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On the Triassic Plants from the Hongay Coalfield, in Tonkin, Indo-China

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Preface

The Hongay flora, Tonkin, is very familiar to us through the well-known work of R. Zeiller, "Flore fossile des gîtes de Charbon du Tonkin" (Études des gîtes minéraux de la France, Paris, 1903), but there are probably a few, if not none, of our students of palaeobotany having actually seen excellently preserved specimens from the anthracite fields. Many years ago, the late S. Tokunaga of the Waseda University personally collected there numerous specimens of the fossil plants of the Hongay flora and brought them back to his laboratory in the University; but the Museum of the University in which this and other Tokunaga's precious collections of fossils had been laid after his death, was unfortunately completely destroyed by an air-raid in 1945.

In the summer of 1942, I had an occasion to visit the Campha coalfield, one of the famous anthracite fields, on the northern shore of the Gulf of Tonkin, and obtained a number of specimens of "Rhaetic" plant fossils; these are illustrated in this paper, with short accounts of each species. These specimens are to be stored in the Tokyo Science Museum in Ueno Park, Tokyo, for the use of our friends in Japan interested in palaeobotany.

I wish to render my heartiest thanks to Dr. H. Yabe, Emeritus Professor of the Tohoku University, and also to Dr. I. Tateiwa and Dr. T. Kobayashi, both Professor of the Tokyo University, for their important help rendered during the course of this work.

Geological Age of the Hongay Flora

The Hongay flora was fully dealt with by Zeiller in his work of 1903 cited above, in which he described

Sphenopteris cf. *princeps* (Presl)=*Todites princeps* (Presl)
Pecopteris (*Asterothecae*) Cottoni Zeiller
P. *adumbrata* Zeiller
P. *tonquiensis* Zeiller
P. (*Bernoullia* ?) sp.
Cladophlebis cf. *lobifolia* Phillips
C. (*Todea*) *Roesserti* (Presl)=*Todites Goeppertianus* (Münster)
C. *nebbensis* (Brongniart)

C. *Raciborskii* Zeiller
Ctenoptersis Sarrani Zeiller
Danaeopteris cf. *Hughesi* Feistmantel
Taeniopteris ensis (Oldham)
T. cf. *Mac Clellandi* (Oldham et Morris)
T. (*Marattia*) *Muensteri* Goeppert=*Marattiopsis Muensteri* (Goeppert)

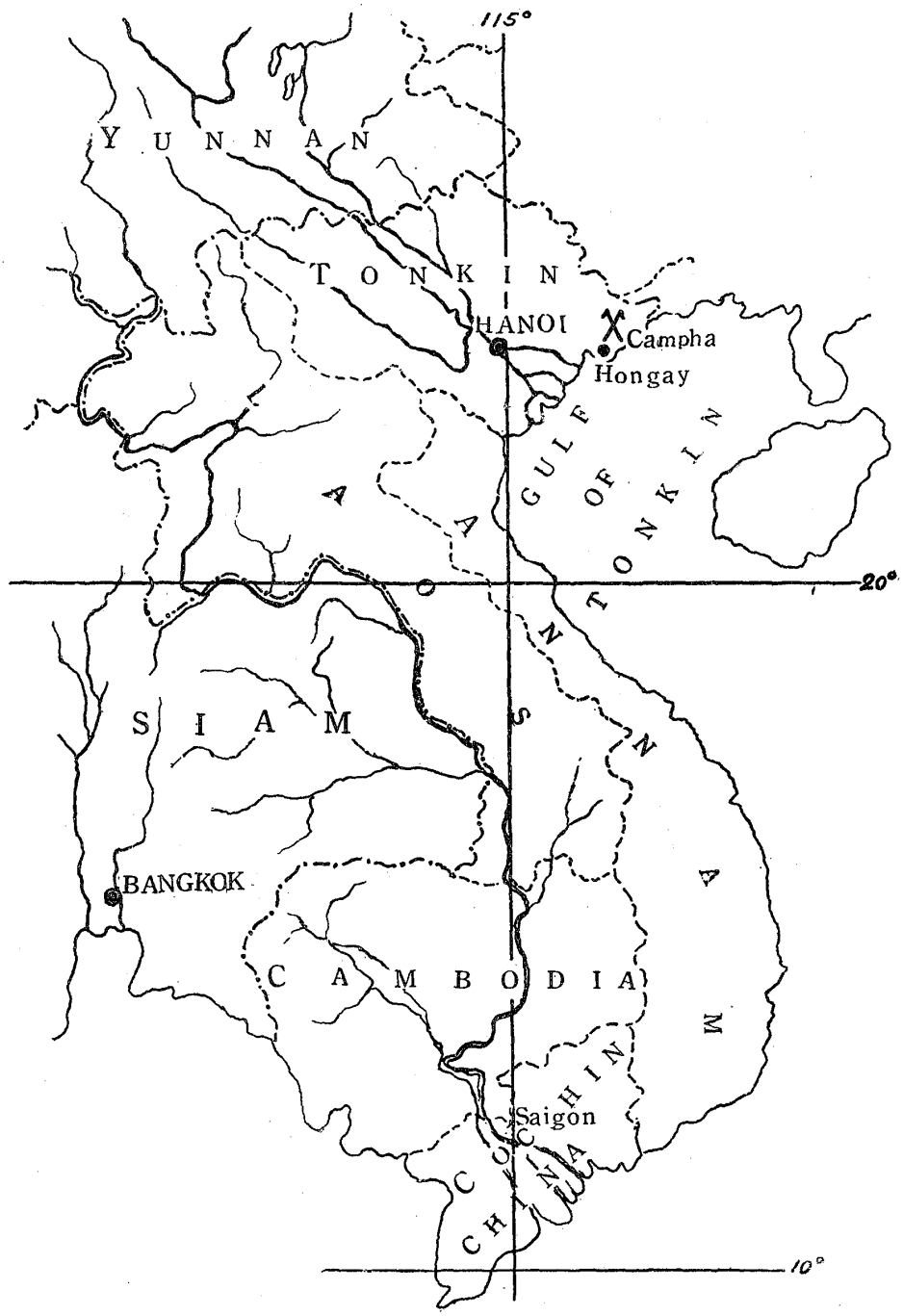

Fig. 1. Outline map of the Indo-China showing the approximate position of the Hongay Coalfield.

T. *Jourdyi* Zeiller=*Nilssoniopteris Jourdyi* (Zeiller)
T. *virgulata* Zeiller
T. *spatulata* Mac Clelland
T. *Nilssonioides* Zeiller
T. *Leclerei* Zeiller
Palaeovittaria Kurzi Feistmantel
Glossopteris indica Schimper
Woodwardites microlobus Schenk
Dictyophyllum Fuchsi Zeiller
D. *Remauryi* Zeiller
D. *Sarrani* Zeiller
D. *Nathorsti* Zeiller
Clathropteris platyphylla (Goeppert)
Annulariopsis inopinata Zeiller
Schizoneura Carrerei Zeiller=*Neocalamites Carrerei* (Zeiller)
Equisetum Sarrani Zeiller
Macrotaeniopteris Hislopi (Bunburg)
Podozamites distans (Presl)
P. *Schenki* Heer
Zamites truncatus Zeiller
Otozamites indosinensis Zeiller
O. *rarinervis* Feistmantel
Ptilophyllum acutifolium Morris
Pterophyllum (*Anomozamites*) *inconstans* (F. Braun)
P. (*A.*) *Schenki* Zeiller
P. *Münsteri* (Presl)
P. *portali* Zeiller
P. *Zietzei* Schenk
P. *contigium* Schenk
P. *equale* (Brongniart)
P. *Bavieri* Zeiller
Cycadolepis corrugata Zeiller
C. cf. *villosa* Saporta
Baiera guilhaumati Zeiller
Trioolepis Leclerei Zeiller
Conites Carpentieri Zeiller
C. sp.
C. sp.
C. sp.
Araucarioxylon Zeilleri Crie

