth of the stem, than in *N. hoerensis*.

*Schizoneura hoerensis* described by YOKOYAMA<sup>(10)</sup> from the Jurassic bed of Nien-tsu-kou, Prov. Liaoning, China, is a stem which is 17 cm. long and 2.5 cm. broad, the internode being 9 cm. in length; in its comparatively long internode, the Chinese specimen resembles very much *N. hoerensis*, but in the absence of any leaf it is almost impossible to determine it generically.

The type-specimen of *N. hoerensis* is a pith-cast from the Liassic beds of Hoer, Sweden, which SCHIMPER<sup>(11)</sup> considered to be identical with those which HISINGER once named *Calamites hoerensis* on the specimens from Hoer, but the former author substituted a distinct generic name *Schizoneura* for *Calamites*. However, HALLE later pointed out that SCHIMPER's specimen did not come from Hoer, but from the Rhaetic beds of Hoeganaes and made clear that SCHIMPER's specimens were quite specifically different from HISINGER's *C. hoerensis* which should rather be included in an already known species of the genus *Equisetites*, *E. scanicus* (STERNB.)<sup>(12)</sup>

*N. hoerensis* is a characteristic plant of the Rhaetic and has been reported from the equivalent beds of Europe, Australia and East Greenland. A specimen figured by MOELLER<sup>(13)</sup> from the Liassic of Bornholm as *Schizoneura hoerensis* is too fragmentary to admit of specific or even generic determination.

Locality: Tsuchisawa.

(10) M. YOKOYAMA: Mesozoic plants from China. L. c.

(11) W. PH. SCHIMPER: Traité de paléontologie Végétale. L. c.

(12) T. G. HALLE: Zur Kenntnis der mesozoischen Equisetales Schwedens. L. c., p. 22.

(13) H. MOELLER: Bidrag till Bornholms Fossila Flora. Pteridofyter. L. c., p. 60, Pl. VI, fig. 19.

## FILICALES

GENUS *Cladophlebis* BRONGNIART*Cladophlebis nebbensis* (BRONGN.)

Pl. XVI, Figs. 4, 4a.

1833. *Pecopteris nebbensis* BRONGNIART: Hist. végét. foss., I, p. 299, Pl. 98, fig. 3.
1876. *Cladophlebis nebbensis* NATHORST: Bidrag till Sveriges fossila flora. I. Kgl. Svensk. Vet.-Akad. Handl., Vol. 14, No. 14, p. 16, Pl. II, figs. 1-6; Pl. III, figs. 1-3.
1876. *Cladophlebis heeri* NATHORST: Ibid., p. 20, Pl. III, figs. 4, 5.
1891. *Asplenium roesserti* YOKOYAMA: On Some Fossil Plants from the Coal-bearing Series of Nagato. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. IV, Pt. 2, p. 241, Pl. XXXII, figs. 1, 2, 5; Pl. XXXIV, fig. 2; (non. Pl. XXXII, figs. 3, 4).
1896. *Cladophlebis roesserti* var. *groenlandica* HARTZ: Planteforsteninger fra Cap Stewart i Østgrønland. Medd. om Grønland, XIX, p. 228, Pls. VII-X; Pl. XII, fig. 1.
1902. *Cladophlebis nebbensis* MOELLER: Bidrag till Bornholms fossila flora. Pteridofyter. L. c., p. 29, Pl. II, fig. 22; Pl. III, fig. 1.
1903. *Cladophlebis nebbensis* ZEILLER: Flore fossile des gîtes du charbon du Tonkin. L. c., p. 45, Pl. IV, figs. 2, 3.
1905. *Cladophlebis nebbensis* YOKOYAMA: Mesozoic Plants from Nagato and Bitchû. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. XX, Art. 5, p. 3, Pl. I, figs. 1-3.
- ?1913. *Cladophlebis oblonga* HALLE: The Mesozoic Flora of Graham Land. Wiss. Ergebn. d. Schwed. Suedpolar-Expedit., 1901-1903, Bd. III, Lief. 14, p. 13, Pl. II, fig. 6; Text-fig. 4.
1920. *Cladophlebis nebbensis* YABE: Geographical Research in China. Atlas of Fossils. L. c., Pl. III, fig. 1.
1922. *Cladophlebis nebbensis* YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. Sci. Rep. Tôhoku Imp. Univ., Sendai, 2nd Ser. (Geology), Vol. VII, No. 1, p. 14.
- ?1922. *Cladophlebis nebbensis* JOHANSSON: Die raetische Flora der Kohlengruben bei Stabbarp und Skromberga in Schonen. Kgl. Svensk. Vet.-Akad. Handl., Bd. 63, No. 5, p. 14, Pl. II, figs. 1-3; Pl. VII, fig. 7; Text-figs. 2, 3.

1925. *Cladophlebis nebbensis* KAWASAKI: Some Older Mesozoic Plants in Korea. Bull. Geol. Surv. Korea, Vol. IV, Pt. 1, p. 17, Pl. VIII, figs. 30-33.
1926. *Cladophlebis nebbensis* HARRIS: The Rhaetic Flora of Scoresby Sound, East Greenland. L. c., p. 60.
1927. *Cladophlebis nebbensis* du TOIT: The Fossil Flora of the Upper Karroo Beds. Ann. South African Museum, Vol. XXII, Pt. 2, p. 321, Text-fig. 2.
1931. *Cladophlebis nebbensis* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. L. c., p. 48.

Pl. XVI, fig. 4 shows a part of an ultimate pinna of 5 cm. in length at least, approximately 2.5 cm. in breadth, and traversed by a moderately broad pinna-rachis which is 1.5 mm. in breadth measured on the impression. The pinnules are oblong, with an obtuse apex, closely set, nearly straight or slightly curving upwards and attached alternately to the pinna-rachis by the whole base at a wide angle. The midnerve is distinct persisting to the very apex of the pinnule and sends off secondary nerves which are only once forked and make an angle generally of 60° or more with the midnerve.

Though the specimen at hand is fragmentary, the characteristic shape of the pinnules and the mode of division of the secondary nerves mentioned above are sufficient for the specific determination of the specimen. The original specimen of *C. nebbensis* illustrated in BRONGNIART's "Histoire des végétaux fossiles" represents three small portions of ultimate pinnae provided with deltoid pinnules while the most of the modern authors seem to include even the pinnae with oblong pinnules like our present specimens in the type of *C. nebbensis*. In the nervation, *C. nebbensis* agree with *C. denticulata*, both having once forking secondary nerves, and there often occurs some confusion in the specific classification between these two forms when young or imperfect specimens are disposed. *C. denticulata* should generally be distinguished from *C. nebbensis* by having falcate pinnules provided with a pointed apex and most typically with dentate margin. The pinnules of *C. nebbensis* have sometimes also dentate margin, and such specimens, for instance, have been figured by ZEILLER<sup>(14)</sup> and HARTZ<sup>(15)</sup> from the Rhaetic strata of Tonkin and Greenland respectively, the

(14) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin. L. c., p. 45, Pl. IV, figs. 2, 3.

(15) N. HARTZ: Planteforsteninger fra Cap Stewart i Østgrønland. L. c., p. 228, Pls. VII-X; Pl. XII, fig. 1.

latter author, however, giving a distinct name *C. roesserti* var. *groenlandica*, which, according to ZEILLER, is synonymous with the BRONGNIART's species. SEWARD,<sup>(16)</sup> on the contrary, once considered HARTZ's specimens to be comparable with *C. denticulata*.

Some very fragmentary specimens figured by MOELLER and HALLE<sup>(17)</sup> from Roedalsberg in Scania as *C. cfr. nebbensis* are represented with falcate pinnules with once forked secondary nerves and cannot be distinguished from the ordinary type of *C. denticulata*, though JOHANSSON<sup>(18)</sup> once considered that the Scanian specimen should rather be included in *C. roesserti*. A beautiful specimen from the Ping-hsiang coal-mine, Prov. Kiangsi, China, illustrated by Prof. YABE<sup>(19)</sup> in his "Atlas of Fossils" under the name of *C. denticulata*, now preserved in the Institute of Geology and Palaeontology in Sendai, may most probably be an example of *C. nebbensis*. *C. denticulata* (BRONGN.)<sup>(20)</sup> and *C. oblonga* HALLE,<sup>(21)</sup> both from the Jurassic strata of Ceylon and Graham Land respectively, bear pinnules which are straight and parallel-sided, with an obtuse apex and secondary nerves only once divided, and accordingly, so far as their sterile pinnules are concerned, they are hardly distinguishable from *C. nebbensis*.

*C. nebbensis* is one of the characteristic Rhaetic species ever found in several localities in Europe, South Africa, Arctic Region, Tonkin, China, Japan and Korea (Lias), and it is also reported even from the Middle Jurassic of Turkestan<sup>(22)</sup> and Siberia.<sup>(23)</sup>

Locality: Tsuchisawa.

### *Cladophlebis denticulata* (BRONGN.)

Pl. XVI, Figs. 5, 5a.

1833. *Pecopteris denticulata* BRONGNIART: Hist. Vég. Foss., p. 301, Pl. 98, figs. 1, 2.

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- (16) A. C. SEWARD: Jurassic Flora. Pt. I, 1900, p. 136.  
 (17) H. MOELLER and T. G. HALLE: The Fossil Flora of the Coal-bearing Deposits of South-Eastern Scania. Arkiv för Botanik, Bd. 13, No. 7, 1913, p. 12, Pl. I, figs. 22, 23; Pl. II, figs. 1, 2.  
 (18) N. JOHANSSON: Die rhaetische Flora der Kohlengruben bei Stabbarp und Skromberga in Schonen. L. c., p. 18.  
 (19) H. YABE: Atlas of Fossils. L. c., Pl. III, fig. 1.  
 (20) A. C. SEWARD and R. E. HOLTUM: Jurassic Plants from Ceylon. Q. J. Geol. Soc. London, Vol. 78, 1922, p. 272, Pl. XII, figs. 11, 14.  
 (21) T. G. HALLE: The Mesozoic Flora of Graham Land. L. c.  
 (22) A. C. SEWARD: Jurassic Plants from Caucasia and Turkestan. Mém. Com. Géol. St.-Pétersbourg. N. S., Liv. 81, 1907, p. 23, Pl. IV, figs. O, Q.  
 (23) W. A. OBRUTSCHEW: Geologie von Sibirien. Fortschr. d. Geol. u. Palaeont., Heft 15, 1926, p. 311.

