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Late Jurassic Plants from the Oginohama Formation, Oshika Group in the Outer Zone of Northeast Japan (II)

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Bennettitales

Genus ***Ptilophyllum*** MORRIS, 1840: 327

Ptilophyllum linearifolium KIMURA et OHANA sp. nov.

(Pl. 9, figs. 1–4; Figs. 16a–c)

Ptilophyllum pecten (PHILLIPS) MORRIS; OISHI, 1940, p. 348 (pars), pl. 35, fig. 1 (Yuasa Formation); HIRATA, 1972, pl. 17 (Upper Monobegawa Formation).

Material: Holotype; HIRATA's collection, no. 12489 (kept in the MAKINO Botanical Garden). Paratypes; HIRATA's collection, no. 12488 (ditto) (counterpart of the holotype), NSM PP-8520 (Tomari). Specimens examined; NSM PP-8521, MMA-0073 (Moné Formation) and many other leaf-fragments.

Stratum typicum: Upper Monobegawa Formation (Aptian-Albian).

Locus typicus: Higashi-Kuma, Kochi City (roughly 133°23′01″E, 33°40′00″N).

Derivatio nominis: According to the markedly linear pinnae.

Occurrence: Rather rare at Tomari, but locally common at the type locality.

Diagnosis: Leaf pinnate, more than 9 cm long and up to 4.5 cm wide; rachis thin, up to 3 mm wide below, nearly parallel-sided for the most part. (Whole leaf unknown.) Pinnae set rather remotely, linear, and attached to the upper surface of rachis nearly perpendicularly, but angle reduced at both ends. Pinnae on the middle part of a leaf typically 2.2 cm long and up to 2 mm wide, gradually narrowed towards the obtusely pointed apex. Veins 6–8 in number in each pinna, simple, running in parallel, ending at the distal margins and not converging at apex. (Cuticle not preserved. Reproductive organs not known.)

Discussion and *comparison*: The present characteristic *Ptilophyllum* leaves were found from Tomari locality and similar leaves were also found from the Lower Cretaceous Upper Monobegawa Formation, Kochi Prefecture and the Upper Jurassic Moné Formation in the Outer Zone of Southwest and Northeast Japan respectively.

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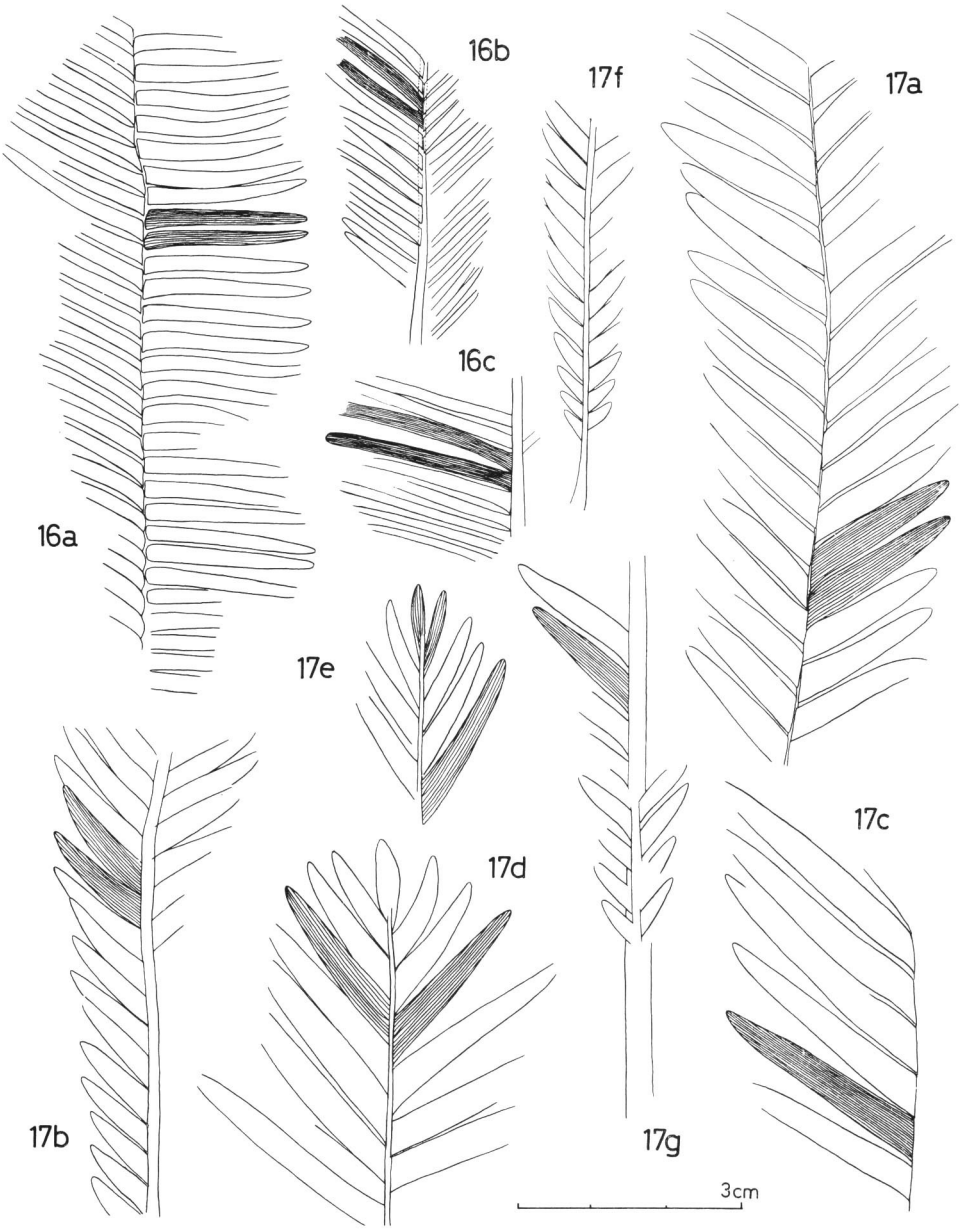


