NOTES ON SOME FOSSIL PLANTS FROM TUNG-NING, PROV. PINCHIANG, MANCHOUKUO

By

Saburô ÔISHI

With 3 Plates and 8 Text-figures

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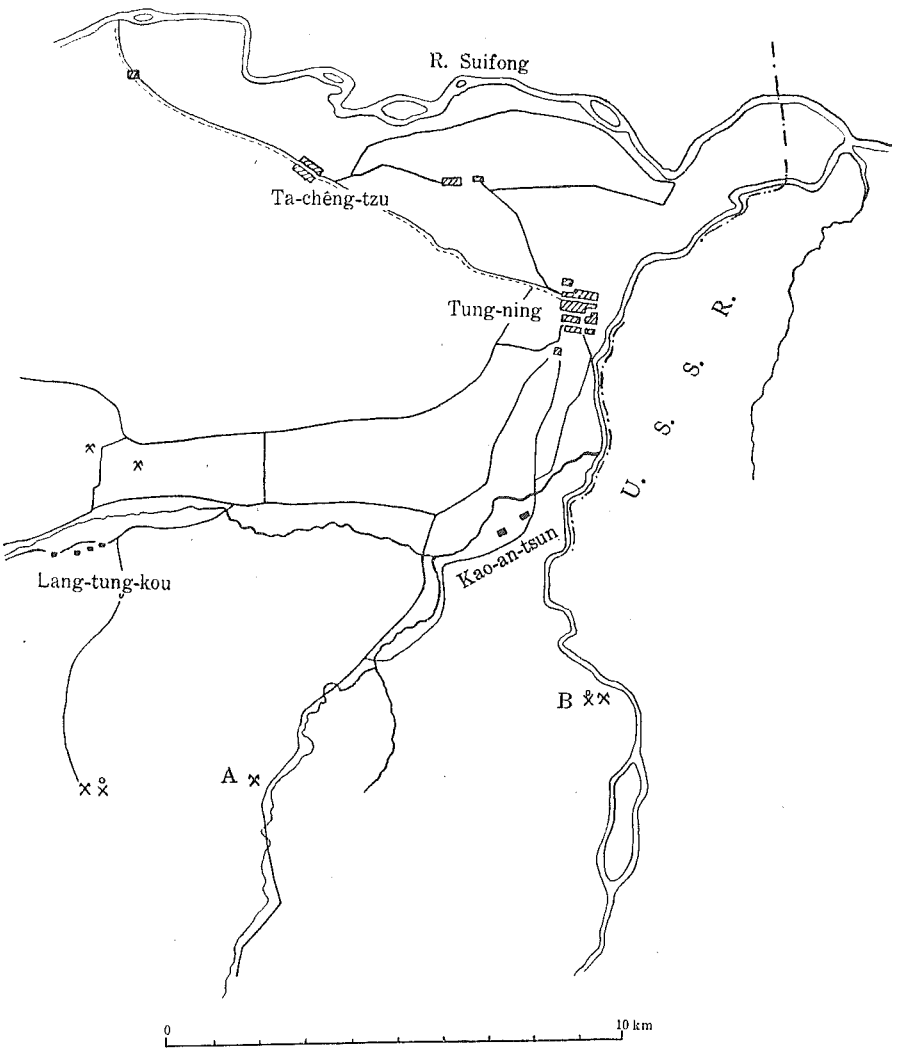
The specimens described in the following pages were collected by Professor KUNIO UWATOKO in 1934 from the coal-bearing series developed near Tung-ning[1], Prov. Pinchiang[2], in the upper course of the Suifong river[3], a small village close to the Russo-Manchurian boundary. The approximate positions of the localities are shown in text-fig. 1. Professor UWATOKO has kindly given the information that the following is the order of succession of the formations near the localities (in descending order):

8.	River gravels, sands and clays	Quaternary
	~~ unconformity ~~~~~	
7.	Terrace gravels, sands and clays	
	~~ unconformity ~~~~~	
6.	Olivine-basalt	
	~~ unconformity ~~~~~	
5.	Soft sands	Lower Cretaceous
	~~ unconformity ~~~~~	
4.	Hard sandstones with layers of arkose sandstones and conglometes	Upper Jurassic
3.	Alternation of sandstones and shales intercalating coal seams and oil-shales	
2.	Basal conglomerate	
	~~ unconformity ~~~~~	
1.	Metamorphic rocks	Permo-Carboniferous ?

(1) 東寧 (2) 濱江省 (3) 綏芬河



Text-fig. 1. Sketch-map of near Tung-ning, showing the approximate positions of the localities (⛏) of fossil plants described in this paper (⛏, coal mine).

The fossil plants were found in the greenish fine sandstone above the coal seams in 3. Prof. UWATOKO assigned the coal-bearing strata to the upper Jurassic age, correlating them to the Jurassic coal-bearing formation developed in south-eastern Manchuria.

The fossil plants described in this paper are listed below:

Species \ Localities	A	B
1. *Cladophlebis* sp. indet.	×	
2. *Sphenopteris* (*Onychiopsis*) *elongata* (GEYLER)		×
3. *Nilssonia pecten* sp. nov.		×
4. *Cycadites manchurensis* sp. nov.	×	
5. *Cycadolepis Toyamae* sp. nov.		×
6. Cfr. *Pterophyllum angustum* (BRAUN)	×	×
7. *Pterophyllum* sp.		×
8. *Taeniopteris Uwatokoi* sp. nov.	×	
9. *Pityospermum* sp.		×
10. *Pityophyllum Nordenskijöldi* (HEER)		×
11. *Pityophyllum longifolium* (NATHORST)	×	
12. *Pityophyllum* cfr. *Lindstroemi* NATHORST		×
13. *Podozamites lanceolatus* (L. and H.)	×	
14. *Podozamites* sp. nov.		×

The total number of species discriminated are fourteen, of which four are specifically identical with, and two are comparable to, previously known species, five are specifically new, while the remaining three are specifically indeterminable. It is noteworthy that 30% of the total number of species is new. Among the new species, *Nilssonia pecten* is closely allied to *N. rajmahalensis* OLDH. from the Rajmahal Series in India; *Cycadolepis Toyamae* is a type of scale-leaf hardly distinct from *Eury-Cycadolepis* figured by SEWARD from the Wealden rock of England; *Taeniopteris Uwatokoi* resembles in its leaf-form, though distinct in the epidermal structure, a characteristic Jurassic species, *T. vittata* BRONGN., figured by several authors from various parts of the world. As a whole, these new species have their allied forms in the Jurassic or Lower Cretaceous flora.