On these numerous fossil plants and several fossil insects, Zeiller claimed the Rhaetic age for the Hongay flora and the anthracolitic formation with it. However, the subsequent geological and palaeontological

works of J. Deprat, H. Mansuy, L. Dussault, J. Fromaget, E. Patte and others led one to doubt the validity of Zeiller's conclusion, and it become gradually known that the deposits with the Hongay flora and the marine one with the characteristic mollusca *Myophoria napengensis* Healey, identified by Patte, exist in close association at Djam Djun near Phu Nho Quan. *M. napengensis* is a characteristic fossil of the Napeng Beds of Burma, Noric in age, and its occurrence is reported in Indochina, for instance, at Muong Thé, in association with *Anodontophora griesbachi* Bittner, first described from the Himalayan Noric, and *Lingula naniensis* Healey, *Burmesis lirata* Healey, *Cardita singularis* Healey all first described from the Noric Napeng Beds of Burma. Cowper Reed doubted the specific identity of *M. napengensis* Healey of Patte and the typical *M. napengensis* Healey, considering the former to be more closely related to *M. subvestita* Krumbeck var. *mansuyi* Reed from the Noric of Miao-Tsway in eastern Yunnan, China; this diversity of opinion does not invalidate the Noric age of the marine deposits with *M. napengensis* of Patte non Healey.

On pure palaeobotanical standpoint, on the other hand, T. M. Harris stated that "the general character of this flora (Hongay flora) which shows a striking number of *Taeniopteris* leaves is considerably different from any European flora. There are, however, a number of closely similar or identical species with some which characterizes the *Lepidopteris* Zone in Europe and Greenland, namely

Nilssoniopteris Jourdyi
Pterophyllum Schenki,

both of which occur in the *Lepidopteris* Zone of Greenland, and some of which characterize the *Thaumatopteris* Zone or younger floras:-

Todites princeps
Woodwardites microlobus
Equisetites Sarrani
Marattiopsis sp. nov. (*M. hoerensis* of Zeiller)

"*Marattiopsis* is a genus not known before the *Thaumatopteris* Zone in Europe." Farther on, it was remarked: "the species which characterize the *Lepidopteris* and *Thaumatopteris* Zones respectively of Europe here appear to be mixed together".[1]

More lately, T. Kobayashi claimed even the Karnic age of at least a part of the anthracite formation of Tonkin on account of the fossil insects with archaeic feature described by Zeiller together with the Rhaetic plants.

1) T. M. Harris: The Fossil Flora of Scoresby Sound, East Greenland. Pt. 5. Stratigraphic Relation of the Plant Beds. 1937, p. 96. Two other characteristic features of the Hongay flora are the rarity of Ginkgoalean remains and that of coniferous ones.

The unity of the Hongay flora is primarily questionable, because it consists of elements derived from many different mines and possibly from several different horizons. Nevertheless, the affinity of the flora, as a whole, to the Rhaetic to Rhaeto-Liassic ones of Europe is apparent to palaeobotanists.

The Nariwa Bed of the Nariwa district, Okayama Prefecture, in Japan, is rich in plant fossils; M. Yokoyama who first attracted his attention to the remains, early recognized the Rhaetic age of the flora. Now, the late S. Oishi with his collaborators, made an extensive research of it and found that it comprises 110 species in 35 genera of plants; on this rich material, he confirmed the Yokoyama's view on the geological age of the Nariwa Bed. The Nariwa flora has the following species in common with the Hongay flora:

Neocalamites Carrerei (Zeiller)
Annulariopsis inopinata Zeiller?
Marattiopsis Muensteri (Goeppert)
Todites Goeppertianus (Münster)
T. princeps (Presl)
Cladophlebis nebbensis (Brongniart)
C. Raciborskii Zeiller
Clathropteris meniscoides (Brongniart)
Pterophyllum Schenki Zeiller
P. aequale (Brongniart)
Taeniopteris Lecleri Zeiller
Baiera Guilhaumati Zeiller
Podozamites Schenki Heer

Further, there are several allied forms in the two fossil floras.

In the Nariwa district the Nariwa Bed exits in close association with the Zito Bed of the Noric age containing *Entomonotis ochotica* (Keyserling) and its varieties in abundance. The stratigraphical relation of the Nariwa Bed and the Zito Bed is a topic of dispute for a long time, and there are many papers published on the subject. That the former is conformably overlain by the latter was first pointed out by D. Sato and later by several geologists, including me.

The Triassic formations of the Nariwa district occupies a narrow belt in the Palaeozoic terrain and intricately disturbed; the opponents of the stratigraphical relation of the two Triassic formations cited above, maintains the upper position of the Noric formation over the younger, Rhaetic one, is only apparent, owing to a tectonic disturbance; further, there is the third view held by T. Takeyama who related his find of *Entomonotis ochotica* not only beneath the plant beds, but also above it. He therefore holds the "Rhaetic" plant bed as contemporaneous with Noric *Entomonotis* Bed.

List of Fossil Plants described

I PTERIDOPHYTA
FILICALES
OSMUNDACEAE

Genus *Cladophlebis* Brongniart
Cladophlebis denticulata Brongniart

DIPTERIDACEAE

Genus *Dictyophyllum* Lindlay and Hutton
Dictyophyllum Nathorsti Zeiller
Genus *Woodwardites* Schenk
Woodwardites microlobus Schenk

II CYCADOPHYTA
BENNETTITALES ?

Genus *Pterophyllum* Brongniart
Pterophyllum aequale (Brongniart)
P. Bavieri Zeiller
P. Portali Zeiller
Genus *Ctenopteris* Brongniart
Ctenopteris Sarrani Zeiller

III CONIFERALES ?

Genus *Podozamites* F. W. Braun
Podozamites distans (Presl)

Seed

Genus *Carpolithus* Linnaeus
Carpolithus sp.

Description of the Species

I PTERIDOPHYTA
FILICALES
OSMUNDACEAE

Genus *Cladophlebis* Brongniart
Cladophlebis denticulata Brongniart
Pl. I, Figs. 1, 2; Pl. II, Figs. 1, 2, 3.

1833. *Pecopteris denticulata* Brongniart: p. 301, pl. XCVIII, Fig. 1, 2.
1900. *Cladophlebis denticulata* Seward: p. 134, Pl. XIV, Figs. 1, 3, 4; Pl. XV, Figs. 4, 5; Pl. XX, Figs. 3, 4.
1910. *C. denticulata* Seward: Vol. II, p. 343; Figs. 265A, 257, 258.
1922. *C. denticulata* Yabe: p. 9, Pl. I, Figs. 3, 4; Pl. II, Figs. 1, 2; Text-Fig. 7.

1925. *C. denticulata* Kawasaki: p. 11, Pl. XLVI, Fig. 123.
1926. *C. denticulata* Kawasaki: p. 2, Pl. I, Figs. 1, 1a-c.
1928. *C. denticulata* Yabe and Oishi: p. 5, Pl. I, Figs. 3-4.
1931. *C. denticulata* Oishi: p. 233, Pl. XVI, Figs. 5, 5a.
1932. *C. denticulata* Oishi: p. 288, Pl. XXIX (XI), Figs. 3-7.
1933. *C. denticulata* Yabe and Oishi: p. 206 (12), Pl. XXX (I), Fig. 8.
1936. *C. denticulata* Oishi and Takahashi: p. 118, Pl. X (I), Fig. 2.
1939. *C. denticulata* Matsuzawa: p. 9, Pl. II, Fig. 5; Pl. III, Fig. 3; Pl. IV, Fig. 5.