Figs. 16–17 (All natural size).

16. *Ptilophyllum linearifolium* KIMURA et OHANA sp. nov.: 16a. Drawn from the holotype (HIRATA's collection; Reg. no. 12489, kept in the MAKINO Botanical Garden). 16b. Drawn from Pl. 9, fig. 3 (NSM PP-8522; Tomari). 16c. Drawn from Pl. 9, fig. 4 (MMA-0073; Moné Formation; kept in the Tokyo Gakegei University).

According to our careful examination of these leaves, they are conspecific and we here establish a new *Ptilophyllum* species, *P. linearifolium*. Its holotype and one of the paratypes were chosen among the HIRATA's collection, because they were comparatively well-preserved.

Ptilophyllum linearifolium is characterized by its markedly linear pinnae. The ratio of L/W of pinnae is 10.5–(11)–11.3.

The leaf-fragments regarded by OISHI (1940. pl. 35, fig. 1) as *Ptilophyllum pecten* (PHILLIPS) from the Lower Cretaceous Yuasa Formation, Wakayama Prefecture are referable to the present *Ptilophyllum linearifolium*. Accordingly *Ptilophyllum linearifolium* is distributed in the Upper Jurassic-Lower Cretaceous plant-beds in the Outer Zone of Japan, although not abundant.

Similar leaves were described by BELL (1956) from the Lower Cretaceous of Western Canada as *Ptilophyllum* (*Anomozamites*) *montanense* (FONTAINE). But they are distinguished from *Ptilophyllum linearifolium* by their falcate pinnae each with a small number of veins (four in each pinna).

Ptilophyllum oshikaense KIMURA et OHANA sp. nov.

(Pl. 9, figs. 5–8; Pl. 10, figs. 1–3; Pl. 12, fig. 1; Figs. 17a–g)

Ptilophyllum pecten (PHILLIPS) MORRIS; OISHI, 1940, p. 348 (pars), pl. 32, fig. 5 (Oyagawa); OYAMA, 1954, pl. 1, figs. 1a, c (Samenoura).

Pterophyllum n. sp. b; OYAMA, 1954, p. 105, pl. 2, fig. 2 (Samenoura).

Nilssonia cf. *sinensis* YABE et OISHI; OYAMA, 1954, p. 105, pl. 3, fig. 3 (ditto).

Material: Holotype; NSM PP-8523 (Samenoura). Paratypes; NSM PP-8524, 8526, 8528 (Samenoura), 8525 (Tomari). Specimens examined; NSM PP-8529～8535 and many other specimens.

Stratum typicum: Oginohama Formation.

Locus typicus: Samenoura Coast (see Fig. 2 of our previous paper).

Derivatio nominis: After the Oshika Group.

Occurrence: Locally common.