Among the species referable to the already known species, *Sphenopteris* (*Onychiopsis*) *elongata* (GEYLER) is one of the most characteristic plants of the Upper Jurassic or Lower Cretaceous flora of Japan and Korea, and it forms also a dominant element in the Nikanian flora (Upper Jurassic) of eastern Siberia and Amurland. Other species, such as *Pityophyllum Nordenskijöldi* (HEER), *P. longifolium* NATHORST and *Podozamites lanceolatus* (L. and H.) show the general persistence of the type through the whole Mesozoic rocks of the world, and their existence in the present florula offers

little data for the determination of the more restricted geological age of the plant-bed, though they are generally assembled in the Jurassic rocks.

Cfr. *Pterophyllum angustum* (BRAUN) is another species worthy of note. Though it is represented by a number of specimens, no one of them is hardly distinguishable, so far as the superficial characters are concerned, from *P. angustum* figured by several authors from Asia and Europe, differing only in the absence of transverse wrinkles on the upper surface of the rachis.

As above mentioned briefly, the specific assemblage of both younger and older Mesozoic elements renders it very difficult to assign such a comparatively small collection of fossil plants to a precise horizon. But the presence of *Sphenopteris* (*Onychiopsis*) *elongata* and the similarity of rock succession of the coal-bearing formation compared with that of the other parts of south-eastern Manchuria make it appropriate to consider the present florula to belong to the Upper Jurassic or to the Nikanian Series, though the occurrence of *Cycadolepis Toyamae* resembling *Eury-Cycadolepis* from the Wealden of Sussex seems to point somewhat upper horizon of the plant-bed[1].

DESCRIPTION OF SPECIMENS

1. *Cladophlebis* sp. indet.

Pl. VI, Fig. 1.

Pl. VI, fig. 1 shows an imperfect specimen of an apical portion of a pinna consisting of a delicate pinna-rachis to which pinnules triangular in shape are attached at an angle of about 45°. The apex

(1) In the Russian part of the Suifong river and close to the Russo-Manchurian boundary, there developes coal-bearing formation, that is so-called Suifong coal-field; the formation has long been believed by the Russian geologists to be the Upper Jurassic, but the later discovery of some fossil plants of Wealden type led KRYSHTOFOVICH to assign the formation to the Lower Cretaceous. KRYSHTOFOVICH discriminated the following species: *Marchantites Yabei* KRYSHT., *Equisetites Yokoyamae* SEW., *Onychiopsis elongata* (GEYL.), *Adiantites denticulata* KRYSHT., *Ruffordia Goepperti* (DKR.), *Cladophlebis suifunensis* KRYSHT., *C. denticulata* (BRONGN.), *C. Browniana* (DKR.), *Taeniopteris rhytidorhachis* KRYSHT., *Sphenopteris suifunensis* KRYSHT., *Ctenis Yokoyamai* KRYSHT., *C. latiloba* KRYSHT., *Nilssonia Schmidti* HR., *N. acutiloba* HR., *Podozamites lanceolatus* (L. and H.), *Elatocladus manchurica* (YOK.), *Nageiopsis* cfr. *anglica* SEW., *Cyparissidium gracile* HR., *Elatocladus curvifolia* DKR. (W. A. OBRUTSCHEW: Geologie von Sibirien. Fortschr. Geol. Palaeont., Hf. 15, 1926, p. 297). The stratigraphical relation between the Tung-ning and Suifong coal-bearing formations is not precisely known to us. However, Prof. UWATOKO is of the opinion that the coal-bearing formation of Tung-ning is equivalent to that which, in south-eastern Manchuria, occupies lower horizon than the *Lycoptera*-bed of the Lower Cretaceous age.

of the pinnule is acutely pointed and the margin is shallowly toothed at the apical region. The midnerve is distinct, but the secondary nerves are entirely obliterated.

The specimen is of the type of *Cladophlebis denticulata* (BRONGN.); without the secondary nerves, however, it is impossible to determine it specifically.

Locality: A.

2. *Sphenopteris (Onychiopsis) elongata* (GEYLER)

Pl. VI, Fig. 2.

1877. *Thyrsopteris elongata* GEYLER: Ueber Fossile Pflanzen aus der Juraformation Japans. Palaeontogr., Bd. XXIV, p. 224, Pl. XXX, fig. 5; Pl. XXXI, figs. 4–5.
1889. *Onychiopsis elongata* YOKOYAMA: Jurassic Plants from Kaga, Hida, and Echizen. Journ. Coll. Sci., Tôkyô Imp. Univ., Vol. III, Art. 1, p. 27, Pl. II, figs. 1–3; Pl. III, figs. 6d; Pl. XII, figs. 9–10.
1905. *Onychiopsis elongata* YABE: Mesozoic Plants from Korea. Ibid., Vol. XX, Art. 8, p. 22, Pl. I, figs. 9–14; Pl. III, fig. 15.
1916. *Onychiopsis elongata* KRYSHTOFOVICH: Material for the Jurassic Flora of Ussuriland. Trav. Mus. Géol. Min., St.-Pétersbourg, Vol. II, p. 100, Pl. VII, fig. 7; Pl. XIII, figs. 1–7.

The history of this well-known younger Mesozoic fern has been given by several authors, and needs not to be described here again. The discovery of fertile specimens by YOKOYAMA led him to the substitution of a new generic designation *Onychiopsis* for this fern which had been called under the name *Thyrsopteris elongata*. But as there is no trace of sori or sporangia in the present material, the present writer used the form-genus *Sphenopteris*.

Though the probable specific identity of this Asiatic species and the European species, *O. Mantelli* (BRONGN.), has been mentioned by certain authors, the present writer wishes to hold them specifically separated on the ground mentioned in his previous paper[1].

Locality: B.

3. *Nilssonia pecten* sp. nov.