There are several specimens of fragmental fronds of the *Cladophlebis* type; the best one of which is shown in Pl. I, Fig. 1. The frond is large, more than 27 cm long and 30 cm broad. It is at least bipinnate, traversed by a slender, but rigid rachis which is 8 mm broad. The pinnae are long, more than 17 cm in length and 3-4 cm in breadth, almost parallel-sided throughout their length, but gradually narrowing to the abtuse apex and also towards the proximal end; they touch each other laterally, and attach to the rachis oppositely, making a subacute angle in general 45-30 degrees with it. The pinna-rachis is slender, 1-2 mm broad, bend somewhat forwards or is even slightly flexuous.

The pinnules are alternate in general, sometimes subopposite to opposite, closely set, elongate trigonal, broadest near the base, thence gradually tapering towards the subacute apex, somewhat falcate with apex directed forwards, and attached by their broad base to the pinna-rachis at an angle of about 50 degrees; the base is dilated on the upper side and slightly contracted on the lower. The pinnules are generally 2-4 cm long, and 6-8 mm broad near the base; they become shorter towards the proximal end of pinna; the posterior proximal pinnule is deltoid in form, about 10 mm long and 8 mm broad, and possesses a characteristic short process at the base, which is 5 mm long and 1 mm high. Each pinnule has a prominent midnerve commonly at an angle of 60 degrees to the pinna-rachis, is slightly decurrent at the base and bends upwards; the midnerve send off many secondary nerves at an angle of 45 degrees or less; the number of lateral nerves is 6-13 on either side of the midnerve. The almost all of the lateral nerves are once forked near the midnerve, while the posterior proximal one is either twice forked or divided into three branches. The pinnules are in general closely set and slightly touch each other laterally as shown in Pl. I, Fig. 2.

Pl. II, Fig. 1 represents the middle part of the frond (Pl. I, Fig. 1), twice enlarged. It shows well the mode of attachment of pinnules to the pinna-rachis and of pinna to the main rachis of the frond, as well as nervature; besides, the short process of the deltoid pinnules is distinct.

Whether the lateral margin of the pinnnles is finely denticulated or not is undecided owing to their inrolled state.

Zeiller described four species of the genus *Cladophlebis*, from Tonkin, namely:-

Cladophlebis cf. *lobifolia*
C. *Roesserti=Todites Goeppertianus* (Münster)
C. *nebbensis*
C. *Raciborskii*

Of them, *C. Raciborskii* and *C. Roesserti* have the lateral nerves in general twice forked; *C. nebbensis* and *C. lobifolia* have the pinnules more or less different in shape. The present form seems to belong to none of them; on the other hand, its resemblance to those fronds known as *Cladophlebis denticulata* (Brongniart) is considerable, agreeing to each other in the size, form and nerveture of pinnules. Yet, pinnae are arranged opposite in our frond, but usually alternate to subopposite in *C. denticulata*. However, I refer the present form for a while provisionally to that species, which is in reality not a single species, but certainly represents a large group of species with similar aspects.

Cladophlebis denticulata has a wide geographical range in the Rhaetic to Jurassic formations.

DIPTERIDACEAE

Genus *Dictyophyllum* Lindley and Hutton

Dictyophyllum Nathorsti Zeiller

Pl. III, Figs. 1-5; Pl. IV, Fig. 1.

1903. *Dictyophyllum Nathorsti* Zeiller: l.c., p. 119, Pl. XXIII, Fig. 1; Pl. XXIV, Fig. 1; Pl. XXV, Figs. 1-6; Pl. XXVI, Figs. 1-3; Pl. XXVII, Fig. 1.

This species was established by Zeiller on a series of splendid specimens from the Hongay mines; it is also well represented in our collection.

Pl. III, Fig. 1 shows a large part of an arm of a frond, with 12 pinnae palmately disposed. These pinnae are more than 27 cm long, radially arranged, crowded and somewhat overlapping laterally, and have their lamina concrescent at the basal part for a length of 5-6 cm. The pinna-rachis is comparatively slender, either straight or slightly curved and running to the apex; it is some 2 mm broad near the proximal end, where somewhat furrowed on the upper surface. The pinnae are linear-lanceolate, broadest, near the middle of their length, measuring 3 cm, thence slightly tapering towards the both ends. The lamina is divided into triangular lobes which are usually falcate, with the upper margin straight or concave and the lower margin convex. The midnerve of the lobes is distinct, coarse, somewhat zigzag and persists to the very apex. The secondary nerves are also distinct forming a reticulum of polygonal meshes. The tertiary nerves are very fine, likewise forming a fine reticulum within each mesh of the secondary nerves.

The pinna-rachi are radially arranged in an interval of 1-1.5 cm through the contiguous basal portion of the lamina. The nerve in this part are less prominent than those in the lobes of the pinna and form a coarse, radially-elongate-polygonal meshwork between the pinna-rachi.

Pl. III, Fig. 2 and Pl. IV, Fig. 1 show the badkside of laminae, with the pinna-rachis as a prominent ridge. Pl. III, Fig. 4 likewise shows the backside of the basal portion of pinnae which are contiguous. Pl. III, Fig. 3 represents the apical portion of a pinna, and Fig. 6 on the same plate a very fragmental one, with a minute dot in each mesh of nerves (fertile?).

Dictyophyllum Nathorsti which is characterized by having the lamina of the pinnae fused basally. This species also occurs in the Triassic of Japan and Ussuriland; that reported by Sze from South China is doubtful according to S. Oishi[2].

Genus *Woodwardites* Schenk

Woodwardites microlobus Schenk

Pl. I, Figs. 3, 3a.

1903. *Woodwardites microlobus* Zeiller: l.c., p. 91, Pl. XVII, Figs. 1–5.

Pl. I, Fig. 3 shows a small fragmental specimen from the distal portion of a frond, which is bipinnate or more probably tripinate. The main rachis is slender, with closely-set pinnae, which alternately attach to it at right angle; the pinnae which reduce their length gradually upwards, are more than 3 cm long and 3-10 mm broad, and posses 5-9 basally united pinnules or lobes, besides the terminal one. The main rachis is is laterally winged by a triangular lobe which is contiguous with the basal lobes of the adjoining pinnae.

The midnerve is distinct and persistent to the apex of each lobe; the secondary nerves are also distinct, forming polygonal meshes; the lateral lobe of the main rachis has a similar reticulum of nerves (Pl. I, Fig. 3a).

This specimen, though very fragmental, resembles closely *Woodwardites microlobus* Zeiller in every feature.

II Cycadophyta

Bennettitales ?

Genus *Pterophyllum* Brongniart

Pterophyllum aequale (Brongniart)

Pl. V, Figs. 2, 3.

1903. *Pterophyllum aequale* Zeiller: l.c., p. 194, Pl. XLIX, Figs. 4–7.
1938. *P. aequale* Oishi: l.c., p. 85, Pl. X (IV), Figs. 4, 4a.

A fragmental frond in Pl. V, Fig. 2 resembles closely *Pterophyllum*

2) S. Oishi: The Mesozoic Floras of Japan, 1940, p. 218.

aequale from Tonkin illustrated by Zeiller. It is probably from an apical portion, more than 6 cm broad, and has the rachis about 2 mm broad. The segments are attached to the lateral side of the rachis at an angle of about 60 degrees; they are closely set, parallel-sided, long and narrow, more than 3 cm in length and uniformly about 5 mm broad.