Diagnosis: Leaf rather small-sized, elongated, parallel-sided for the most part, gradually narrowed towards both ends and with thick petiole. (Whole leaf unknown.) Leaf variable in size, the largest one more than 9.5 cm long and up to 4 cm wide and the smallest one more than 9 cm long and up to 2.5 cm wide. Pinnae alternate, closely set, subulate to elongate-deltoid in form, gradually narrowed from the base

17. *Ptilophyllum oshikaense* KIMURA et OHANA sp. nov.: 17a. Middle part of a leaf, drawn from the holotype (NSM PP-8523; Samenoura). 17b. Lower part of a leaf, drawn from Pl. 10, fig. 3 (paratype; NSM PP-8525: Tomari). 17c. Middle part of a leaf, drawn partly from Pl. 10, fig. 2 (NSM PP-8532), showing the crowded veins (15 in each pinna). 17d. Apical part of a leaf, drawn from Pl. 9, fig. 6 (NSM PP-8529; Samenoura). 17e. Ditto, drawn from Pl. 9, fig. 7 (NSM PP-8527; Samenoura). 17f. Lower part of a leaf, drawn from NSM PP-8535 (Tomari). 17g. Ditto, drawn from Pl. 9, fig. 8 (paratype; NSM PP-8526; Samenoura).

to obtusely pointed or rounded apex and attached to the upper surface of slender rachis at an angle of 55 degrees, but angle reduced near the both ends of a leaf. Veins originated at the base of pinna, simple, running in parallel, ending at the apical margins and not converging at apex; 10–13 in number in each pinna (13 per cm in density), but in some leaves veins 15 in number in each pinna. (Reproductive organs not known.)

Discussion and *comparison*: *Ptilophyllum oshikaense* is characterized by its rather small-sized, obliquely inserted and gradually narrowed pinnae. *Ptilophyllum oshikaense* is very close in pinna form and size to *P. jurassicum* originally described in our previous paper (KIMURA and OHANA, 1988) from the Tochikubo Formation, but is distinguished by its obliquely set pinnae narrowing gradually towards the obtusely pointed or rounded apex, instead of nearly perpendicularly set pinnae abruptly narrowing towards the pointed apex in the latter.

Two leaves illustrated by OISHI (1940, pl. 32, fig. 5) from Oyagawa (close to Samenoura) as *Ptilophyllum pecten* are referable undoubtely to *P. oshikaense*.

OYAMA (1954) described several bennettitaleans and cycadaleans from Samenoura. Of these, two leaves regarded by him as *Ptilophyllum pecten* (his pl. 1, figs. 1a, c) are indistinguishable from the holotype of *P. oshikaense*. It is highly probable that OYAMA's *Pterophyllum* n. sp. b (his pl. 2, fig. 2) and *Nilssonia* cf. *sinensis* (his pl. 3, fig. 3) also from Samenoura belong to our *Ptilophyllum oshikaense*. We are of the opinion that the former is represented by a proximal part of faily large-sized leaf (wrong-side view) and the latter is an extremely large-sized and spread leaf of *Ptilophyllum oshikaense* of which apical pinnae appear to come up to those of *P. jurassicum* in form and size, but the proximal pinnae are typical ones of *P. oshikaense*.

Many *Ptilophyllum* leaves had been described by the previous authors from the Upper Jurassic-Lower Cretaceous plant-beds in the Outer Zone of Japan as *P. pecten*. But we are of the opinion that there is no *Ptilophyllum* leaf safely referable to this well known species in the Mesozoic of Japan.

So far as we know, no similar *Ptilophyllum* leaf to those of *P. oshikaense* has been described in the Mesozoic of East and Southeast Asia and other regions.

Genus ***Weltrichia*** BRAUN em. HARRIS, 1969: 158

Weltrichia sp.

(Pl. 10, fig. 4A)

Material: NSM PP-8536. *Occurrence* and *locality*: A single broken male flower was obtained from Samenoura.

Description: Unfortunately this flower was represented by its reverse side, so that we could not observe such appendage as pollen sacs supposed to be seen on the adaxial side of its lobes. The flower consists of a massive cup more or less obliquely compressed, 2.7 cm in diameter dividing above into equal lobes; the depth of cup is uncertain, because the basal part of cup is missing. Preserved lobes are 12 in number, but originally they are supposed to be 14. The lobes taper to the obtusely

pointed apex, 3.7 cm long and 1 cm wide at the base and are longitudinally striated but with a strong median keel; margins are entire and no appendage is recognized.