1922. *Cladophlebis denticulata* YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L.c., p. 9, Pl. I, figs. 3, 4; Pl. II, figs. 1, 2; Text-fig. 7.
1925. *Cladophlebis denticulata* KAWASAKI: Some Older Mesozoic Plants in Korea. L.c., p. 11, Pl. IX, figs. 34; Pl. X, figs. 35-38; Pl. XXXVI, fig. 100; Pl. XL, figs. 108, 109; Pl. XLVI, fig. 123.
1926. *Cladophlebis denticulata* KAWASAKI: Addition to the Older Mesozoic Plants in Korea. Bull. Geol. Surv. Korea, Vol. IV, Pt. 2, p. 2, Pl. I, figs. 1, 1a-c.
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* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. L.c., p. 48.
1931. *Cladophlebis denticulata* YABE and ÔISHI: Mesozoic Plants from Manchuria. Sci. Rep. Tôhoku Imp. Univ., 2nd Ser. (Geology), Vol. XIV, No. 2 (in preparation).

For further reference see YABE, 1922, l.c.

A specimen in Pl. XVI, fig. 5 consists of three fragmental pinnae, closely set together and arranged in parallel. They are 6 cm. long at least, straight, and traversed by a distinct pinna-rachis. The pinnules are short and falcate, their apices directed forwards, gently attenuating towards the bluntly pointed apex, and attached to the pinna-rachis by their broad bases at an angle of about 60°. The margin seems to be entire. The nervation is of usual *Cladophlebis*-type, the midnerve sending off secondary nerves which are oblique to the midnerve and only once dichotomising.

Though *C. denticulata* is rather common in the Jurassic strata of the world, it has been reported also in the Triassic and the Lower, or even the Upper, Cretaceous, sometimes under different names.

Locality: Tsuchisawa, and south of Kuruma.

*Cladophlebis* cfr. *raciborskii* ZEILLER

Pl. XVI, Figs. 6, 6a; Pl. XVII, Fig. 1.

Compare:

1903. *Cladophlebis raciborskii* ZEILLER: Flore fossile des gites de charbon du Tonkin. L. c., p. 49, Pl. V, fig. 1.
1906. *Todites williamsoni* YOKOYAMA (pars): Mesozoic Plants from China. L. c., p. 18, Pl. III; p. 20, Pl. V, fig. 1a.

1911. *Cladophlebis kamenkensis* THOMAS: The Jurassic Flora of Komenka. Mém. Com. Géol. St.-Pétersbourg. N.S., Liv. 71, p. 66, Pl. III, figs. 1-3.
1922. *Cladophlebis raciborskii* YABE: Atlas of Fossils. L.c., Pl. V, fig. 3.
1925. *Cladophlebis raciborskii* KAWASAKI: Some Older Mesozoic Plants in Korea. L.c., p. 15, Pl. VII, figs. 15-19; Pl. XXXIV, fig. 94.

Fronde bipinnate at least; frond or penultimate pinnae comparatively large; its rachis very thick in the lower portion of the frond, narrowing gradually towards the apical portion, and generally smooth or finely striated longitudinally on the surface. Ultimate pinnae opposite in the lower and alternate in the upper portion of the frond, forming an angle of generally  $45^{\circ}$ - $65^{\circ}$  with the rachis, linear to linear-lanceolate, more than 10 cm. in length and maximum breadth 7 cm., overlapping to each other laterally, and with moderately thick pinna-rachis. Pinnules closely set, slightly contiguous at the base, long and narrow, attaining sometimes more than 4 cm. in length, slightly falcate, forming a wide angle with the pinna-rachis or sometimes attached perpendicularly to it, and acutely pointed at the apex. Midnerve distinct, persisting to the apex of pinnule. Secondary nerves arching, arising from the midnerve generally at angles of  $40^{\circ}$ - $50^{\circ}$ , forking usually twice or rarely once, in the latter case any one of the branches dividing once more. Margins seems to be almost entire.

Pl. XVII, fig. 1 shows a specimen of imperfect pinnae, of which the right one is more than 7.7 cm. in length. The pinnules are generally long and narrow, falcate, provided with acuminate apex, and make a wide angle with the pinna-rachis. The secondary nerves are twice forking. A specimen of pinna in Pl. XVI, fig. 6 is somewhat interesting because of its having tolerably long acuminate pinnules which attain 3.5 cm. in length; fig. 6a shows its nervation very clearly.

*C. cfr. raciborskii* here described differs from *C. raciborskii* from Tonking<sup>(24)</sup> in having entire pinnules only, though otherwise both are almost indistinguishable. As previous record of this species is very scanty, it is not certain to what extent the dentation of the pinnules of *C. raciborskii* occurs constantly nor whether it is limited to a certain portion in a frond. In the material at hand, however, the pinnules have always the margin perfectly entire or very slightly undulating

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(24) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin. L. c.

possibly due to the preservation, and accordingly it is not desirable to treat the present specimens as specifically identical with *C. raciborskii* from Tonkin. On this point, KAWASAKI<sup>(25)</sup> once expressed his opinion that the margin of pinnules has a "tendency to roll down to make the very margin of pinnules obscure, thus the dentation, if any, might have gotten unseen" and that the presence or absence of dentation is almost valueless in the specific distinction. And thus the specimens described by KAWASAKI from Korea under ZEILLER's name contain two forms of pinnules, one with dentate margins and the other entire, but the pinnules are decidedly smaller than those in ZEILLER's specimens. Prof. YABE<sup>(26)</sup> also assigned a Chinese specimen with entire pinnules to *C. raciborskii*. Some of *Todites williamsoni* described by YOKOYAMA<sup>(27)</sup> from Chin-kang-lin and Ta-shih-ku, Prov. Ssuchuang, China, were already mentioned by SEWARD<sup>(28)</sup> as possibly *C. raciborskii* and subsequently the same view was supported by Prof. YABE,<sup>(29)</sup> but having a perfectly entire margin of the pinnules, they resemble well *C. cfr. raciborskii* described here. *C. kamenkensis* THOMAS<sup>(30)</sup> from the Bathonian bed of Kamenka is very similar to our present form and both seem to be specifically almost identical though the specimens of the former are too small in size for comparison and derived from the rocks geologically younger. The writer will quote here some lines from THOMAS' description concerning the comparison of *C. Kamenkensis* with *C. raciborskii*: "ZEILLER's species *C. raciborskii* from the Rhaetic of Tonkin can perhaps be most closely compared with *C. kamenkensis*. It appears to have a similar nervation to our examples, but its pinnules are long and narrow, denticulate above, and with secondary veins oblique to the strongly curved midrib. The comparison is however not an exact one and taking into consideration the fact that *C. raciborskii* is of Rhaetic age, it seems advisable to adopt the new specific name of *kamenkensis* for our species." Another allied form is a certain specimen figured by SEWARD<sup>(31)</sup> from the Jurassic of

(25) S. KAWASAKI: Some Older Mesozoic Plants in Korea. L. c.

(26) H. YABE: Atlas of Fossils. L. c.

(27) M. YOKOYAMA: Mesozoic Plants from China. L. c.

(28) A. C. SEWARD: The Jurassic Flora of Sutherland. Trans. Roy. Soc. Edinburgh, Vol. XLVII, Pt. IV, No. 23, 1911, p. 670.

(29) H. YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L. c. pp. 10 and 17.

(30) H. H. THOMAS: The Jurassic Flora of Kamenka. Mém. Com. Géol. St.—Petersbourg, N. S., Liv. 71, 1911, p. 66, Pl. III, figs. 1-3.

(31) A. C. SEWARD: Mesozoic Plants from Afghanistan and Afghan-Turkestan. Pal. Indica, N. S., Vol. IV, Mem. No. 4, 1912, p. 19, Pl. II, fig. 32.

Afghanistan as *Cladophlebis haiburnensis*. A certain specimen from Shitaka, Prov. Tango, assigned by Prof. YABE<sup>(32)</sup> to *C. haiburnensis* may be specifically identical with the present form.

Locality: Tsuchisawa.

*Cladophlebis haiburnensis* (L. and H.)

Pl. XVII, Fig. 2.

1837. *Pecopteris haiburnensis* LINDLEY and HUTTON: Fossil Flora of Great Britain, Vol. III, p. 97, Pl. 187.
1922. *Cladophlebis haiburnensis* YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L.c., p. 16, Pl. II, figs. 9-11; Text-figs. 12-16.
1925. *Cladophlebis haiburnensis* KAWASAKI: Some Older Mesozoic Plants in Korea. L.c., p. 18, Pl. V, figs. 16-20; Pl. VI, figs. 21-22.
1927. *Cladophlebis haiburnensis* KRYSHTOFOVICH: Contribution to the Jurassic Flora of Middle Siberia. Bull. Com. Géol. Lénigrad, Vol. XLVI, p. 560, Pl. XXXI, figs. 3, 4.
1928. *Cladophlebis haiburnensis* YABE and ÔISHI: Jurassic Plants from the Fang-tzu Coal-Field, Shantung. L.c., p. 5, Pl. I, fig. 2; Pl. III, fig. 1.
1931. *Cladophlebis haiburnensis* YABE and ÔISHI: Mesozoic Plants from Manchuria. L.c.
1931. *Cladophlebis haiburnensis* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. L.c., p. 48.

For further references see YABE, 1922, l.c.