Pl. VII; Pl. VIII, fig. 2; Text-fig. 2.

Frond linear, more than 32 cm. long, 4–8 cm. broad, broadly V-shaped in cross section and contracted abruptly to both ends. Rachis

(1) S. ÔISHI: Fossil Plants from Japan and Korea. Sci. Rep., Tôhoku Imp. Univ., 2nd Ser. (Geol.), Vol. XIV, No. 2A, 1931, p. 111 (5).

stout and strong, being more than 6 mm. across measured on the impression of a large frond and more or less expanded at the base. Lateral lamina covers the uppre side of the rachis leaving a narrow space ±0.5 mm. along the median line of the rachis, transversely folded, each fold corresponding to a single nerve; outer margins generally deeply cut nearly right up to the rachis into segments apically truncated or acuminated. Nerves thin and delicate, at wide angle or nearly perpendicular to the rachis, straight or slightly curved upwards, and approximately 1 mm. apart.

Text-fig. 2. *Nilssonia pecten* sp. nov. A, a transverse section of a frond. ×1. B, a hypothetical longitudinal section of a lamina showing the relation between nerves and folds; *n*, nerve-courses.

The largest frond in the collection is shown in Pl. VII. It is an impression of the upper side, and incomplete at both ends. Only a single specimen shows the base of the rachis (Pl. VIII, fig. 2; seen from the back side); in this specimen, the rachis is expanded at the proximal end, and ends in a concave base, with which it may have been attached to an axis; the lamina is only 3 cm. broad possibly owing to its being the proximal portion of the frond, and strongly fimbriated into narrow segments giving an appearance of linear segments with a single midnerve as in *Cycadites*.

Unfortunately, it is not possible to know the difference of the relief, if any, between the upper and the lower sides of the lamina, because of the absence of any carbonized leaf-substance which shows the real relief; but the following may be said at least as to one side of the lamina that it forms a more prominent ridge between any two adjacent nerves than the nerves themselves do (Text-fig. 2, B).

The present species is closely allied to *N. rajmahalensis* (OLDH.)[1] from the Rajmahal Series of India, and the two seem to be almost specifically identical. But as the relation between the nerves and the folds of the lamina and the density of the nerves in the Indian species are not precisely shown to us even in the recent

(1) T. OLDHAM and J. MORRIS: Fossil Flora of the Rajmahal Series in the Rajmahal Hills. Pal. Indica, Ser. II, Vol. I, Pt. 1, 1863, p. 15, Pl. II, figs. 1, 2; Pl. VIII, fig. 1.

paper by SEWARD and SAHNI[1] who examined the type-specimen, the present writer has provisionally kept the two specimens specifically separate. The difference between the Indian and the Manchurian rocks in the geological age of the plant bed is another reason for the specific separation. Another allied species is *N. brevis* BRONGN.,[2] which, however, has irregular folding of the lamina.

Locality: B, abundant.

4. *Cycadites manchurensis* sp. nov.

Pl. VI, Figs. 4, 4a, 4b, 5, 6; Text-fig. 3.

An imperfect specimen in Pl. I, fig. 4 seems to represent a new form belonging to the genus *Cycadites*. The frond is pinnate, linear, more than 8 cm. long and 6.5 cm. broad. The general outline of the frond is unknown. The rachis also is not preserved. The pinnae are linear, 2 mm. broad, entire, straight, obtusely rounded at the apex, slightly expanded at the base and at an angle of approximately 80° to the rachis. The nerves are not distinct. But when seen from the upper side, there is a broad central ridge 1 mm. broad, with corresponding median furrow on the lower.

Cuticle obtained from the apical portion of a pinna:—The cuticle of both sides of the lamina is nearly the same, of moderate thickness, and much cutinised. The upper is badly preserved, but shows as a whole rectangular cells with straight wall. No stomata and papillae present at least in the single fragment of upper cuticle examined. The lower cuticle shows rectangular or somewhat polygonal cells. The cell-walls are also straight and sometimes show irregular sinuous thickenings. The stomata are slightly sunken below the general surface of the epidermis and irregularly orientated; the subsidiary cells are usually more highly cutinised than the rest of the lower epidermis and frequently arch over the guard-cells; the thickening of the guard-cells is 36 μ long. Each stoma has in its pole a small cell, a polar cell. Some circular, small, thickly cutinised cells are found irregularly scattered over the cuticle, each bearing a thin place or hole in the middle; they possibly represent hair-bases.

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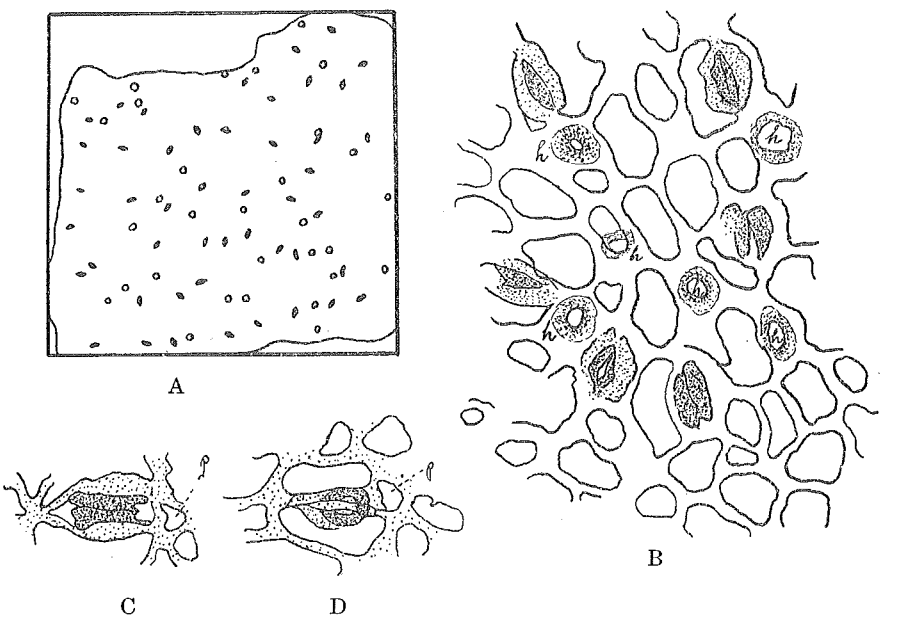
(1) A. C. SEWARD and B. SAHNI: Indian Gondwana Plants: A Revision. Pal. Indica, N. S., Vol. VII, Mem. No. 1, 1920, p. 32, Pl. III, fig. 34; Pl. V, fig. 42.