Remarks: The present flower is preserved in close association with the leaves of *Zamites densipinnatus* (Pl. 10, fig. 4B).

Our flower resembles in general appearance and size that of *Weltrichia spectabilis* (NATHORST) described by HARRIS (1969) from Yorkshire in association with the leaves of *Otozamites gramineus* (PHILLIPS).

Two large-sized bennettitalean male flowers were illustrated by TURUTANOVA-KETOVA (1963) from the Lower Cretaceous of Southern Primorye as *Williamsonia pacifica* KRYSHTOFOVICH. This species is possibly distinguished from ours by its large-sized male flower with a large number of elongate lobes (possibly 17 or more).

Genus ***Williamsonia*** CARRUTHERS, 1870

Williamsonia sp.

(Pl. 11, fig. 1)

Material: NSM PP-8537. *Occurrence* and *locality*: A single supposed female flower was obtained from Oginohama.

Remarks: Obtained specimen is a spherical body covered with many bract-like organs, 7 cm in diameter. Unfortunately the details of its internal structure are uncertain. It is highly probable that this body is a bennettitalean female flower and thus we describe it provisionally as *Williamsonia* sp.

Cycadales

Genus ***Pseudoctenis*** SEWARD, 1911: 691

Pseudoctenis sp. cf. ***P. lanei*** THOMAS

(Pl. 11, fig. 2)

Pseudoctenis lanei THOMAS; OISHI, 1940, p. 322, pl. 29, figs. 1–3 (Oshika Group, exact horizon is uncertain).

Material: NSM PP-8538~8541. *Occurrence* and *locality*: Rare at Samenoura.

Description: Obtained specimens are all leaf-fragments of which two are represented possibly by the apical portion of leaves and one is by the middle-lower portion of a leaf. The rachis as shown in Pl. 11, fig. 2 is comparatively thick, 3 mm wide, and sends off long and narrow and rather remotely set pinnae which are 7.5 cm long and 5 mm wide at the middle region and attached to the lateral sides of rachis at an angle of about 50 degrees. The pinna is contracted near the base, then decurrent, gradually narrowed to a maximum width in the middle region and then gradually narrowed to an acuminate apex. Veins are once forked and 8 in number at the middle of each pinna.

The leaf (NSM PP-8540) shows a middle or lower portion of leaf; the rachis is

thick, 8 mm wide and sends off the pinnae perpendicularly.

Remarks: Although our leaves obtained are all fragmental, they are externally very similar in pinna-form to those of *Pseudoctenis lanei* THOMAS redescribed and illustrated in detail by HARRIS (1964) from Yorkshire.

OISHI (1940) described similar leaves from Koyatori locality (exact horizon uncertain) as *Pseudoctenis lanei*.

As our leaves are represented only by impression, we at present describe these leaves mentioned above as *Pseudoctenis* sp. cf. *P. lanei*.

KIMURA (1959) once described a leaf as *Pseudoctenis lanei* from the Upper Jurassic Kuzuryu Group in the Inner Zone of Japan. As mentioned by KIMURA (1959), the pinnae of that leaf is more or less broader and much decurrent. Therefore, we now think that the Inner Zone leaf is distinct from the present leaves specifically.

Pseudoctenis sp. described by KIMURA *et al.* (1986) from the Upper Liassic Nishinakayama Formation is also similar in pinna-form to the present *P.* sp. cf. *P. lanei*, but its pinnae are not acuminately pointed but obtusely pointed.

Genus ***Nilssonia*** BRONGNIART, 1825: 200

Nilssonia sp. cf. ***N. densinervis*** (FONTAINE) BERRY

(Pl. 11, figs. 3–4)

Nilssonia cf. *orientalis* HEER; OYAMA, 1954, p. 105, pl. 4, fig. 4 (Samenoura).

Material: Specimens examined; NSM PP-8542～8558, 8634. *Occurrence* and *locality*: Locally common at Tomari.

Description: The leaves obtained are all broken; both ends are missing. The leaves are usually broad, up to 6 cm wide and with a thick rachis, 5 mm wide. The lamina covers entirely the upper surface of rachis but often strips off to expose the upper surface of rachis. The lamina is divided rather regularly into squarish or rectangular segments and their angles are not rounded. Veins are simple, straight, parallel and 26 per cm in density.