Another fragmental frond, in Pl. V, Fig. 3, is probably from a basal part, having a 4 mm broad rachis, and is 3 cm long. The segments attached to the lateral sides of the rachis, are parallel-sided, more than 2 cm long and about 5 mm broad; the apical part is preserved in none of the segments. The nerves are simple and parallel, numbering about 20-25 per 4 mm. This also may belong to the same species with the preceding one.

Zeiller described another species of the same genus, *Pterophyllum* (*Anomozamites*) *Schenki* Zeiller from Tonkin; this species is distinguishable from *P. aequale* by its broader, somewhat quadrate segments, with the outer margin truncated parallel to the rachis, and attached to the rachis at a right angle. *Pterophyllum contigium* Schenk is another ally; it has a coarser nervation.

This species is reported from various localities in Europe and Asia, inclusive Japan, Korea and China.

Pterophyllum Bavieri Zeiller
Pl. V, Figs. 4, 4a and 5.

1903. *Pterophyllum Bavieri* Zeiller: l.c., p. 198 Pl. XLIX, Figs. 1–3.

There are several specimens in the present collection, which are believed to be specifically identical with the species cited above.

The frond is linear-lanceolate, more than 15 cm long, and broad; it is probably broadest from a short distance below the apex to the middle part, thence gradually attenuated towards the base. The rachis is slender, being 1-2 mm broad, with a narrow longitudinal groove and often transverse wrinkles on the upper surface: it forms a prominent stout rib on the back side of the frond and is prolonged beyond the lamina to a short petiole, which is 3 mm broad at the proximal end and more than 1.5 cm long.

The segments are long and narrow, opposite, forming an angle of approximately 80 degrees with the rachis and attached to it by the whole base. The segments are parallel-sided, rounded at apex, long and uniformly 1 mm broad throughout their length; they are longest at the middle part of the frond, there measuring 12-15 mm, and thence reduce their length towards the apex as well as the base. The nerves are often bipartite at the very base, being otherwise simple; they run parallel to the lateral margins of the segments, which bear constantly 4 nerves (Pl. V, Fig. 4a).

Pl. V, Figs. 4 and 6 show the back side of two fronds, in which the ridged rachis and somewhat thick petiole are well exposed. The gradual reduction in breadth of the lamina towards the petiole and uniformly narrow and long segments closely set alternately almost normal to the rachis are the characteristic feature of this species.

Pterophyllum Bavieri is a characteristic element of the Triassic Hongay flora.

Pterophyllum Portali Zeiller
Pl. IV, Figs. 2-4; Pl. V, Fig. 1.

1903. *Pterophyllum Portali* Zeiller: l.c. p. 186, Pl. XLVI, Figs. 1-5, Figs. 4, 5.

We have several specimens of this species in our collection; none of them are complete.

The frond is petiolate, linear to lanceolate, at least 10 cm long and 1-4.5 cm broad, broadest at the middle part, thence gradually narrowing towards the apex and the base. The rachis is stout appearing as a prominent rib on the back side of the frond; on the upper surface, it is covered by lamina from both sides, leaving a narrow median longitudinal interspace free, which is at most 2 mm broad, and impressed by fine longitudinal striae.

The lamina is deeply incised to almost very base and divided into many unequal segments which are quite free from one another. The segments are attached to the rachis nearly at right angles or slightly oblique upwards; they are broad, nearly parallel-sided and truncated at the outer margin, variably broad, the breadth varying from 0.8 cm to 2 cm, and 1-2.2 cm long.

The lateral nerves number in general 18-20 per 1 cm at their proximal end, and fork once or twice, first close to the base of the segments, and in the second time at the middle between the base and the outer margin or near the latter; they are parallel to the lateral margins of the segments and extend to their outer margin.

Pl. IV, Fig. 2 shows a frond with its apical part well preserved; it bears penultimate segments, while its very tip is broken off. Pl. V, Fig. 1 shows the backside of another frond; the lamina is divided into unequal segments, and the rachis is stout and prominent, bears fine longitudial striae, and is produced to the short petiol more than 1.8 cm long, which is proximally dilated and 3 mm broad and longitudinally striated.

In size, form and nervature, the present specimens closely resemble *Pterophyllum Portali* Zeiller from Tonkin figured by Zeiller. There is, however, some doubt about its generic reference, bearing in mind the above cited mode of attachment of lamina to the rachis.

Genus *Ctenopteris* Brongniart
Ctenopteris Sarrani Zeiller
Pl. VI, Figs. 1, 1a, 2, 3.

1903. *Ctenopteris Sarrani* Zeiller: l.c., p. 53, Pl. VI, Fig. 1; Pl. VII, Fig. 1; Pl. VIII, Figs. 1, 2.

The frond is elongate obovate, more than 14 cm long and varying in breadth between 7 cm and 5 cm. The rachis is straight and rather stout, being in general 4-6 mm broad in the proximal part of the frond, thence tapering gradually upwards to 2 mm in its distal part; it has narrow longitudinal furrows on its upper surface.

The segments or pinnules are attached laterally to the rachis at an angle of about 70 degrees; usually they are closely set, but sometimes more or less spaced, and arranged in subalternate or opposit position. They are thick, elongate-trigonal, unequilaterally rounded, tapering from the base to the rounded apex, somewhat falcate in the apical portion where the anterior margin is almost straight and the posterior broadly convex. The pinnules are variable in size according to their position, some attaining 4 cm in length and 2.2 cm in breadth at the base while another is 2 cm long and 1.5 cm broad. The nerves are coarse and little distinct; they are in general simple and parallel, but sometimes bifurcate close to their proximal end where they are decurrent.

10-12 per 1 cm are the approximate number of the nerves which make an angle of some 70 degrees with the rachis. The margin of the pinnules is entire, but their surface is sometimes undulated, a characteristic feature of this frond.

The specimens in Pl. VI, Figs. 1, 1a, and 2 agree quite well with Zeiller's original ones of *Ctenopteris Sarrani* Zeiller from Tonkin in the general habit of the frond and in the shape of pinnules, though the rachis is not so stout in the former as in the latter.

Pl. VI, Fig. 3 is a sketch of one of the splendid specimens illustrated by Zeiller for comparison.

III CONIFERALES ?

Genus *Podozamites* F. W. Braun
Podozamites distans (Presl)
Pl. VII, Fig. 1.

1843. *Podozamites distans* (Presl) Braun: p. 28.
1903. *Podozamites distans* (Presl) Zeiller: l.c., p. 159, Pl. XLII, Figs. 1-4.
1911. *P. distans* (Presl) Schuster: p. 450, Pl. XVII, Figs. 1-4.
1914. *P. distans* (Presl) Gothan: p. 57, Pl. XXIX, Fig. 1.
1925. *P. distans* (Presl) Kawasaki: p. 54, Pl.XXXIV, Figs. 93-95; Pl. XXXV, Figs. 96-99; Pl. XLVII, Figs. 124-126.
1926. *P. distans* (Presl) Harris: p. 111, Text-Fig. A.
1937. *P. distans* (Presl) Harris: p. 75.
1939. *P. distans* (Presl) Kawasaki: p. 46, Pl. XVI, Figs. 65-66.

A specimen from the Campha Mines, shown in Pl. VII, Fig. 1, is the best one in our collection; there are three shoots, each of which has some eight or more crowded leaves at an acute angle to a slender axis. The largest shoot is 18 cm long, and its slender axis bears linear-lanceolate leaves, which are sometimes falcate at the apical portion. The leaves are 5-10 cm long and 12 mm broad at the broadest part, thence gradually tapering towards the apex and contracted at the base. The nerves, about 20-22 in number, are often once forked near the base, and farther on are simple and parallel, only slightly converging in approaching pointed apex.