A part of a rather large frond belonging to this species is shown in Pl. XVII, fig. 2. It comprises three ultimate pinnae overlapped laterally with each other; they are more than 10 cm. in length and 5 cm. in breadth and of nearly the same breadth throughout their whole length. The pinnules are broadly linear, closely set, being contiguous at the base, and attached to the pinna-rachis at wide angles with it generally of 70°-90°, and obtusely rounded at the apex; the texture of the pinnules is thin and delicate. The midnerve persisting to the apex of pinnules sends off numerous delicate secondary nerves which are twice dichotomising, at an angle of about 45°.

(32) H. YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L. c., p. 17, Pl. II, fig. 11.



Though we have no specimen of complete frond in the present material, the uniform 4.5 cm. breadth of pinnae suggests to us the attaining of a considerable size of this plant. As there is no trace of rachis, the mode of attachment of pinnae to the rachis is obscure.

*C. haiburnensis* is a widely spread Jurassic species; *C. yamanoiensis* YOK.<sup>(33)</sup>, which YOKOYAMA<sup>(34)</sup> first identified with *Asplenium roesserti* var. *whitbiensis*, from the Rhaetic of Yamanoi, was lately regarded by YABE<sup>(35)</sup> to be an example of this species. Recently the present writer announced the occurrence of *C. haiburnensis* also in our Rhaetic Nariwa Flora.<sup>(36)</sup>

Locality: Tsuchisawa.

#### *Cladophlebis* sp. a.

Pl. XVII, Fig. 3.

Pl. XVII, fig. 3 shows a back surface of a portion of an ultimate pinnae traversed by a pinna-rachis which is 1.5 mm. in breadth measured on the compressed surface. It is characterised by having large pinnules with delicate texture, which are more than 3 cm. in length and 1.2 cm. in breadth, nearly parallel-sided, closely set, and attached to the pinna-rachis sub-oppositely, making an angle of approximately 80° with it. The nervation is delicate and very crowded; from the midnerve are given off secondary nerves at a wide angle, which are generally forked three times, first close to the midnerve, secondly midway and lastly near the margin of the pinnules.

So far as the writer knows, there is no known species comparable with the present form, but the specific name is reserved for a while as the specimen is too fragmentary for the election of a new species. Remarkably large size of the pinnules and the crowded nervation are the characteristic features of this plant.

Locality: Tsuchisawa.

#### *Cladophlecbis* sp. b.

1931. *Cladophlebis argutula* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari, Prov. Shinano. L. c., p. 48.

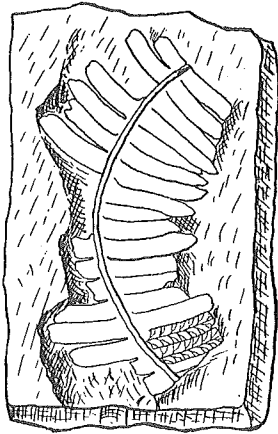
(33) M. YOKOYAMA: Mesozoic Plants from Nagato and Bitchû. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. XX, Art. 5, 1905, p. 4.

(34) M. YOKOYAMA: On Some Fossil Plants from the Coal-bearing Series of Nagato. Ibid., Vol. IV, Pt. 2, 1891, p. 242, Pl. XXXII, figs. 3, 3a, 4.

(35) H. YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L. c., p. 17.

(36) S. ÔISHI: On the Upper Triassic Formation in Nariwa. L. c.

A specimen from Tsuchisawa which the writer<sup>(37)</sup> formerly assigned provisionally to the Middle Jurassic species *C. argutula* (Hr.) is left without giving a definite specific name and only called here *C. sp.* The



Text-fig. 2. *Cladophlebis*  
sp. b.  $\times 1$ . Tsuchisawa

specimen is a portion of a pinna with slender rachis, more than 5 cm. long, narrowing gradually towards the rounded apex. The pinnules are in delicate texture, long and narrow, being generally 1.7 cm. long and 2.5 cm broad in the proximal ones, nearly parallel-sided, contracting rather abruptly to the obtuse apex and attached to the pinna-rachis at a wide angle. The midnerve is thin, delicate, straight, and persists to the apex of the pinnules. The secondary nerves which are very delicate are given off from the midnerve at an angle of  $45^\circ$  and only once forked a short distance from their origin, the branches forming narrow angles.

A comparable species is *C. argutula* described by HEER<sup>(38)</sup> and NOVOPOKROVSKIJ<sup>(39)</sup> from the Jurassic rocks of Ust-Balei in Amurland and of Tyrma-valley respectively, but in ours the pinnae are more markedly delicate and slender than those of *C. argutula*.

Locality: Tsuchisawa.

#### GENUS *Thaumatopteris* GOEPPERT

##### *Thaumatopteris schenki* NATHORST

Pl. XVI, Figs, 7, 7a, 8, 8a.

1866. *Thaumatopteris brauniana* ? NATHORST: Bidrag till Sveriges fossila flora. I. Kgl. Svensk. Vet.-Akad. Handl., Vol. 14, No. 3, p. 30, Pl. VIII, fig. 1.

1878. *Thaumatopteris schenki* NATHORST: Bidrag till Sveriges fossila flora. II. Floran vid Hoeganaes och Helsingborg. Ibid., Vol. 16, No. 7, p. 47, Pl. VI, fig. 1; Pl. VIII, fig. 4.

(37) S. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L. c.

(38) O. HEER: Beitrage z. Juraflora Ostsibiriens und des Amurlandes. Mém. l'Akad. Sci. St.-Petersbourg, Ser. VII, Vol. XXII, No. 12, 1876, Pl. XIX, fig. 3.

(39) I. NOVOPOKROVSKIJ: Beitrage z. Kenntnis der Jura-Flora des Tyrma-Tal, p. 20, Pl. I, figs. 5, 5a.

1892. *Thaumatopteris schenki* RACIBORSKI: Przeszynek do Flory Retyckiej Polski, p. 348, Pl. II, fig. 19.
1902. *Thaumatopteris schenki* MOELLER: Bidrag till Bornholms fossila flora. Pteridofyter. Lunds Univ. Årsskrift, Bd. 38, Afd. 2, No. 5, p. 45, Pl. IV, fig. 13.
1909. *Thaumatopteris schenki* NATHORST: Ueber *Thaumatopteris schenki* Nath. Kgl. Svensk. Vet.-Akad. Handl., Vol. 42, No. 3, p. 3, Pl. I, figs. 1-11; Pl. II.
1913. Cfr. *Thaumatopteris schenki* MOELLER and HALLE: The Fossil Flora of the Coal-bearing Deposits of South-Eastern Scania. Arkiv för Botanik, Bd. 13, No. 7, p. 10, Pl. I, fig. 17.
1914. *Thaumatopteris schenki* GOTHAN: Die unter-liassische (rhaetische) Flora der Umgegend von Nürnberg. Abhandl. d. naturhist. Gesell. z. Nürnberg, Bd. XIX, p. 104. Pl. 19, figs. 3, 3a.
1919. *Thaumatopteris Schenki* ANTEVS: Die liassische Flora des Hoersandsteins. Kgl. Svensk. Vet.-Akd. Handl., Vol. 59, No. 8, p. 13, Pl. I, fig. 4.
1922. *Thaumatopteris schenki* JOHANSSON: Die rhaetische Flora der Kohlengruben bei Stabbarp und Skromberga in Schonen. Kgl. Svensk. Vet.-Akad. Handl., Vol. 63, No. 5, p. 8.
1931. *Woodwardites microlobus* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

Pl. XVI, figs. 7 and 8 represent two small specimens of fern fragments which in their characteristic nervation agree closely with the well known Rhaetic species above referred to. In fig. 7 are seen four imperfect pinnules attached on one side of the pinna-rachis forming a wide angle with it. The pinnules are more than 1.5 cm. in length, and 4-5 mm. in breadth at the base, thence tapering gradually towards the apex, closely set and slightly contiguous laterally at the very base. The margin of the pinnules seems to be slightly undulating. The midnerve is delicate, straight and almost perpendicular to the pinna-rachis. The secondary nerves, arising at a right angle from the midnerve, subdivide into a reticulum with polygonal meshes in which the nervelets sometimes end blindly. Another specimen in fig. 8 shows imperfect pinnules crowded on a slab of rock; a pinnule reaches a

length of more than 3 cm. and breadth of 4 mm. ; it is nearly parallel-sided and has the margin slightly undulating. The nervation is quite similar to the former specimen.

In the long and narrow pinnules *T. schenki* somewhat resembles *Dictyophyllum muensteri* figured by NATHORST<sup>(40)</sup> from the Rhaetic strata of Sweden, but in the latter the pinnules are more widely spaced, less parallel-sided and more markedly confluent laterally at the bases of the pinnules. Certain imperfect pinnae figured by MOELLER and HALLE<sup>(41)</sup> as *D. muensteri* from the Rhaetic of Rödalsberg in Scania agree closely in size, form and nervation with our specimen figured in Pl. I, fig. 8.

*T. schenki* is the characteristic species of the Rhaetic ; outside Japan it has been recorded from Sweden, Bornholm, Poland, Germany and Franconia, occurring in all these districts in Rhaetic and Lower Liassic strata.

Locality : South of Kuruma.

#### GENUS *Clathropteris* BRONGNIART

##### *Clathropteris* sp.

1918. *Clathropteris* sp. KRYSHTOFOVICH : in YAGI's On the Occurrence of Jurassic Plants in Kita-Otari. L.c.
1931. *Clathropteris* sp. ÔISHI : On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

The original specimen of *Clathropteris* sp. determined by KRYSHTOFOVICH is now preserved in the Nagano Girls' High School in Nagano. It is a fragment of a leaf, more than 5 cm. long and 3 cm. broad, showing characteristic rectangular form of the nervation-meshes, and there is little doubt in its belonging to the genus *Clathropteris*. All features available for comparison show that the present specimen closely agrees with the Rhaetic and Lower Liassic species *C. meniscoides* Brongn., but our specimen is too imperfect for giving a definite specific name.

Locality : Tsuchisawa.