(2) A. G. NATHORST: Ueber die Gattung *Nilssonia*. Kgl. Svensk. Vet.-Akad. Handl., Bd. 43, No. 12, p. 12, Pl. I, figs. 2–35; Pls. II, III, IV; Pl. V, figs. 1–5, 8; Pl. VI, figs. 14–22; Pl. VII, figs. 1–15.



Text-fig. 3. Cycadites manchurensis sp. nov. A, distribution and orientation of stomata (black ovals) and hair-bases (circles) on a fragment of the lower cuticle. The square is 1 sq. mm. B, a part of A showing six stomata and the hair-bases (h) of the same number, ×180. C and D, stomata from the cuticle in A. The guard-cells are exposed. Each stoma has a polar cell (p), ×180.

In the figured specimen (Pl. VI, fig. 4), 21 pinnae are seen arranged in parallel, and some of which are attached to the rachis (R) at the lower portion of the specimen. The breadth and the surface features of the rachis are unfortunately not observable. There are no well-defined nerves on any of the pinnae except a broad central ridge which is one of the characteristic features of this species (Pl. VI, fig. 4b).

The present specimen agrees essentially in its external features with fronds which had been included in the genus *Cycadites*. However, the investigation of epidermal structures of some *Cycadites*-fronds by NATHORST[1], led him to the institution of a new genus *Pseudocycas*. According to this author, the epidermal cell-walls of *Pseudocycas* has sinuous walls, and the structure of the stomata agrees with the Bennettitalean type.

(1) A. G. NATHORST: *Pseudocycas*, eine neue Cycadophytengattung aus den cenomanen Kreideablagerungen Groenlands. Palaeobot. Mitt., 1, 1907.

It is of utmost interest, however, that the epidermal cell-walls of the present specimen are straight, though sometimes they appear to be sinuous owing to the irregular thickening of the cuticle, and not sinuous as in *Pseudocycas*. This essential character excludes the present specimen from NATHORST's genus. In the application of the genus *Cycadites*, the present writer followed Miss HOLDEN.[1] But, if this generic name should be retained only for the fronds whose epidermal structures are as yet unknown, then an erection of a new genus is desirable for such fronds as ours which are habitually allied to *Pseudocycas* but whose epidermis is of Cycadean type. According to FLORIN[2], *Cycadites Blomqvisti* ANTEVS[3] from the Hoersandstone is said to have straight epidermal cell-walls.

Locality: A.

5. *Cycadolepis Toyamae* sp. nov.

Pl. VI, Figs. 3, 3a, 3b; Text-fig. 4.

Pl. VI, fig. 3 shows a convex scale-leaf or bract more or less orbicular in outline, attaining a length of approximately 6.5 cm. and a breadth of an almost equal dimension, and with a base about 2.5 cm. in breadth with which it may have been attached to the supporting organ. Over the surface of the outer (convex) side of the lamina is a prominent raised reticulum with polygonal meshes ±1 mm. long in their longer axes varying in direction; while in the inner (concave) side, it is traversed by a series of narrow ridges (nerves?) spreading radially, or nearly in parallel, from the base. They vanish at a short distance from the base.

In the collection we have another specimen of scale-leaf which is shown in text-fig. 4. It is smaller in shape than the former, though otherwise indistinguishable.

It is highly interesting to note that the scale here described occurred in close association with the crowded fronds of *Nilssonia pecten* sp. nov. almost exclusive of other species of fossil plants; hence, though there can be seen no organic connection between the

(1) R. HOLDEN: On the Relation between *Cycadites* and *Pseudocycas*. New Phyt., Vol. XIII, No. 10.

(2) R. FLORIN: Studien ueber die Cycadales des Mesozoikums. Kgl. Svensk. Vet.-Akad. Handl., T. S., Bd. XII, No. 5, 1933, p. 119.

(3) E. ANTEVS: Die liassische Flora des Hoersandsteins. Kgl. Svensk. Vet.-Akad. Handl., Bd. LIX, No. 8, 1919, p. 25, Pl. III, figs. 3, 3a, 4.

Text-fig. 4. *Cycadolepis Toyamae* sp. nov., in association with *Nilssonia pecten* sp. nov. ×1. Loc. B. (Reg. No. 6309).

fronds and the scales, it is at least quite probable that the latter may have belonged to *N. pecten*.

There is a small number of Mesozoic scale-leaves known under the generic name *Cycadolepis;* of these one from the Wealden bed of Sussex figured by SEWARD as *Eury-Cycadolepis*[1] seems to be almost identical in external features with the present specimens.

The specific name has been given in honor of the late SHIRÔ TOYAMA, who devoted himself to geological research in Manchuria.

Locality: B.

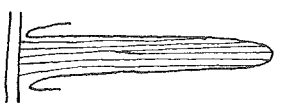
6. Cfr. *Pterophyllum angustum* (BRAUN)

Pl. VIII, Fig. 1 A; Text-fig. 5.

There are a good number of specimens of the Cycadophytan fronds which are above referred to cfr. *Pterophyllum angustum* (BRAUN); a slab of rock covered with some fronds is shown in Pl. VIII, fig. 1. The frond is slender, obovate, more than 7 cm. long, 3–5 cm. broad, and broadest near the distal end, thence contracting rapidly to the apex and gradually towards the base. The rachis is thin and delicate, 1–1.5 mm. broad on the back side and slightly narrower than this on

(1) A. C. SEWARD: A Contribution to our Knowledge of Wealden Floras, with Special Reference to a Collection of Plants from Sussex. Q. J. G. S., London, Vol. 69, 1913, p. 85, Pl. XII, fig. 4a.

the upper; no transverse wrinkles. The pinnae are narrow and linear, generally 1.5–2.5 mm. broad or rarely reaching 3 mm., straight or slightly falcate, slightly expanded at the base, thus leaving a narrow sinus between any two adjacent ones, tapering gradually towards the acute or obtusely pointed apex, and attached to the lateral sides of the rachis. The nerves are in most cases simple and very rarely forked close to the base or at some distance from their origin, parallel, approximately 4–6 in number in the narrow pinnae and 7–8 in the broader ones, and lightly decurrent at the base.