Zeiller described *Podozamites distans* (Presl) from the Dong-Trieu and Hongay Mines, Tonkin; the present specimen is specifically identical with it.

Seed

Genus *Carpolithus* Linnaeus

Carpolithus sp.

Pl. VII, Fig. 2.

Pl. VII, Fig. 2 shows a small slab of rock with two small cycadian seeds which are rounded triangular in shape; in being conical and tapering to a blunt apex and somewhat rounded at the base, they resemble small chestnuts. They are smooth on surface, probably being mere casts of kernel.

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Deprat, J. (1913) Note sur les terrains primaires dans le Nord-Annam et dans le bassin de la Revière Noire (Tonkin).

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Pl. I

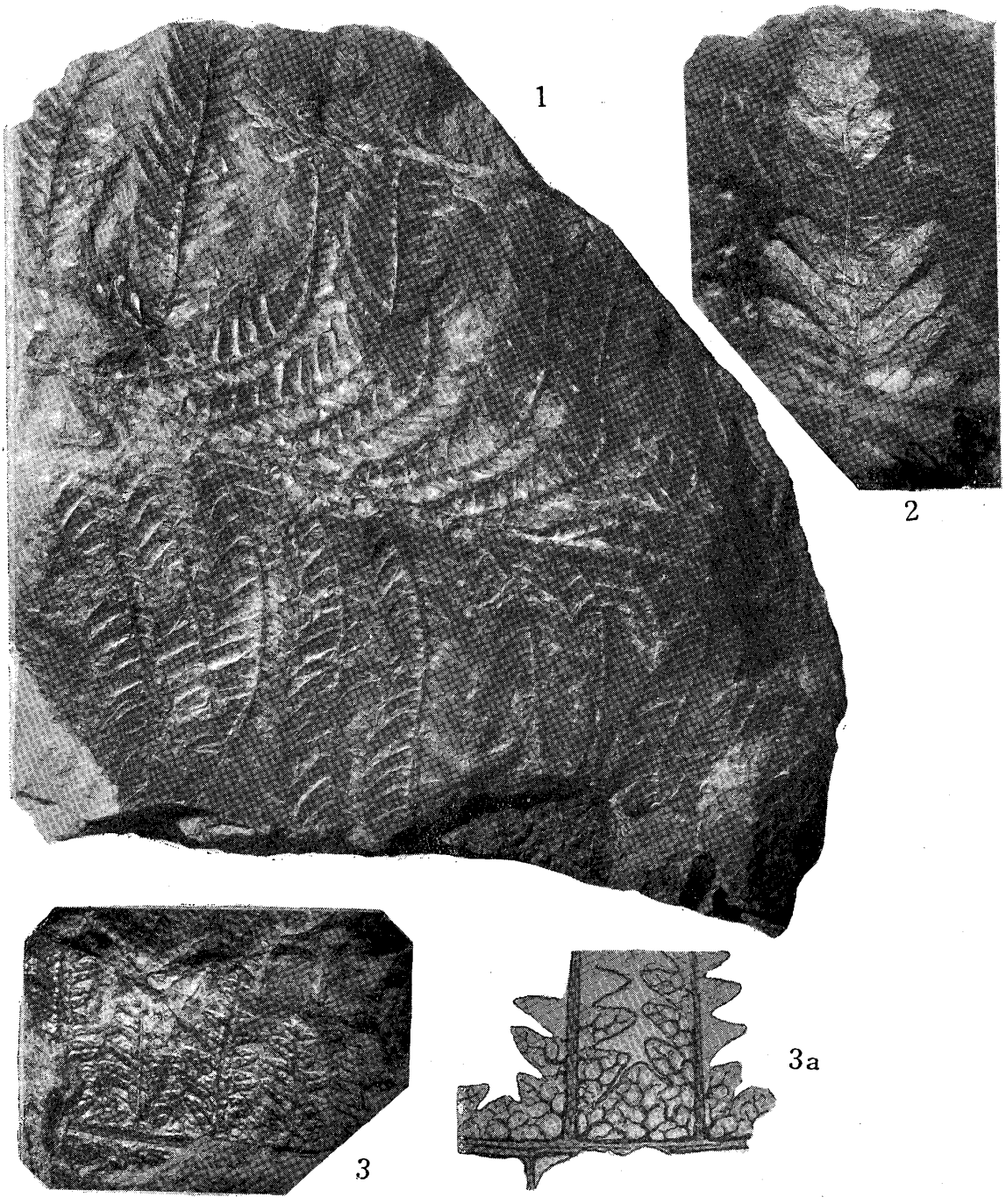
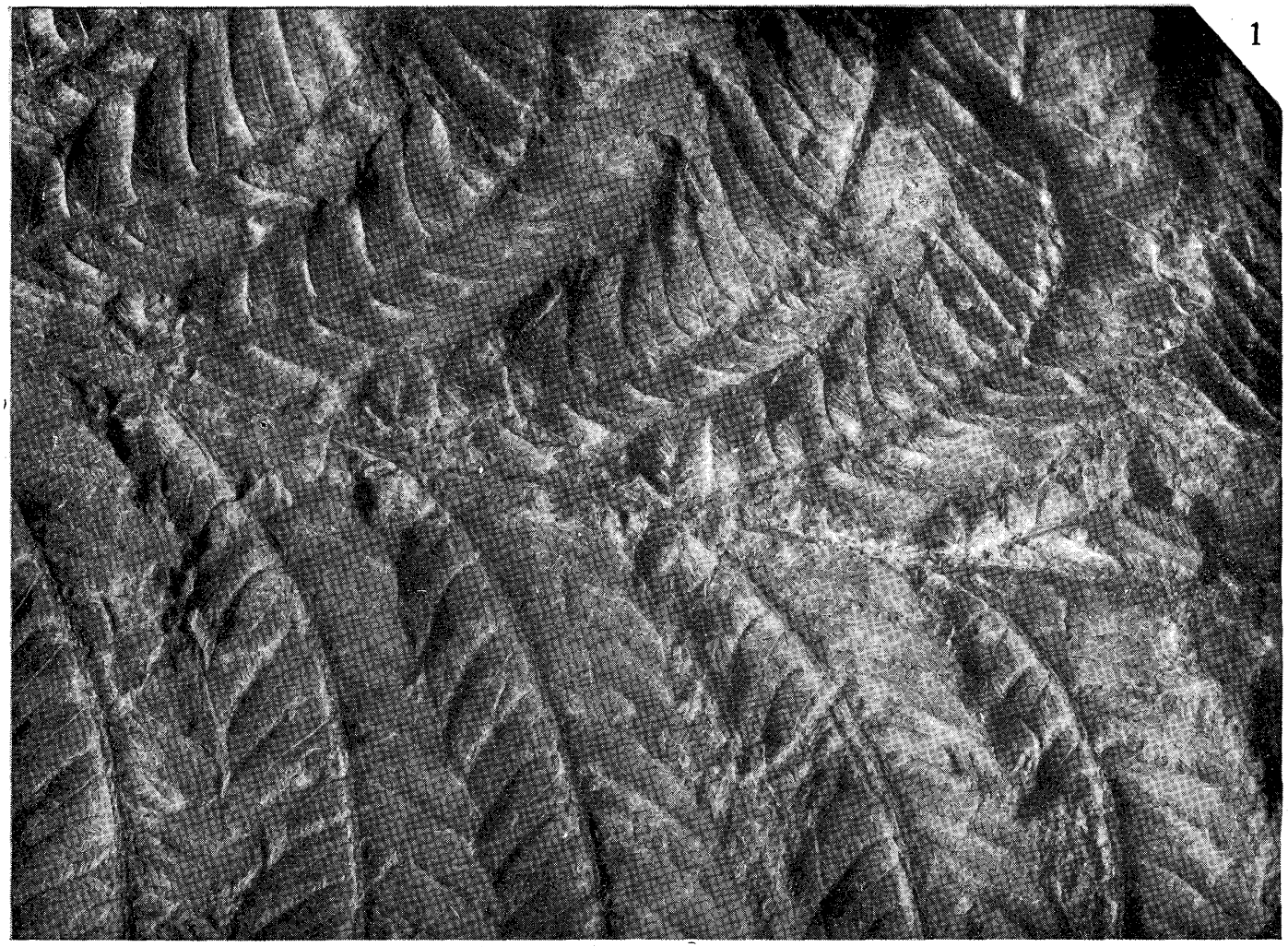