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- (40) A. G. NATHORST : Bidrag till Sveriges fossila flora. I. L.c., p. 29, Pl. VI, fig. 1 ; Pl. XVI, figs. 17, 18. A. G. NATHORST ; Bidrag till Sveriges fossila flora. II. L.c., p. 45, Pl. V, figs. 14-16 ; Pl. VIII, figs. 8-10.
- (41) H. MOELLER and T. G. HALLE : The Fossil Flora of the Coal-bearing Deposits of South-Eastern Scania. L.c., p. 15, Pl. II, figs. 6-8, non 5.

GENUS *Dictyophyllum* LINDLEY AND HUTTON*Dictyophyllum* sp.

Pl. XVI, Fig 9.

1927. *Dictyophyllum* sp. KOBAYASHI: On the Tetori Series. L.c., p. 63.
1931. *Dictyophyllum* sp. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

In Pl. XVI, fig. 9 is shown a fragmental leaf which is undoubtedly of a *Dictyophyllum* but too imperfect to be determined specifically. The specimen consists only of a portion of a pinna which is more than 3.5 cm. long and 6 cm. broad and traversed by a thin but well-defined midnerve. A fragmental lobe is seen on the photograph; it is more than 1.5 cm. long and about 1 cm. broad at the base, triangular in shape, somewhat falcate with the upper margin slightly concave and the lower convex. As the apical portion of the lobe is broken, the nature of the very apex is not known. The nervation stands out very distinctly in relief. The secondary nerves are subopposite, distinct and form a wide angle with the midnerve. The tertiary nerves which are at about a right angle with, and finer than, the secondaries, are divided into a fine reticulum, in the meshes of which the nervelets end sometimes blindly as it is usually the case in this genus.

Comparable forms are *Dictyophyllum nilssoni* BRONGN., *D. nathorsti* ZEILL.<sup>(42)</sup> and *D. japonicum* YOKOYAMA<sup>(43)</sup>, all from the Rhaetic of Sweden, Tonkin and Japan respectively: among these a certain specimen of *D. nilssoni* from Palsjö in Sweden<sup>(44)</sup> is the nearest ally of ours.

Locality: A block at the upper course of the River Dairagawa.

GENUS *Marattiopsis* SCHIMPER*Marattiopsis muensteri* (GOEPP.)

Pl. XVI, Figs. 10, 10a.

1842. *Taeniopteris muensteri* GOEPPERT: Les genres des plantes fossiles. Liv. III and IV, p. 51, Pl. IV, figs. 1-3.

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(42) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin. L.c., p. 109, Pl. XXIII, fig. 1; Pl. XXIV, fig. 1; Pl. XXV, figs. 1-6; Pl. XXVI, figs. 1-3; Pl. XXVII, fig. 1; Pl. XXVIII, fig. 3.

(43) M. YOKOYAMA: On Some Fossil Plants from the Coal-bearing Series of Nagato. L.c., p. 243; Pl. XXX.

(44) A. G. NATHORST: Bidrag till Sveriges fossila Flora. I: L.c., p. 25, Pl. VII.

1869. *Angiopteridium muensteri* SCHIMPER: *Traité de pal. végét.*, Tom. I, p. 603. Pl. XXXVIII, figs. 1-6.
1874. *Marattiopsis muensteri* SCHIMPER: *Ibid.*, Tom. III, p. 514.
1878. *Marattiopsis muensteri* NATHORST: *Bidrag till Sveriges fossila flora. II. Floran vid Hoeganaes och Helsingborg.* Kgl. Svensk. Vet.-Akd. Handl., Vol. 16, No. 7, p. 48, Pl. V, fig. 6.
1886. *Marattiopsis muensteri* ZEILLER: *Note sur les empreintes végétales recueillies par M. Jourdy au Tonkid.* Bull. Soc. Géol. France, Ser. III, Vol. XIV, p. 457, Pl. XXIV, figs. 5-7.
1892. *Taeniopteris (Marattiopsis) muensteri* BARTHOLIN: *Nogle i den Bornh. Juraform. forekommedne Planteforsteninger.* I. Bot. Tidskr. Bd. 18, p. 23, Pl. IX, figs. 6, 9.
1902. *Marattia muensteri* MOELLER: *Bidrag till Bornholms Fossila Flora. Pteridofyter.* L.c., p. 17. Pl. I, fig. 1.
1903. *Taeniopteris (Marattia) muensteri* ZEILLER: *Flore fossile des gîtes de charbon du Tonkin,* p. 63, Pl. IX, figs. 6-8.
1925. *Marattiopsis muensteri* KAWASAKI: *Some Older Mesozoic Plants in Korea.* L.c., p. 26, Pl. XVI, fig. 53; Pl. XXXVI, fig. 101; Pl. XXXVII, fig. 102.
1927. *Taeniopteris* cfr. *virgulata* KOBAYASHI: *On the Tetori Series.* L.c., p. 63.
1931. *Marattiopsis muensteri* ÔISHI: *On the Mesozoic Plant-bearing Beds of Kita-Otari.* L.c., p. 48.

An imperfect fertile pinna in Pl. XVI fig. 10 is at least 6 cm. in length and 1.8 cm. in breadth, slightly narrowing anteriorly and traversed by a moderately strong midnerve, from which are given off secondary nerves nearly at a right angle; the secondary nerves are simple or once forked close to the midnerve, generally numbering 15 per cm.; each secondary nerve has near its end a linear oval synangium which is 3 mm. long in the lower portion of the pinna and 1.5 mm. long near the apex. The nature of the very margin of the pinna is indistinct.

Though the specimen is imperfect, it is clear from the size and form of the synangia that this characteristic Rhaetic and lower Liassic species occurs also in the plant bed of Kuruma, the Kuruma Bed. DU TOIT<sup>(45)</sup> believes that the midnerve which "divides the

(45) A. L. DU TOIT: *The Fossil Flora of the Upper Karroo Beds.* Ann. South African Museum, Vol. XXII, Pt. 2, 1927, p. 322, Pl. XVIII, figs. 1, 2.

lamina into two parts that are not of strictly equal width" to be an important generic character of *Marattiopsis*, and assigned a sterile specimen from the Molteno Bed of South Africa to *Marattiopsis muensteri*. It is clear that such character as mentioned by DU TOIT is of minute importance as the generic character of this genus, and the present writer believes it may belong to the genus *Yabeiella* from its characteristic clearly defined marginal nerve and has called the S. African specimen *Yabeiella? dutoiti* ÔISHI<sup>(46)</sup>. An Allied form is *Angripteridium hoerensis* described by SCHIMPER<sup>(47)</sup> and subsequently by ANTEVS<sup>(48)</sup> as *Marattiopsis hoerensis* from the Liassic bed of Hoer in Scania; it is, however, usually distinguished from *M. muensteri* in the more cordate base of pinna and the longer synangia.

Locality: Tsuchisawa.

#### BENNETTITALES

#### GENUS *Taeniopteris* BRONGNIART

#### *Taeniopteris* sp.

Pl. XVII, Fig. 4.

1927. *Taeniopteris* sp. KOBAYASHI: On the Tetori Series. L.c., p. 63.
1931. *Taeniopteris* sp. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

Pl. XVII, fig. 4 shows an apical portion of a *Taeniopteroid* leaf which is more than 5.5 cm. long and 3.5 cm. broad in the broken proximal end, thence narrowing gradually towards the bluntly crenulated apex, and is traversed by delicate midnerve. The secondary nerves given off from the midnerve nearly at a right angle are straight and simple or bifurcating at variable distances from their origin, and there are about 15 of them in the interval of 1 cm. measured along the margin of the pinna. Without the aid of further material it is difficult to determine the present specimen specifically.

Locality: Tsuchisawa.

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- (46) S. ÔISHI: On *Fraxinopsis* Wieland and *Yabeiella* Ôishi Gen. Nov. Jap. Journ. Geol. Geogr., Vol. VIII, No. 4, 1931.
- (47) W. P. SCHIMPER: Traité de paléontologie végétale, Tom. I, 1869, p. 604, Pl. XXXVIII, fig. 7.
- (48) E. ANTEVS: Die liassische Flora des Hoersandsteins. Kgl. Svensk. Vet.-Akad. Handl., Vol. 59, No. 8, 1919, p. 21, Pl. II, figs. 2-13; Pl. VI, fig. 40

GENUS *Pterophyllum* BRONGNIART*Pterophyllum propinquum* GOEPPERT

Pl. XVIII, Figs. 1, 2.

1916. *Pterophyllum propinquum* LOZANO: Description de algunas Plantas Liasicas de Huayacocotla, Ver. Boll. Inst. Geol. Mexico, No. XXXIV, p. 11, Pl. VI, figs. 3, 4.
1919. *Pterophyllum propinquum* ANTEVS: Die liassische Flora des Hoersandsteins. L.c., p. 28, Pl. III, fig. 7-19; Pl. IV. figs. 18-21 (?).
1927. *Ptilophyllum* sp. KOBAYASHI: On the Tetori Series. L.c., p. 63.
- ?1929. *Pterophyllum* aff. *propinquum* YABE and ÔISHI: Notes on Some Fossil Plants from Korea and China Belonging to the Genera *Nilssonia* and *Pterophyllum*. Jap. Journ. Geol. Geogr., Vol. VI, Nos. 3-4, p. 91, Pl. XVIII, fig. 6.
1931. *Pterophyllum propinquum* YABE and ÔISHI: Mesozoic Plants from Manchuria. L.c.
1931. *Pterophyllum propinquum* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

Two specimens in Pl. XVIII, fig. 1 and 2 are believed, though fragmental, to belong to the species above referred to. One in in fig. 1 is a portion of a frond, more than 8.5 cm. long and 6 cm. broad and traversed by a narrow rachis about 1.5 mm. in breadth. The pinnae are 1.2 cm. broad, opposite, straight, nearly parallel-sided, slightly spaced between two adjacent ones and attached to the rachis laterally at a wide angle, though the pinnae in the right hand side in the figure are somewhat displaced from the original position and make an acuter angle with the rachis. The nerves are fine, parallel, simple or dichotomising, and there are generally 23 of them in each pinna counted at the middle portion of the pinna. Another specimen in fig. 2 shows also a small portion of a frond, more than 4.5 cm. long and 5 cm. broad and is traversed by a narrow rachis, 1.5 mm. in breadth. The pinnae are narrower than those of the preceding specimen, being generally 8 mm. broad at the slightly expanded base, thence narrowing gradually to the apex. As the apices of pinnae are broken, the true nature of the apex is indistinct.