Text-fig. 5. Cfr. *Pterophyllum angustum* (BRAUN). A pinna, showing the nerves. ×2.

P. angustum was first described by BRAUN[1] in 1843 under the name *Ctenis angusta;* while its generic designation was later transferred to *Pterophyllum* by GOTHAN[2], who included with it some fronds assigned by several authors to *P. Braunianum* GOEPPERT.

So far as the superficial characters of the fronds are concerned, it is very difficult to find differences between the Manchurian specimens and BRAUN's species described from the various countries. After careful comparison of our specimens with the illustrations of BRAUN's species given by several authors, however, the present writer found that the rachis in *P. angustum* had in many cases well-marked transverse wrinkles, as, for instance, the specimens shown by SCHENK[3] and ANTEVS[4]; moreover, *P. angustum* is usually of a lower Mesozoic element, being hitherto reported from the Rhaetic and the Liassic rocks of the world, in spite of the fact that it is from an Upper Jurassic plant-bed that the present material was obtained. All these facts led the present writer to assign our specimens to cfr. *P. angustum.* Externally, the Manchurian specimens closely resemble *P. angustum* as figured by GOTHAN[5], YABE and ÔISHI[6], and

(1) F. W. BRAUN: Beitraege zur Urgeschichte der Pflanzen bei KUENSTER: Beitr. z. Petrefk., VI, 1843.

(2) W. GOTHAN: Die unter-liassische (rhaetische) Flora der Umgegend von Nuernberg. Abhandl. d. naturhist. Gesell. Nuernberg, Bd. XIX, No. 4, 1914, p. 46.

(3) See A. C. SEWARD: Fossil Plants, Vol. III, 1917, p. 554, fig. 613.

(4) E. ANTEVS: Die liassische Flora des Hoersandsteins. Kgl. Svensk. Vet.-Akad. Handl., Bd. LIX, No. 8, 1919, p. 30, Pl. IV, fig. 4.

(5) W. GOTHAN: Op. cit., 1914.

(6) H. YABE and S. 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, 1929, p. 96, Pl. XVIII, fig. 5; Pl. XIX, figs. 5, 5a, 6.

P. Braunianum as figured by SCHENK[1] and BARTHOLIN.[2]

Localities: A and B.

7. *Pterophyllum* sp.

Pl. VIII, Figs. 3-4; Text-fig. 6.

The imperfect Pterophyllum fronds in Pl. VIII, figs. 3–4 show the following characters:

Text-fig. 6. Pterophyllum sp. A transverse section of a frond. ×1.

Frond linear, broadly V-shaped in transverse section, more than 8 cm. long, 4.5 cm. broad, and traversed by a slender rachis 1.5 mm. across. Pinnae 7–12 mm. broad, parallel-sided, broadly rounded at apex or outer posterior margin curving upwards forming a gentle curve, and attached to the lateral sides of the rachis. Nerves very dense, being approximately 50 in number per cm., parallel to each other, simple (as far as can be seen), and at a wide angle to the rachis.

The present specimens are characterised by the very dense nervation. It seems that they represent a new form of the genus *Pterophyllum;* but as the specimens are too imperfect to admit comparison with known species, the present writer wishes to call it only *Pterophyllum* sp.

Among the species already known, a specimen of *P. inconstans* BRAUN figured by ZEILLER[3] from the Rhaetic of Tonkin resembles ours, especially in the dense nervation. But in BRAUN's species figured by ZEILLER the nerves fork frequently, and there is a considerable divergence between the geological age of the plant-beds of Tonkin and Manchuria.

Locality: B.

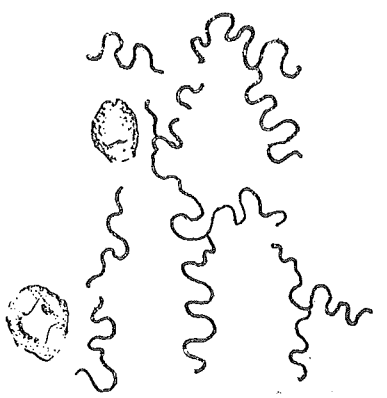
8. *Taeniopteris Uwatokoi* sp. nov.

Pl. VIII, Figs. 5-7; Text-fig. 7.

Leaf shortly petiolate, petiole being 1.2 cm. long, simple, linear lanceolate, reaching a length of 15 cm. and a breadth of about 2.5 cm.

(1) See A. C. SEWARD: Fossil Plants, Vol. III, 1917, p. 554.
(2) C. T. BARTHOLIN: Nogle i den bornholmske Juraformation forekommende Planteforsteninger. Bot. Tidskr., Bd. XIX, 1894, p. 91, Pl. II, figs. 3–4.
(3) R. ZEILLER: Flore fossile des gîtes de charbon du Tonkin, 1903, p. 177, Pl. XLIV, fig. 5.

Rachis thick, 12 mm. broad on its upper side and slightly broader than this on the lower, and transversely wrinkled. Lamina, with marginal corrugation, increases gradually in breadth from the base and tapers towards subacute apex. Impressions of lower surface of the lamina with numerous minute pittings which probably indicate the traces of hairs or glands. Nerves simple, perpendicular to the rachis, and varying between 20–30 in number per cm.



Text-fig. 7. Taeniopteris Uwatokoi sp. nov. Cuticle of unknown side (probably lower), showing strongly sinuous cell-walls and two stomata, ca.×200.

Cuticles being very badly preserved, an opinion about the nature of the epidermis can hardly be formed: as seen in text-fig. 7, the epidermal cells are of Bennettitalean type, the cell-walls being strongly sinuous; some stomata are also seen, but their structure is obscure.