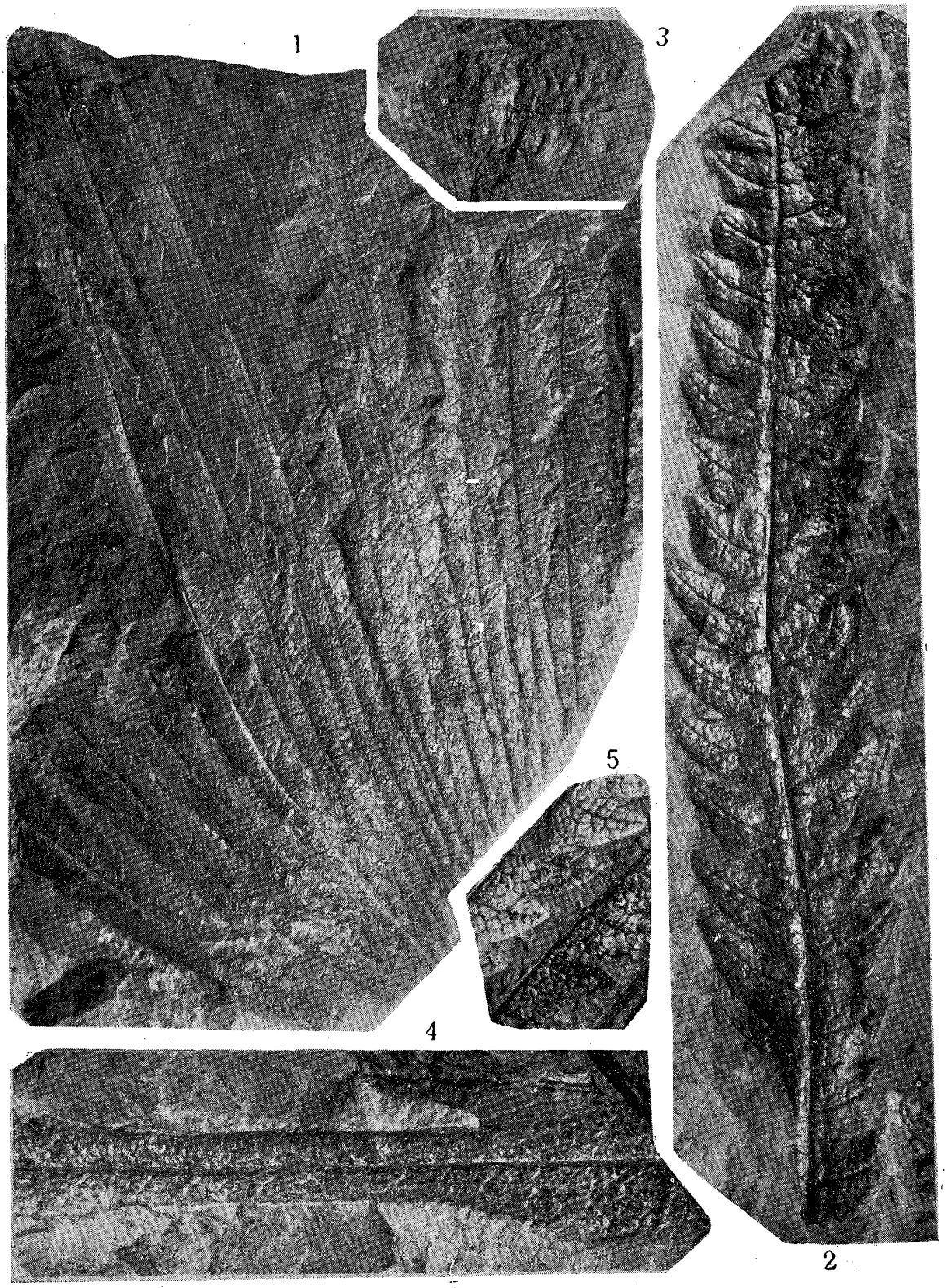
Fig. 1. *Cladophlebis denticulata* (Brongniart). A typical specimen. ×1/3
Fig. 2. *Cladophlebis denticulata* (Brongniart). Apical portion of a pinna. ×1
Fig. 3. *Woodwardites microlobus* Schenk. A fragmental frond. ×1.1
Fig. 3a. *Woodwardites microlobus* Schenk. Nervation of pinnules.

Pl. II



Cladophlebis denticulata (Brongn.) Fig. 1. The middle portion of Pl. I, fig. 1 enlarged, showing the shape of the pinnules. ×1.2
Fig. 2. Nervation of a pinnule.
Fig. 3. The lowest corner pinnule.

Pl. III



Dictyophyllum Nathorsti Zeiller.

Fig. 1.	A portion of a frond.	×2/3
Fig. 2.	Back surface of a pinna.	×1
Fig. 3.	Apical portion of a pinna	×1
Fig. 4.	Basal part of a pinna.	×1
Fig. 5.	Upper surface of pinnules. (Fertile frond.)	×1.1