This species displays a considerable variation in regard to the size of frond and breadth of pinnae, and a specimen assigned by ANTEVS<sup>(49)</sup> to this species shows a long and narrow, falcate pinnae, which according to this author, represents an apical portion of a frond. Though the nature of the apices of pinnae are not known in our specimens at hand, the other features available for comparison warrant the specific identification of the Japanese specimens with *P. propinquum*.

*P. propinquum* is one of the characteristic elements of the Liassic flora of Hoer sandstone, and LOZANO<sup>(50)</sup> reported the occurrence of this species in the Liassic of Mexico and Prof. YABE and the present writer<sup>(51)</sup> from the Middle Jurassic of Manchuria. *P. aff. propinquum* described by the last two authors<sup>(52)</sup> from Korea is another example of the occurrence of an allied form in the Lower Jurassic horizon.

Locality : Tsuchisawa.

### *Pterophyllum jaegeri* BRONGN.

Pl. XVIII, Fig. 3.

1850. *Pterophyllum jaegeri* UNGER : Genera et Species, p. 287.  
 1851. *Pterophyllum jaegeri* BRONN and ROEMER : Lethaea Geognostica, Pt. III, p. 37, Pl. XII, fig. 1.  
 1865. *Pterophyllum jaegeri* HEER : Urwelt der Schweiz, p. 52, Pl. III, fig. 2.  
 1872. *Pterophyllum jaegeri* SCHIMPER : Traité de paléontologie végétale, Tom. II, p. 134, Pl. LXX, fig. 7.  
 1875. *Pterophyllum jaegeri* SAPORTA : Plantes Jurassiques, Vol. II, p. 43, Pl. LXXX, fig. 1.  
 1877. *Pterophyllum jaegeri* HEER : Flora fossilis Helvetiae, p. 79, Pl. XXXI, figs. 1-4 ; Pl. XXXII, figs. 1, 2.  
 1903. *Pterophyllum jaegeri* LEUTHARDT : Keuperflora von Neuwelt bei Basel. Abhandl. Schweiz. Palaeontol. Gesell., Vol. XXX, p. 14, Pl. V, figs. 1-3 ; Pl. VI, figs. 1-2 ; Pl. X, fig. 1.

(49) E. ANTEVS : Die liassische Flora des Hoersandsteins. L.c., p. 28, Pl. III, fig. 10.

(50) E. D. LOZANO : Description de algunas Plantas Liasicas de Huayacocotla, Ver. L. c.

(51) H. YABE and S. ÔISHI : Mesozoic Plants from Manchuria. L. c.

(52) H. YABE and S. ÔISHI : Notes on Some Fossil Plants from Korea and China Belonging to the Genera *Nilssonia* and *Pterophyllum*. L.c., p. 91, Pl. XVIII, fig. 6.

1929. *Pterophyllum jaegeri* YABE and ÔISHI: Notes on Some Fossil Plants from Korea and China Belonging to the Genera *Nilssonia* and *Pterophyllum*. L. c., p. 95, Pl. XIX, fig. 4; Pl. XX, fig. 4.
1931. *Pterophyllum jaegeri* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L. c., p. 48.

A specimen in Pl. III, fig. 3 is believed to be comparable to the well known Upper Triassic cycadean species *Pterophyllum jaegeri* BRONGN. It is a portion of a frond, more than 5 cm. long and traversed by a rather long and narrow, being 2 cm. long at least and 3 mm. broad, parallel-sided, straight, and they make a wide angle with the rachis. The nerves are fine, simple or forking, generally numbering 13 in each pinna, and run parallel to the lateral margin of the pinna.

*P. Jaegeri* is one of the characteristic species of the Upper Triassic of Europe, and HEER<sup>(53)</sup> and LEUTHARDT<sup>(54)</sup> figured a number of large specimens of this species from the Keuper beds of Basel. Recently Prof. YABE and the present writer<sup>(55)</sup> reported the occurrence of this species in the Upper Triassic rocks in Nan-hsian coal-field, Prov. Hunan, China, and the latter author<sup>(56)</sup> knows it also from the Rhaetic Nariwa Bed of Nariwa, Prov. Bitchû, Japan.

Locality: Tsuchisawa.

## GINKGOALES

### GENUS *Ginkgoites* SEWARD

#### *Ginkgoites digitata* (BRONGN.) var. *huttoni* SEWARD

Pl. XVIII, figs. 1B, 4.

1833. *Cyclopteris digitata* LINDLEY and HUTTON: Fossil Flora of Great Britain, Vol. I, p. 179, Pl. LXIV.
1884. *Salisburia huttoni* SAPORTA: Plantes Jurassiques, Vol. III, p. 299, Pl. XXXI, figs. 4, 5; Pl. XXXII, fig. 8.

(53) O. HEER: Flora Fossilis Helvetiae. L. c., p. 79, Pl. XXXI, figs. 1-4; Pl. XXXII, figs. 1, 2.

(54) LEUTHARDT: Keuper Flora von Neuwelt bei Basel. L. c., p. 14, Pl. V, figs. 1-3; Pl. VI, figs. 1, 2; Pl. X, fig. 1.

(55) H. YABE and S. ÔISHI: Notes on Some Fossil Plants from Korea and China Belonging to the Genera *Nilssonia* and *Pterophyllum*. L. c., p. 95, Pl. XIX, fig. 4; Pl. XX, fig. 4.

(56) S. ÔISHI: On the Upper Triassic Formation in Nariwa District. L. c.

1900. *Ginkgo digitata* forma *huttoni* SEWARD: Jurassic Flora, Pt. I, p. 259, Pl. IX, figs. 2, 10 (?).
1905. *Ginkgo digitata* FONTAINE: in Ward's Status of the Mesozoic Floras of Unites States. U. S. Geol. Surv., Mon. Vol. XLVIII, p. 121, Pl. XXX, figs. 1-7.
1905. *Ginkgo huttoni* FONTAINE: Ibid., p. 123, Pl. XXX, figs. 8-12, Pl. XXXI, figs. 1-3.
1905. *Ginkgo sibirica* FONTAINE (pars): Ibid., p. 125, Pl. XXXIII, figs. 5, 7.
1919. *Ginkgoites digitata* var. *huttoni* SEWARD: Fossil Plants, Vol. IV, p. 15, fig. 633.
1913. *Ginkgoites digitata* var. *huttoni* YABE and ÔISHI: Mesozoic Plants from Manchuria. L.c.
1931. *Ginkgoites sibirica* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

Some specimens with laminae of *Ginkgoites digitata*-type but more deeply dissected into usually four or five broadly lanceolate segments are, following SEWARD,<sup>(57)</sup> tentatively grouped as a variety of *G. digitata*. One in Pl. XVIII, fig. 4 shows a lamina, 5 cm. high and 7 cm. broad, deeply cleft into four segments. The segments are broadly lanceolate, being swollen in the middle portion and thence contracting abruptly to a rounded apex and rather gradually towards the basal portion. The nerves are distinct, forking, about 1 mm. apart from one another, running parallel to the lateral margin of the segment and converging to the apex. The petiole is not known. Another specimen in fig. 1B shows an imperfect lamina, more than 4 cm. high and 6 cm. broad, cleft at least into four segments, in which the cleft between the left two segments is very shallow. The nerves are also about 1 mm. apart and the general features of the lamina agree well with the form shown in fig. 4.

Though FONTAINE<sup>(58)</sup> retained *huttoni* as a specific name and delimited the form to lamina which have as a rule four segments, the present writer wishes to include even the laminae which have segments more or less than four in the type of *huttoni*, and to place them in a rank of variety of *G. digitata* as mentioned above.

(57) A. C. SEWARD: Jurassic Flora, Pt. 1. L.c.; Fossil Plants, Vol. IV. L.c.

(58) W. M. FONTAINE: In ward's Status of the Mesozoic Floras of Unites States. L.c., p. 123.

This form thus considered may naturally include the specimens from the Jurassic of Oregon assigned by FONTAINE to *Ginkgo digitata*<sup>(59)</sup> and certain specimens described by the same author as *Ginkgo sibirica*<sup>(60)</sup> from the same district. *Ginkgo huttoni magnifolia* FONTAINE<sup>(61)</sup> from Oregon differs from *Ginkgoites digitata* var. *huttoni* only in having greater width and length of segments, though WALKOM<sup>(62)</sup> and DU TOIT<sup>(63)</sup> wish to retain *magnifolia* as a rank of species. Certain Korean specimens figured by Prof. YABE<sup>(64)</sup> and KAWASAKI<sup>(65)</sup> as *Ginkgo sibirica* and *Ginkgoites sibirica* respectively have broader segments than the usual type of *G. sibirica* and rather resemble the Japanese form. Another closely allied form is *Ginkgo hermelini* NATH. figured by HARTZ<sup>(66)</sup> and CHOW<sup>(67)</sup> from the Liassic beds of eastern Greenland and Scania respectively.

Locality: Tsuchisawa.

#### GINKGOALES?

##### GENUS *Czekanowskia* HEER

##### *Czekanowskia rigida* HEER

Pl. XVIII, Figs. 5, 6.

1876. *Czekanowskia rigida* HEER: Beitræge zur Jura-Flora Ost-sibiriens und des Amurlandes, p. 70, Pl. V, figs. 8-11; Pl. VI, fig. 7; Pl. X, fig. 2a.
1878. *Czekanowskia rigida* HEER: Beitræge zur fossile Flora Sibiriens und Amurlandes, p. 7, 26, Pl. I, figs. 16, 17; Pl. V, figs. 3b, c.