T. Uwatokoi resembles *T. vittata* (BRONGN.) in respect to the size and form of the leaf, the strong rachis and the density of the lateral nerves which are at a right angle to the rachis; however, it differs from the type-specimens of *T. vittata*[1] and several other specimens figured by other authors under Brongniart's name in having simple lateral nerves. Moreover our species differs in the epidermal structures at least from *T. vittata* in which the cuticles have been investigated: the sinuosity of the epidermal cell-wall in *T. Uwatokoi* is stronger than that in *T. vittata* from Gristhorpe.[2]

The imperfect specimen figured by TOYAMA and ÔISHI[3] from the Jurassic bed of Chalai-nor in the northwestern border region of Manchoukuo as *Taeniopteris vittata* (BRONGN.)? is closely allied to the present specimens in respect to the leaf-form and the lateral nerves which are apparently simple and at a right angle to the rachis;

(1) A. BRONGNIART: Histoire des végétaux fossile, 1828, p. 263, Pl. LXXXII, figs. 1–4.

(2) H. H. THOMAS and N. BANCROFT: On the Cuticles of Some Recent and Fossil Cycadean Fronds. Trans. Linn. Soc. London, 2nd Ser., Vol. VIII, Pt. 5, 1913, p. 188, Pl. XX, fig. 5.

(3) S. TOYAMA and S. ÔISHI: Notes on Some Jurassic Plants from Chalai-nor, Prov. North Hsingan, Manchoukuo. This Journal, Vol. III, No. 1, 1935, p. 67.

but as the epidermal structure in the Chalai-nor specimen are not known, it is not desirable to treat them as specifically identical.

Locality: A.

9. *Pityospermum* sp.

Text-fig. 8.

Text-figure 8 shows an Abietinous winged seed 1.2 cm. long and more than 6 mm. broad at the imperfect middle portion of the wing bearing at one end an oval seed 5 mm. long and 3 mm. broad. A general idea as to the form of the specimen may be acquired from the accompanied text-figure. The specimens of Coniferous affinity associated with this winged seed are a somewhat broad leaf here assigned to *Pityophyllum Nordenskijöldi* and numerous needle-like leaves called *P. Lindstroemi.*

Text-fig. 8.
Pityospermum sp.
×1. Loc. B.
(Reg. No. 6320)

Locality: B.

10. *Pityophyllum Nordenskijöldi* (HEER)

Pl. VIII, Fig. 1 B.

A long and narrow leaf more than 6 cm. long, about 6 mm. broad near the base, tapering gradually towards the apex and contracting abruptly to a rounded base, and traversed by a well-defined midnerve. The apex is not known. No particular surface ornamentation on the lamina.

The present specimen agrees essentially in leaf-form with *P. Nordenskijöldi* figured by YABE and ÔISHI[1] from the Fang-tzu coal-field in China, and resembles also specimens figured by the same authors from Wei-chia-pu-tzu in Manchuria[2] under the same name and by HEER[3] from Ust Balei as *Pinus Nordenskijöldi,* but it differs from the original specimens from Spitzbergen figured by HEER[4] in

(1) H. YABE and S. ÔISHI: Jurassic Plants from the Fang-tzu Coal-field, Shantung. Jap. Journ. Geol. Geogr., Vol. VI, Nos. 1–2, 1928, p. 12, Pl. IV, fig. 4.

(2) H. YABE and S. ÔISHI: Mesozoic Plants from Manchuria. Sci. Rep., Tôhoku Imp. Univ., 2nd Ser., Vol. XII, No. 2B, 1933, p. 37, Pl. VI, fig. 6B.

(3) O. HEER: Nachtraege zur Jura-Flora Sibiriens. Mém. l'Acad. Imp. Sci. St.-Pétersbourg, Ser. VII, Tom. XXVII, No. 10, 1880, p. 28, Pl. I, fig. 8b.

(4) O. HEER: Beitraege zur fossilen Flora Spitzbergens. Kgl. Svensk. Vet.-Akad. Handl., Bd. XIV, No. 5, 1876, p. 45, Pl. IX, figs. 1–6.

the former's having broader lamina. According to the original diagnosis of *Pinus Nordenskijöldi,* the base of the leaf is said to be rounded, while the leaves which have narrow bases also like *P. longifolium* NATH. are often assigned to this species of HEER. At any rate, the long and narrow, detached, needle-like leaves which have been called under the form-genus *Pityophyllum* are often very difficult to determine specifically, and at the same time they have no real botanical value.

Locality: B.

11. *Pityophyllum longifolium* NATHORST

There is a number of long and narrow coniferous leaves which are in their leaf-form not distinguishable from the leaves usually designated under the name *P. longifolium.* One of our specimens (not illustrated) is more than 8 cm. long, 3 mm. broad, and narrows gradually towards the base, instead of being rounded off there. A prominent midnerve is found elevated as a ridge on the back side. The surface of the lamina is smooth, though in some cases there are prominent transverse wrinkles.

It is by no means certain that the leaves here assigned to *P. longifolium* are specifically identical with those frequently recorded from the Lower Jurassic rocks of the world under the same name. But as the leaves of this type have little significance from the botanical point of view, and it is at the same time very difficult or almost valueless to try to distinguish specifically among such leaves, the present writer has included all such long and narrow leaves which taper gradually towards the narrow base and traversed by a single midnerve under *P. longifolium.*

P. longifolium has a broader lamina than that of *P. Lindstroemi.* It resembles also *P. Nordenskijöldi,* but the lamina of the latter species has a rounded base.

Locality: A.

12. *Pityophyllum* cfr. *Lindstroemi* NATHORST

There are numerous detached needle-like leaves which may be comparable to *Pityophyllum Lindstroemi* described by NATHORST[1]

(1) A. G. NATHORST: Zur mesozoischen Flora Spitzbergens. Kgl. Svensk. Vet.-Akad. Handl., Vol. XXX, No. 1, p. 40; p. 67, Pl. V, figs. 13–15; Pl. VI, figs. 17–18.

from the Jurassic of Spitzbergen. Our specimens are all fragmentary, and the whole length of the leaves is not known. They are more than 5 cm. long and 1 mm. broad, and straight or somewhat sickle-shaped. The nature of the apex and base is obscure. There is a prominent midnerve elevated as a ridge on the lower surface and a corresponding narrow furrow on the upper, and there is also an indication of faint longitudinal striations on either side of the midnerve. It is very probable that the present specimens agree with *P.* cfr. *Lindstroemi* figured by YABE and ÔISHI[1] from several localities in Manchuria, but it is not certain whether they agree specifically with *P. Lindstroemi* from Spitzbergen because of the absence in our specimens of an indication of the elevated marginal nerve defined by NATHORST.