Pl. IV

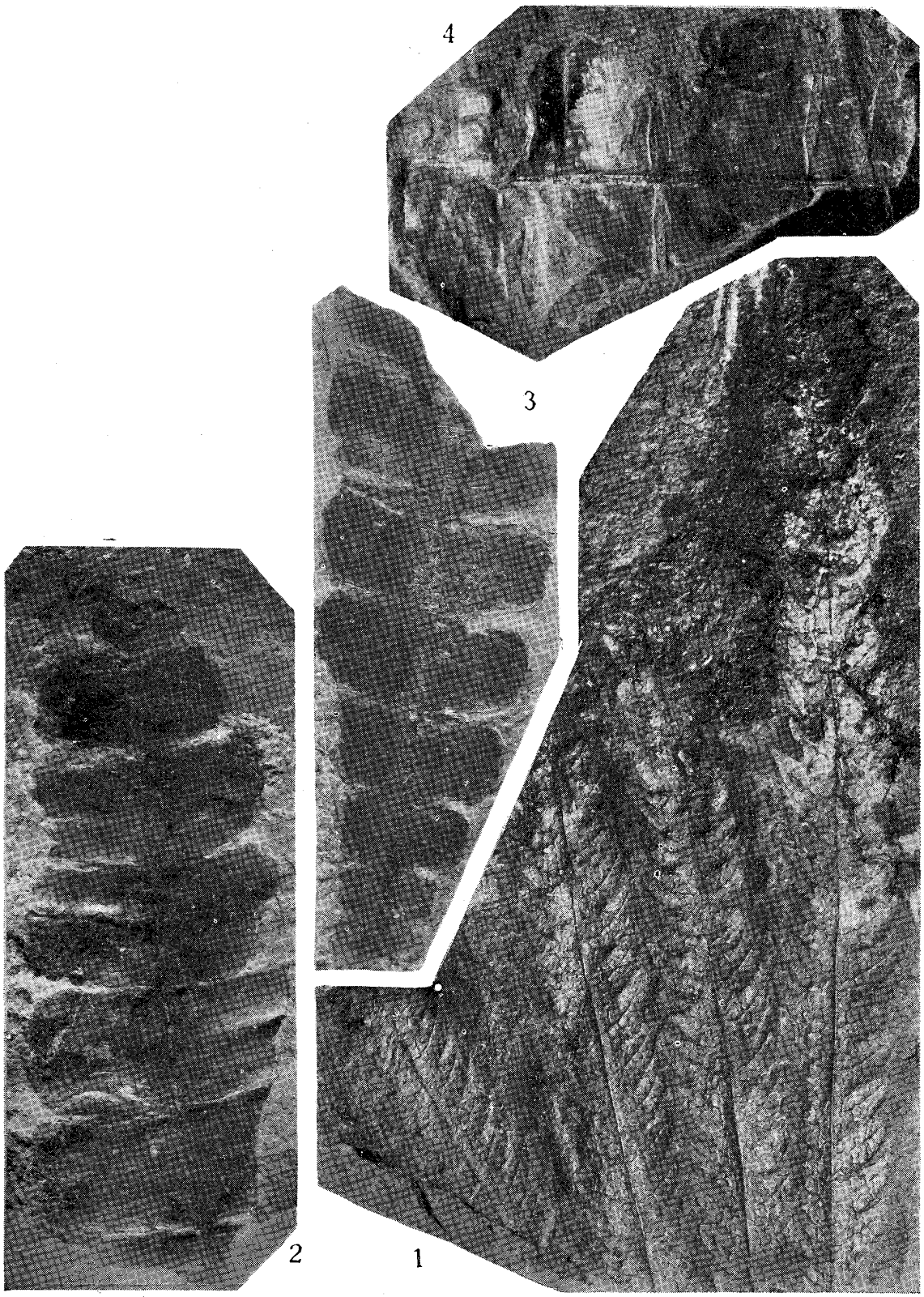


Fig. 1. *Dictyophyllum Nathorsti* Zeiller. Apical portion of a frond. (Back surface.) ×1
Fig. 2. *Pterophyllum portali* Zeiller. Apical portion of pinnae. ×1
Fig. 3. *Pterophyllum portali* Zeiller. Basal portion of a pinna. ×1
Fig. 4. *Pterophyllum portali* Zeiller. Middle portion of a pinna. ×1

Pl. V

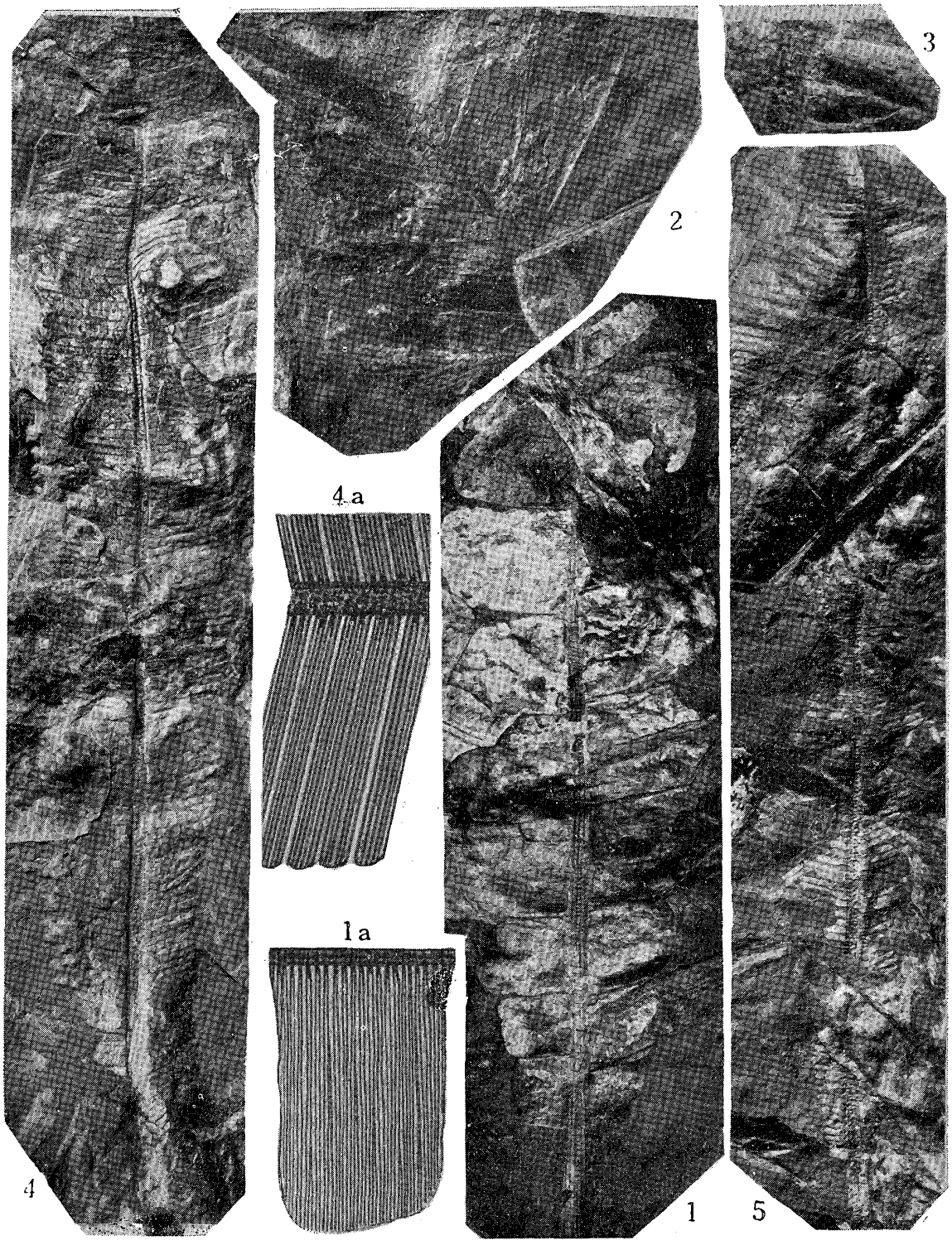
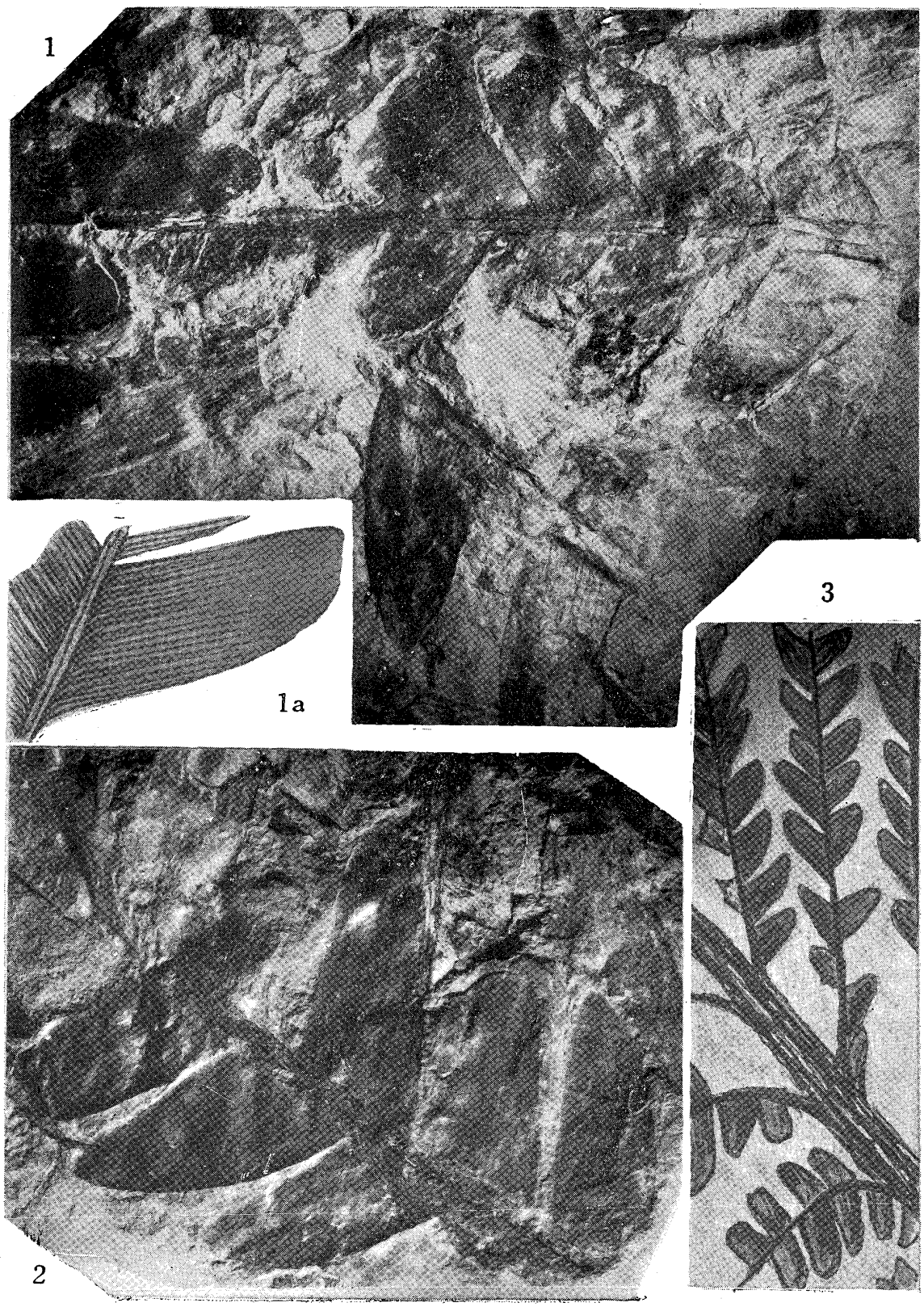