(59) W. M. FONTAINE: Ibid., p. 121, Pl. XXX, figs. 1-7.

(60) W. M. FONTAINE: Ibid., p. 125, Pl. XXXIII, figs. 5, 7.

(61) W. M. FONTAINE: Ibid., p. 124, Pl. XXXI, figs. 4-8; Pl. XXXII, figs. 1, 2.

(62) A. B. WALKOM: Mesozoic Floras of Queensland. Pt. I.—Cont. The Flora of the Ipswich and Walloon Series. Queensland Geol. Surv. Publ. No. 259, 1917, p. 9, Pl. IV, figs. 3, 4.

(63) A. L. DU TOIT: The Fossil Flora of the Upper Karroo Beds. L.c., p. 370, Pl. XX, fig. 1; text-fig. 17.

(64) H. YABE: Notes on Some Mesozoic Plants from Japan, Korea and China. L.c., p. 23, Pl. IV, fig. 10.

(65) S. KAWASAKI: Some Older Mesozoic Plants in Korea. L.c., p. 44, Pl. XXIII, fig. 68.

(66) N. HARTZ: Planteforsteninger fra Cap Stewart i Østgrønland, p. 240, Pl. XIX, fig. 1.

(67) T. C. CHOW: The Lower Liassic Flora of Sofiero and Dompäng in Scania. Arkiv f. Botanik, Bd. 19, No. 4, p. 8, Pl. I, figs. 13-15.

1880. *Czekanowskia rigida* HEER: Nachtrag zur Jura-Flora Sibiriens, p. 19, Pl. VI, figs. 7-12.
1883. *Czekanowskia rigida* SCHENK: Jurassische Pflanzen in Richthofen's China, Vol. IV, p. 251, Pl. L, fig. 7; p. 262, Pl. LIV, fig. 2a.
1884. *Czekanowskia rigida* SCHENK: Die waehrend der Reise des Grafen Béla Széchenyi in China gesammelten fossilen Pflanzen, p. 14, Pl. XV, fig. 13.
1886. *Czekanowskia rigida* NATHORST: Floran vid Bjuf, p. 96, Pl. XX, fig. 6.
1889. *Czekanowskia rigida* ? YOKOYAMA: Jurassic Plants from Kaga, Hida and Echizen, p. 61, Pl. XII, fig. 11; Pl. XIII, fig. 10.
1896. *Czekanowskia rigida* HARTZ: Planteforsteninger fra Cap Stewart i Østgrønland, p. 241, Pl. XVII, figs. 1, 4.
1900. *Czekanowskia rigida* ZEILLER: Element de Paléobotanique, p. 253, fig. 181.
1906. *Czekanowskia rigida* NATHORST: Om nagra ginkgoväxter från kolgrufvorna vid Stabbarp i Skåne. Lunds Univ. Arssk., N. F., Afd. 2, Bd. 2, Nr. 8, p. 11, Pl. I, fig. 8; Pl. II, figs. 1-15.
1907. *Czekanowskia rigida* SEWARD: Jurassic Plants from Caucasia and Turkestan, p. 31, Pl. VIII, figs. 62-63.
1908. *Czekanowskia rigida* ? YABE: Jurassic Plants from Tao-chia-tun, China, p. 10, Pl. II, fig. 1c.
1910. *Czekanowskia rigida* KRYSHTOFOVICH: Jurassic Plants from Ussuriland, p. 14, Pl. III, fig. 6.
1911. *Czekanowskia rigida* THOMAS: Jurassic Flora of Kamenka, p. 76, Pl. IV, fig. 13.
1911. *Czekanowskia rigida* SEWARD: Jurassic Plants from Chinese Dzungaria, p. 48, Pl. IV, fig. 46.
1911. *Czekanowskia rigida* SEWARD and THOMAS: Jurassic Plants from the Balagansk District. Mém. Com. Géol. St.-Pétersbourg, N. S., Vol. LXXIII, p. 20, Pl. II, fig. 14.
1918. *Czekanowskia rigida* ZALESSKY: Flore paléozoïque de la série d'Angara, Atlas, Pl. XXXI, figs. 1, 2, 5.
1919. *Czekanowskia rigida* ANTEVS: Liassische Flora des Hoersandsteins. L.c., p. 47, Pl. V, figs. 28, 29.

- ?1924. *Czekanowskia rigida* CHOW: The Lower Liassic Flora of Sofiero and Dompäng in Scania. Ark. fuer Botanik, Bd. 19, No. 4, p. 12, Pl. II, fig. 9.
1928. *Czekanowskia rigida* YABE and ÔISHI: Jurassic Plants from the Fangtzu Coal-Field, Shantung. L. c., p. 10, Pl. III, figs. 3-5; Pl. IV, fig. 1.
1931. *Czekanowskia rigida* YABE and ÔISHI: Mesozoic Plants from Manchuria. L. c.
1931. *Czekanowskia rigida* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L. c., p. 48.

Long and narrow, needle-like leaves which the writer wishes to assign to this well known Jurassic species occur rather abundantly in the plant-bed of Tsuchisawa. They are generally 1-1.5 mm. broad and more than 10 cm. long frequently branching and occurring always in bundles of at least seven leaves, arising possibly from a common support. Each leaf has three or four parallel nerves, of which the median one is more or less well-defined. The best specimen in the collection is shown in Pl. XVIII, fig. 5; it consists of bundles of long and narrow leaves which branch occasionally as is usually the case in this species. Another specimen in fig. 6 in the same plate shows a portion of two leaves arranged in parallel, of which the left one is branching.

*C. rigida* is one of the wide-spread Jurassic species; it occurs also in the Liassic of Sweden and the Rhaetic of East Greenland. An allied form is *C. hartzi* HARRIS<sup>(68)</sup> described by HARRIS<sup>(69)</sup> from the Rhaetic rock of Scoresby Sound, East Greenland, but the leaves of *C. hartzi* are said to be only 1 mm. in breadth at the leaf-base, contracting above gradually to the acute tip. A short shoot which HARRIS<sup>(70)</sup> described as *Phoenicopsis tenuis* in his same paper bears too narrow leaves for referring it to the genus *Phoenicopsis* and the figured stoma resembles very much the usual type of stomata seen in the *Czekanowskia*-leaves; the apical branching of the leaves shown by this author is very rarely met with in *Phoenicopsis*.

Besides Tsuchisawa, this species occurs also at Shimodera and south of Kuruma.

Localities: Tsuchisawa; Shimodera; and south of Kuruma.

(68) T. M. HARRIS: The Rhaetic Flora of Scoresby Sound, East. Greenland. Medd. om Grønland, Bd. LXVIII, 1926, p. 104. Pl. IV, figs. 1-3; text-figs. 25 E-G.

(69) T. M. HARRIS: Ibid., p. 106, Pl. III, fig. 6, 7; Pl. IV, figs. 5, 6; Pl. X, fig. 5; text-figs. 26 A-E.

(70) T. M. HARRIS: Ibid., p. 107, fig. 26B.

GENUS *Phoenicopsis* HEER*Phoenicopsis* ? sp.

Pl. XVII, Fig. 5; Pl. XVIII, 7.

1918. *Phoenicopsis angustifolia* HEER forma *media* KRYSHTOFOVICH :  
in YAGI's On the Occurrence of Jurassic Plants from Kita-  
Otari. L.c., p. 79.
1931. *Phoenicopsis* ? sp. ÔISHI: On the Mesozoic Plant-bearing  
Beds of Kita-Otari. L.c., p. 48.

We have a number of specimens of linear leaves derived from Tsuchisawa, but they are all fragmental and only provisionally assigned to the genus *Phoenicopsis*. A specimen in Pl. XVII, fig. 5 is more than 9.3 cm. long and 4 mm. broad at one end and narrows very gradually towards the other. There are eight parallel nerves but it seems to have no interstitials. A small specimen in Pl. XVIII, fig. 7 shows some imperfect leaves arranged in parallel suggesting their arising from a common support, though there is no indication of it. *Phoenicopsis angustifolia* HR. form *media* KRASSER determined by KRYSHTOFOVICH<sup>(71)</sup> on a specimen derived from Tsuchisawa, which is now preserved in the Nagano Girls' High School in Nagano, is also a specimen of imperfect leaves which are more than 9 cm. long and 4-5 mm. broad, bearing 7-10 parallel nerves, and there is no reasonable ground for referring it to KRASSER's form.

Locality: Tsuchisawa.

## CONIFERALES

GENUS *Pityophyllum* NATHORST*Pityophyllum longifolium* (NATHORST)

Pl. XVII, Fig. 7.

1876. *Cycadites* ? *longifolium* NATHORST: Bidrag till Sveriges  
Fossila Flora. I. L.c., p. 47, Pl. XII, figs. 1-3.
1878. *Taxites longifloius* NATHORST: Bidrag till Sveriges Fossila  
Flora. II. Floran vid Hoeganaes och Helsingborg. L.c., p.  
50, Pl. VI, figs. 6, 7.

(71) A. KRYSHTOFOVICH: In Yagi's On the Occurrence of Jurasssic Plants from  
Kita-Otari. L.c.

1894. *Taxites longifolius* BARTHOLIN: Nagle i den bornholmske Juraformation forekommende Planteforsteninger. II. Bot. Tidsskrift, Bd. 19, Heft, 1, p. 99, Pl. IV, figs. 5, 6.
1903. *Pityophyllum longifolium* MOELLER: Bidrag till Bornholms Fossila Flora. Gymnospermer. Kgl. Svensk. Vet.-Akad. Handl., Bd. 36, No. 6, p. 40, Pl. VI, figs. 9-11.
1931. *Pityophyllum longifolium* ÔISHI: On the Mesozoic Plant-bearing Bed of Kita-Otari. L.c., p. 48.