Locality: B.

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

An apical portion of *Podozamites*-leaf more than 3 cm. long and 1 cm. broad provided with rounded apex. The nerves are parallel and number about 25. This is a type of *Podozamites lanceolatus Eichwaldi* SCHIMPER.

Locality: A.

14. *Podozamites* sp. nov.

Pl. VIII, Figs. 8-9.

The leaves in Pl. VIII, figs. 8–9 seem to represent a new type of *Podozamites,* although the material is hardly adequate to justify the institution of a new specific name for it. The very imperfect specimen represented in fig. 8 shows a posterior portion of a leaf in connection with a slender axis. It is nearly parallel-sided, 1.3 cm. broad and narrows rather abruptly to the base. The nerves are parallel and numerous, and may be counted to the number of about 40.

Another specimen shown in fig. 9 is also an imperfect leaf, both ends broken; it is more than 9 cm. in length and 1.7 cm. in breadth in its broadest middle portion, thence it narrows gradually towards one end (probably the apex). The nerves are also numerous, and there are as many, 42 of them, as in the specimen in fig. 8.

(1) H. YABE and S. ÔISHI: Op. cit., 1933, p. 231 (37), Pl. XXXIV (V), fig. 9.

It is usually very difficult to settle the limit of variation of various *Podozamites*-leaves in their leaf-form and other external characters, and it may seem inconsistent to make a new species on our imperfect specimens, but the usually dense nervation is a feature deserving recognition. The specimens show a great resemblance to a type of *Podozamites* known as *P. lanceolatus* var. *latifolius* HEER as figured by several authors[1] from the Jurassic rocks of Asia, but the nerves in ours are always denser than var. *latifolius*, the nerves of which number ±28.

Locality: B.

In the end, the author tender his grateful acknowledgement to Prof. K. UWATOKO for the loan of the material and for giving geological information around the localities.

Department of Geology and Mineralogy,
Hokkaidô Imperial University, Sapporo.
May, 1935.

(1) O. HEER: Beitraege zur Jura-Flora Ostsibiriens und des Amurlandes. Mém. l'Acad. Sci. St.-Pétersbourg, Ser. VII, Vol. XXII, No. 12, 1876, p. 109, Pl. XXVI, figs. 5, 6, 8b-c. A. C. SEWARD: Mesozoic Plants from Afghanistan and Afghan-Turkistan. Pal. Indica, N. S., Vol. IV, Mem. No. 4, 1912, p. 33, Pl. IV, fig. 57. H. YABE and S. ÔISHI: Op. cit., 1933, p. 232 (38), Pl. XXXV (VI), figs. 3B, 6A; Pl. XXXIV (V), fig. 10.

PLATE VI

PLATE VI

(The figures are natural size, unless otherwise stated)

Fig. 1. *Cladophlebis* sp. indet. Loc. A. (Reg. No. 6319). P. 82.

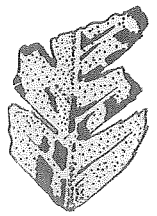
Fig. 2. *Sphenopteris* (*Onychiopsis*) *elongata* (GEYLER). Loc. B. (Reg. No. 6311). P. 83.

Figs. 3, 3a, 3b. *Cycadolepis Toyamae* sp. nov. Loc. B. (Reg. No. 6308). 3, in the upper part is an apical portion of a frond of *Nilssonia pecten* sp. nov. 3a, a drawing of the basal part, showing also reticulum on the outer surface and a series of narrow ridges on the inner side. 3b, a portion of the outer surface, showing the reticulum, ×3. P. 87.

Figs. 4, 4a, 4b. *Cycadites manchurensis* sp. nov. Loc. A. (Reg. No. 6305). R, rachis. 4a, a pinna, ×2; 4b, a cross-section of a pinna, diagrammatically drawn. P. 85.

Fig. 5. The same species. Lower cuticle, ×82.

Fig. 6. A part of fig. 5, showing two stomata and a hair-base (lower middle), ×350.



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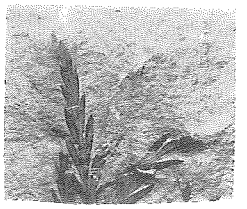
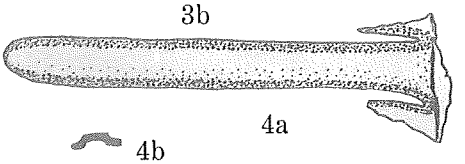


2

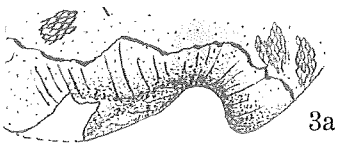
3

3b

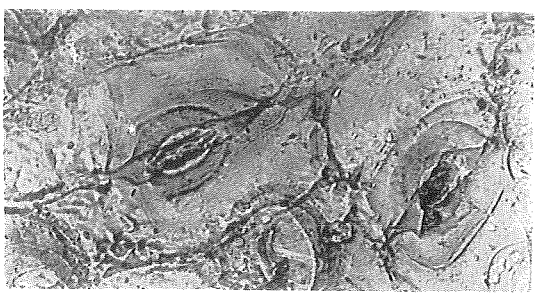


4a

4b



3a



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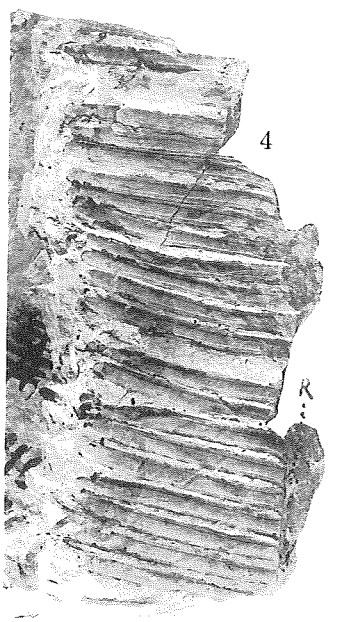
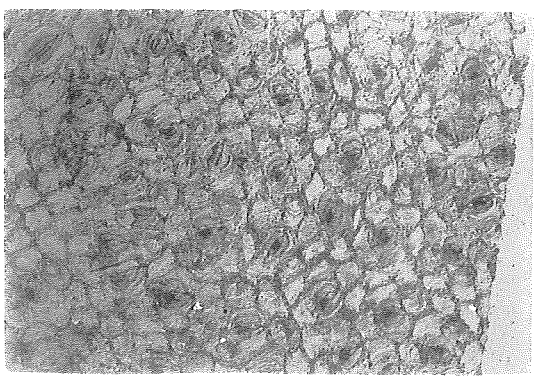


4

R



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Takeda photo. and Ôishi del.