Fig. 1. *Pterophyllum portali* Zeiller. A pinna with petiole. ×1
Fig. 1a. *Pterophyllum portali* Zeiller. Nervation of segment.
Fig. 2. *Pterophyllum aequale* Brongniart. Basal part of a frond. ×1
Fig. 3. *Pterophyllum aequale* Brongniart. Basal part of a frond. ×1.2
Fig. 4. *Pterophyllum Bavieri* Zeiller. A pinna with petiole. ×1
Fig. 4a. *Pterophyllum Bavieri* Zeiller. Nervation of segments.
Fig. 5. *Pterophyllum Bavieri* Zeiller. ×1

Pl. VI

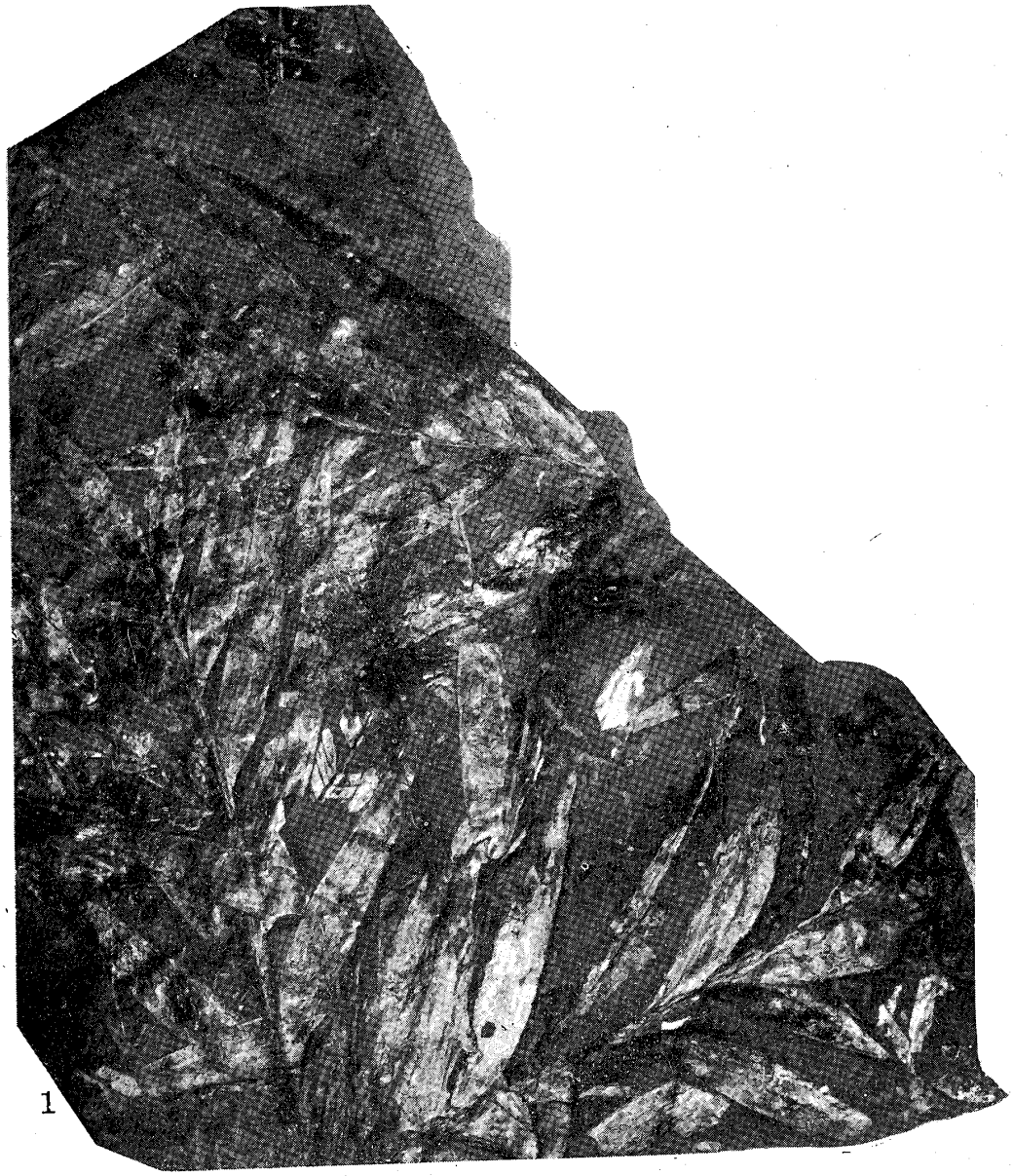


Ctenopteris Sarrani Zeiller.

Fig. 1. Crowded segments of pinnae. ×1
Fig. 1a. Nervation of a pinnule.
Fig. 2. A portion of a pinna. ×1
Fig. 3. A portion of a frond. (After Zeiller. ×1/3)

Pl. VII

2



1

Fig. 1. *Podozomites distans* (Presl). Many crowded leaves on three shoots. ×1/2
Fig. 2. *Carpolithus sp.* Two casts of kernel. ×3