Some fragmental, long and narrow leaves which are somewhat broader than *Czekanowskia rigida* above described are provisionally assigned to the species here referred. A specimen in Pl. XVII, fig. 7 is from Shimodera and represents a lower portion of a leaf, more than 4.5 cm. long, 4 mm. broad in its upper broken end and narrowed very gradually towards the base. The midnerve is prominent and elevated as a relief. We have some other specimens of the same form from Tsuchisawa and south of Kuruma, but they are all fragmentary and none of them show the whole length of the leaves.

This species was first described by NATHORST<sup>(72)</sup> from the Rhaetic beds of Sweden as *Cycadites ? longifolius* and afterwards as *Taxites longifolius*,<sup>(73)</sup> and later MOELLER,<sup>(74)</sup> in his memoir of the Liassic flora of Bornholm, adopted NATHORST's generic name *Pityophyllum* for detached long and narrow coniferous leaves. An allied form is a Middle Jurassic having needle-like leaves known as *Pityophyllum nordenskjoldi* HEER; in this species, however, the leaves are nearly parallel-sided and characterised, according to HEER, by having a rounded base.

Localities: Tsuchisawa; Shimodera; and south of Kuruma.

#### GENUS *Elatocladus* HALLE

##### *Elatocladus* sp.

Pl. XVIII, Fig. 8.

1927. *Pagiophyllum* sp. KOBAYASHI: On the Tetori Series. L.c., p. 64.
1931. *Elatocladus* sp. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

(72) A. G. NATHORST: Bidrag till Sveriges Fossila Flora. I. L.c., p. 47.

(73) A. G. NATHORST: Ibid., II. L.c., p. 50.

(74) H. MOELLER: Bidrag till Bornholms Fossila Flora. Gymnospermer. L.c., p. 40.



Pl. XVIII, fig. 8 shows a small portion of a coniferous sterile shoot found on the same slab of rock on which *Dictyophyllum* sp. here described is also impressed. It consists of a thick stem, more than 4.5 cm. long and 2 mm. broad, on which the leaves are arranged spirally. The leaves are falcate, 6 mm. long, 0.5 mm. broad at the broadest basal part, thence widening gradually to 1 mm. and then contracting rather abruptly to the obtuse apex.

It is notable that this specimen closely resembles the Wealden or Upper Jurassic species *Elatocladus curvifolius* (DUNKER) figured by NATHORST<sup>(75)</sup> from the Upper Jurassic of Spitzbergen, but the resemblance may possibly be superficial. The specific name is reserved for a while until better specimens are available to us.

Locality: A block at the upper stream of the River Daira.

#### GENUS *Podozamites* BRAUN

##### *Podozamites lanceolatus* (L. and H.)

Pl. XVII, Fig. 6.

1918. *Podozamites lanceolatus* KRYSHTOFOVICH: in YAGI's On the Occurrence of Jurassic Plants from Kitari-Otari. L.c.
1931. *Podozamites lanceolatus* ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.

A shoot in Pl. XVII, fig. 6, collected by Mr. KOBAYASHI from Tsuchisawa, reaches a length of more than 4 cm. with a slender axis to which the leaves are attached alternately. The leaves, making an angle of about 45° with the axis, are generally 5.5 cm. long and 8-9 mm. at their maximum width, which is at a third of the distance from the base to the apex, thence narrow gradually to the bluntly pointed apex and rather abruptly to the narrow base. The nerves are parallel, and there are about 17-19 of them counted in the middle portion of the leaf.

It is often very difficult or almost impossible to distinguish specifically *P. lanceolatus* on the basis of leaf-form only from a Rhaetic form known under the name *P. distans* (PRESL). HARRIS<sup>(76)</sup> who investigated

(75) A. G. NATHORST: Zur mesozoischen Flora Spitzbergens. Kgl. Svensk. Vet.-Akad. Handl., Bd. 30, No. 1, 1897, p. 35, Pl. I, figs. 25-27; Pl. II, figs. 3-5; p. 58, Pl. IV, figs. 1-18; Pl. VI, figs. 6-8.

(76) T. M. HARRIS: The Rhaetic Flora of Scoresby Sound, East Greenland. L.c., p. 110.

the epiderma cells of *P. distans* derived from the Rhaetic beds of East Greenland stated that the cells on the nerves are elongated, while those between the nerves are polygonal and with sometimes a very distinct papilla, the stomata occurring on the lower surface. However, as it is impossible at present to compare the specimen in its cuticle with *P. distans*, the writer wishes here to apply the name *P. lanceolatus* on this specimen. HARRIS<sup>(77)</sup> noted that the leaves of *P. distans* are broadest at the middle portion while those of *P. lanceolatus* are below the middle. In this point the present specimen belongs to the former type. A certain specimen of *P. distans* described by ZEILLER<sup>(78)</sup> from the Rhaetic of Tonkin is a form closely allied to our specimen.

Besides the figured specimen we have a number of detached leaves with similar shape from Shimodera and south of Kuruma.

Localities: Tsuchisawa; Shimodera; and south of Kuruma.

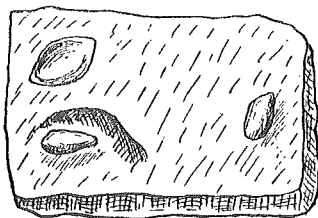
## SEED

### GENUS *Carpolithus* LINNAEUS

#### *Carpolithus* sp.

Text-fig. 3.

1931. *Carpolithus* sp. ÔISHI: On the Mesozoic Plant-bearing Beds of Kita-Otari. L.c., p. 48.



Text-fig. 3. *Carpolithus*  
sp. × 1. Tsuchisawa.

Text-fig. 3 shows a slab of rock with three small ovoid seeds, which, excepting the lower left one which is a little larger than the others, are generally 6-7 mm. long and 3-3.5 mm. broad and terminate in obtuse or rounded ends. As there is no sufficient ground for referring the present seeds to any special group or genus, the convenient term *Carpolithus* is applied to the present specimen.

Locality: Tsuchisawa.

(77) T. M. HARRIS: Ibid., p. 118.

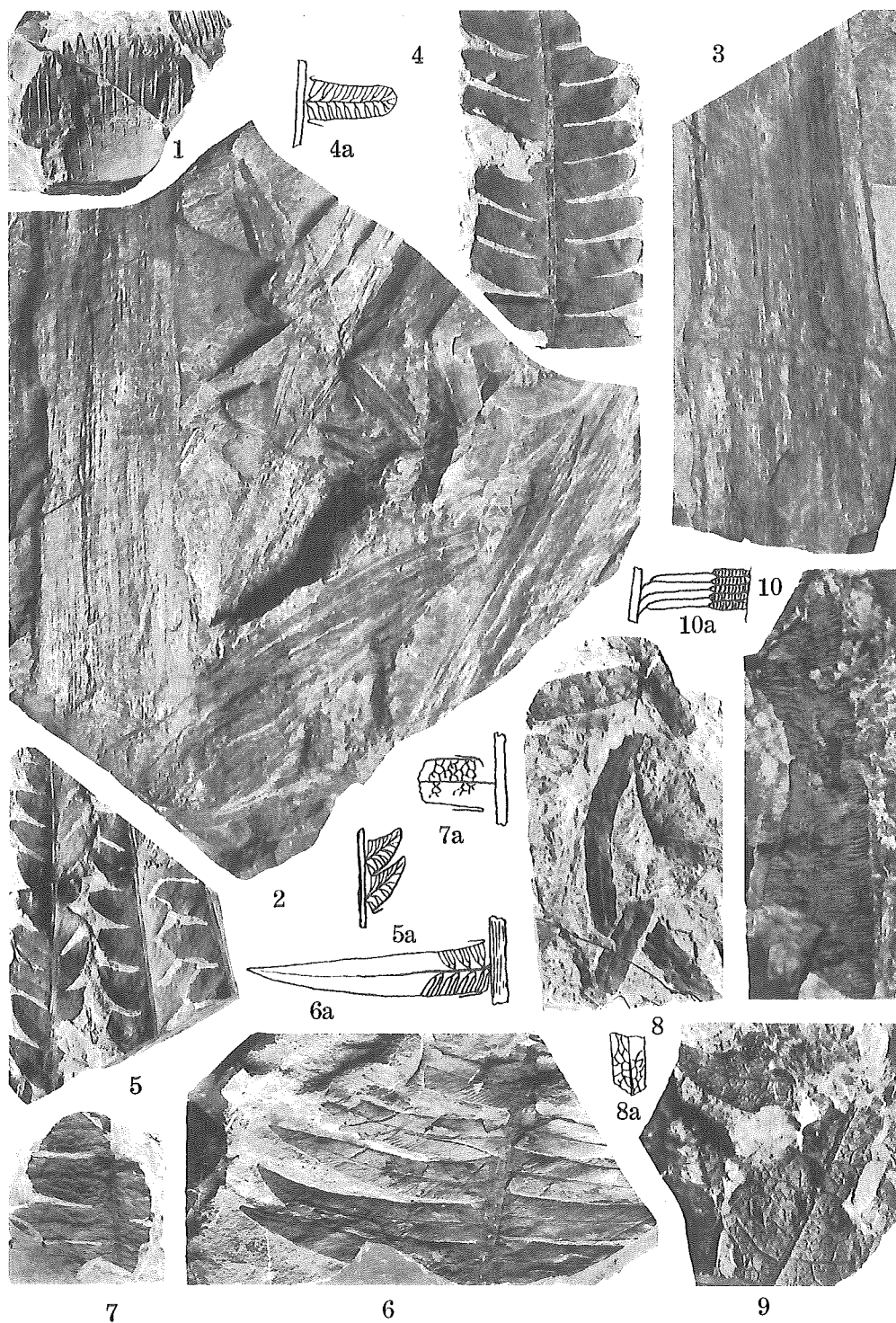
(78) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin. L.c., p. 159, Pl. XLII, fig. 1.

**Plate XVI (I)**

PLATE XVI (1).