S. Ôishi : Fossil Plants from Tung-ning.

PLATE VII

PLATE VII

Nilssonia pecten sp. nov. Nat. size. Loc. B. (Reg. No. 6314). P. 83.

Takeda photo.

S. Ôishi : Fossil Plants from Tung-ning.

PLATE VIII

PLATE VIII

(The figures are natural size)

Fig. 1A. Cfr. *Pterophyllum angustum* (BRAUN). Loc. B. (Reg. No. 6306). P. 88.

Fig. 1B. *Pityophyllum Nordenskijoldi* (HR.) Loc. B. (Reg. No. 6306). P. 92.

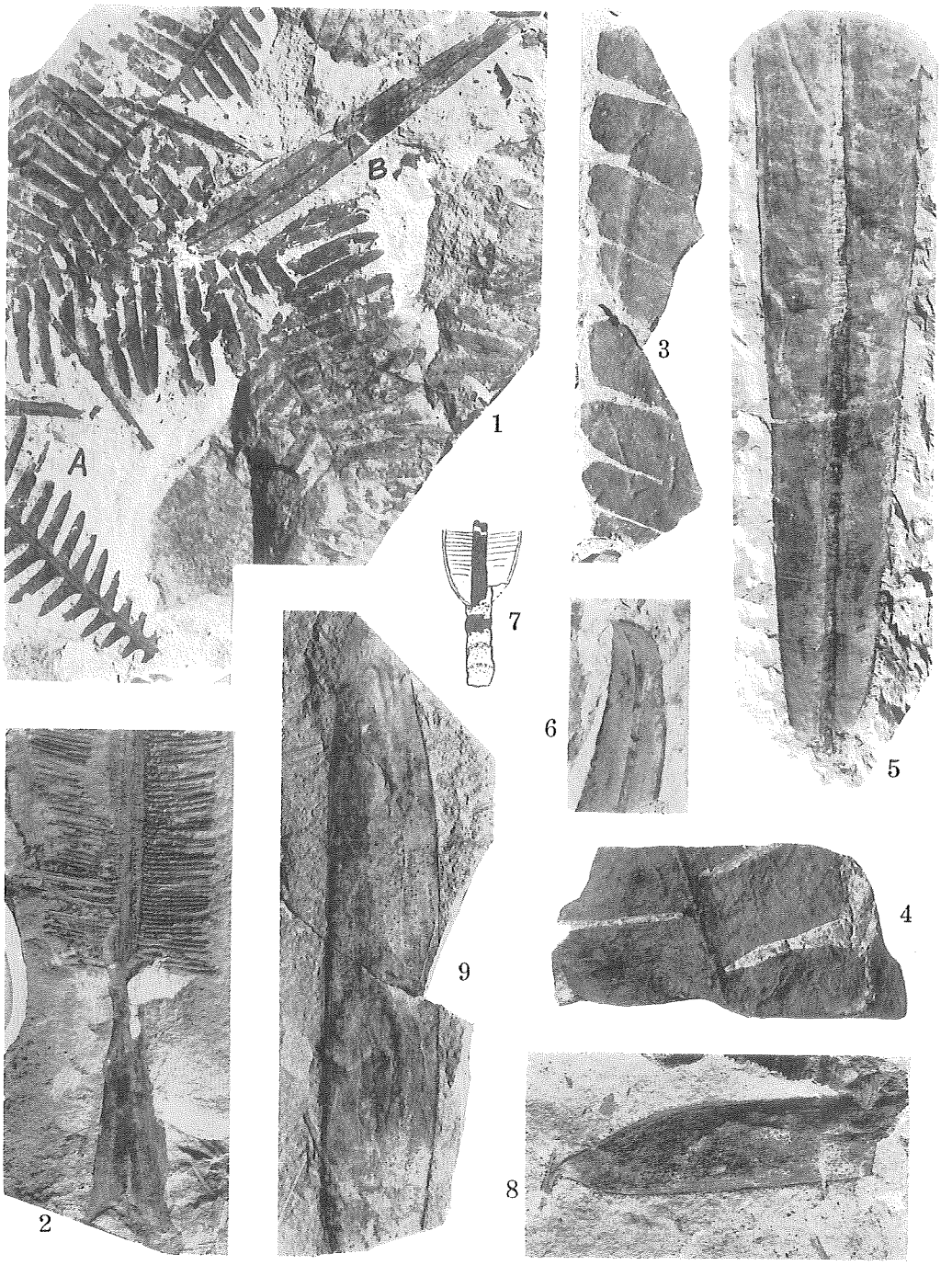
Fig. 2. *Nilssonia pecten* sp. nov. A basal portion. Loc. B. (Reg. No. 6314). P. 83.

Figs. 3–4. *Pterophyllum* sp. Loc. B. (Reg. No. 6304). P. 90.

Figs. 5–7. *Taeniopteris Uwatokoi* sp. nov. 6, an apex. 7, a base; it shows also marginal corrugation of the lamina and the transverse wrinkles on the rachis. Loc. A. (Reg. No. 6315). P. 90.

Fig. 8. *Podozamites* sp. nov. Loc. B. (Reg. No. 6313).

Fig. 9. *Podozamites* sp. nov. Loc. B. (Reg. No. 6314).



Takeda photo. and Ôishi del.

S. Ôishi : Fossil Plants from Tung-ning.