(The figures are natural size unless otherwise stated)

- Fig. 1. *Equisetites* sp. Tsuchisawa.
- Figs. 2, 3. *Neocalamites hoerensis* (SCHIMPER). Tsuchisawa.
- Figs. 4, 4a. *Cladophlebis nebbensis* (BRONGN.). Tsuchisawa.
- Figs. 5, 5a. *Cladophlebis denticulata* (BRONGN.). Tsuchisawa.
- Figs. 6, 6a. *Cladophlebis raciborskii* ZEILLER. Tsuchisawa.
- Figs. 7, 7a, 8, 8a. *Thaumatopteris schenki* NATHORST. South of Kuruma.
- Fig. 9. *Dictyophyllum* sp. R. Dairagawa.
- Figs. 10, 10a. *Marattiopsis muensteri* (GOEPP.). 10a  $\times$  2. Tsuchisawa.



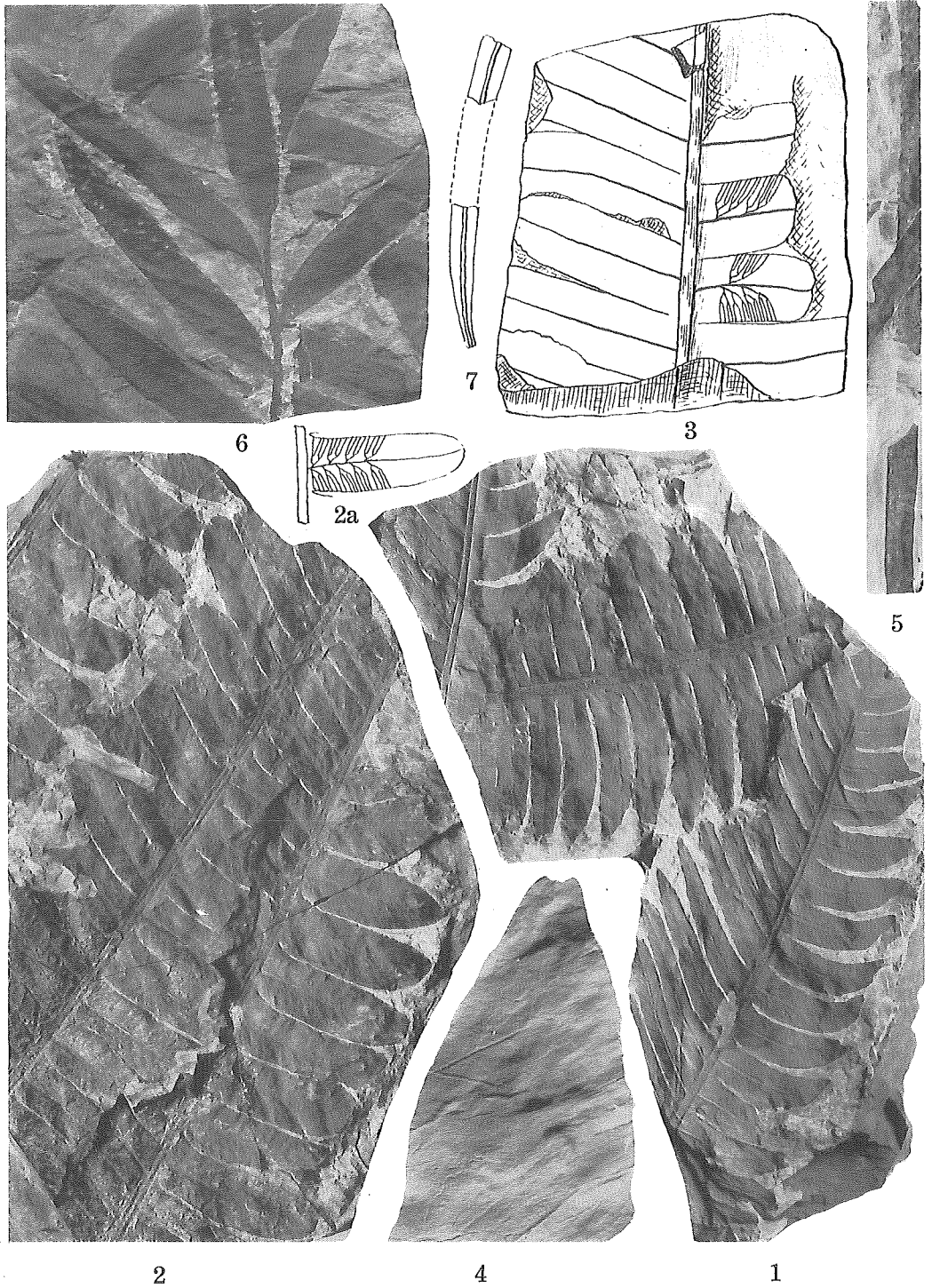
Mashiko photo. & Ôishi del.

**Plate XVII (II)**

PLATE XVII (II).

(The figures are natural size)

- Fig. 1. *Cladophlebis raciborskii* ZEILLER. Tsuchisawa.  
Figs. 2, 2a. *Cladophlebis haiburnensis* (L. and H.). Tsuchisawa.  
Fig. 3. *Cladophlebis* sp. a. Tsuchisawa.  
Fig. 4. *Taeniopteris* sp. Tsuchisawa.  
Fig. 5. *Phoenicopsis* ? sp. Tsuchisawa.  
Fig. 6. *Podozamites lanceolatus* (L. and H.). Tsuchisawa.  
Fig. 7. *Pityophyllum longifolium* (NATHORST). Shimodera.



Mashiko photo. & Ôishi del.

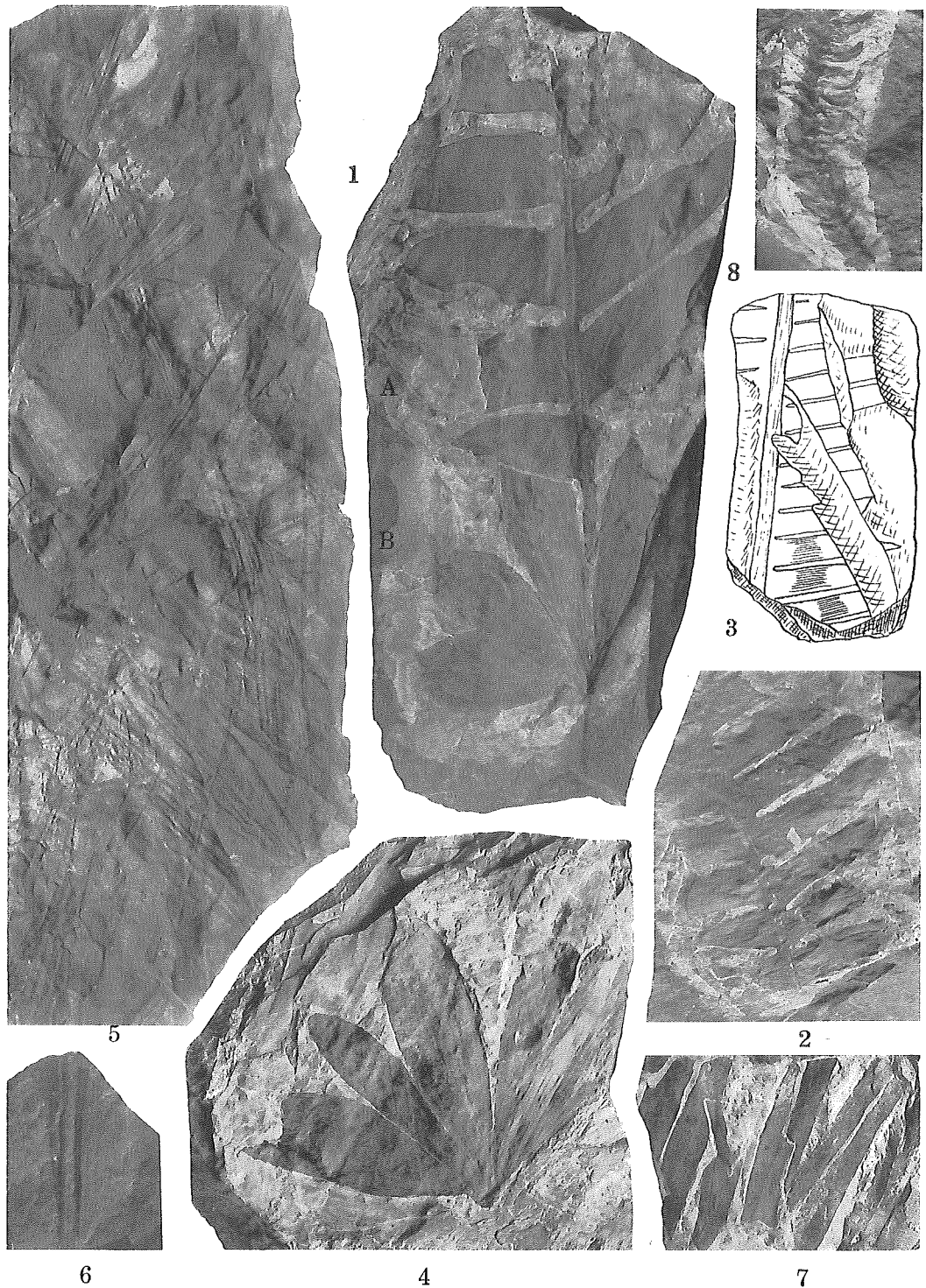


Plate XVIII (III)

PLATE XVIII (III).

(The figures are natural size)

- Figs. 1A, 2. *Pterophyllum propinquum* GOEPPERT. Tsuchisawa.  
Fig. 3. *Pterophyllum jaegeri* BRONGN. Tsuchisawa.  
Figs. 1B, 4. *Ginkgoites digitata* (BRONGN.) var. *huttoni* SEWARD.  
Tsuchisawa.  
Figs. 5, 6. *Czekanowskia rigida* HEER. Tsuchisawa.  
Fig. 7. *Phoenicopsis*? sp. Tsuchisawa.  
Fig. 8. *Elatocladus* sp. R. Dairagawa.



Mashiko photo. & Ôishi del.