Remarks: The present leaves are characterized by the broader laminae divided rather regularly into squarish or rectangular segments, and in this they differ from those described as *Nilssonia* sp. cf. *N. densinervis* from the Tochikubo Formation (KIMURA and OHANA, 1988) and as *N. densinervis* from the Lower Cretaceous plant-beds in the Outer Zone of Japan (e.g. KIMURA and KANSHA, 1978) of which the basiscopic apical angles are usually rounded or curved. However, as other features of our leaves are almost similar to those mentioned above, then we at present describe our leaves as *Nilssonia* sp. cf. *N. densinervis*.

It is highly probable that *Nilssonia* sp. cf. *N. densinervis* hitherto known from the Middle Jurassic Utano Formation and from the Upper Jurassic-Lower Cretaceous plant-beds in the Outer Zone of Japan contains 2 or 3 natural *Nilssonia* species.

Nilssonia sp. cf. ***N. oblique-truncata*** KIMURA et OHANA

(Pl. 12, fig. 2)

Material: NSM PP-8564~8566. *Occurrence* and *locality*: Rare at Samenoura.

Remarks: Three broken *Nilssonia* leaves were obtained. Although all of their pinna apices are missing, they are very similar to those of *Nilssonia oblique-truncata* originally described by us (KIMURA and OHANA, 1988) from the Tochikubo Formation in leaf-size and pinna-form and size. Therefore, we here describe them provisionally as *Nilssonia* sp. cf. *N. oblique-truncata*.

Nilssonia ex gr. ***schaumburgensis*** (DUNKER) NATHORST

Material: Specimens examined; NSM PP-8559~8563 and many other leaf fragments. *Occurrence* and *localities*: Locally common at Tomari and Samenoura.

Remarks: *Nilssonia schaumburgensis*-type leaves are common in the Upper Jurassic-Lower Cretaceous plant-beds in the Outer Zone of Japan, and the Upper Jurassic (or Lowermost Cretaceous) Kiyosué Formation and Lower Cretaceous Gyeongsang Group (Nagdong or Naktong Formation) exposed in the Mixed Zone (e.g. KIMURA, 1984, 1987, 1988) in between the Inner and Outer Zones of Southwest Japan and in South Korea respectively.

The present leaves agree well with those described by us (KIMURA and OHANA, 1988b) from the Tochikubo Formation as *Nilssonia* ex gr. *schaumburgensis* in all respects.

It is difficult to know whether the present *Nilssonia* ex gr. *schaumburgensis* is conspecific with the original *N. schaumburgensis* described from the European Wealden, or not, depending only on their external morphology.

Coniferales

Form-genus ***Elatocladus*** HALLE em. HARRIS, 1979: 104

Elatocladus sp. B

(Fig. 18)

Material: NSM PP-8567~8570. *Occurrence* and *locality*: Rate at Tomari.

Description: Four broken sterile leafy-shoots were obtained. The leaves are homomorphic, bifacial and spirally disposed, but expanded in approximately the same plane by twisting of the decurrent leaf bases. The leaves are linear, uninerved, typically 1 cm long and up to 1.5 mm wide, constricted at the base and with obtusely pointed apex.

Remarks: As the details of our leafy-shoots are too indistinct to afford any proof of affinity of conifer, we at present unavoidably regard them as *Elatocladis* sp. B.

Externally similar leafy-shoots were described by KRASSILOV (1967) from the Lower Cretaceous of Southern Primorye such as *Torreya nicanica* KRASSILOV and

Tomharrisia florinii KRASSILOV.

Form-genus ***Cupressinocladus*** SEWARD, 1919: 307

Cupressinocladus koyatoriensis OISHI

(Pl. 11, fig. 5; Figs. 19a–b)

Material: Specimens examined; NSM PP-8571～8591 and many other broken leafy-shoots. *Occurrence* and *localities*: Locally common at Tomari and Samenoura.

Description: Many detached leafy-shoots were obtained, but none of them was complete. The preserved leafy-shoots are branched in one plane. The leaves are arranged in decussate pairs, small, spatulate or rhomboidal in form, 2–3 mm long and up to 1–1.5 mm wide, keeled dorsally and with obtusely pointed apex. The leaves in one pair are closely appressed to the axis, while those of the other pair are free except for their bases and mostly directed aside at an angle of 50 degrees. Reproductive organs are unknown.

Remarks: Our leafy-shoots agree well with those of *Cupressinocladus koyatoriensis* originally described by OISHI (1940) from the same localities in all respects.

Similarly looking sterile leafy-shoots were already mentioned by OISHI (1940).

Cupressinocladus sp. C

Cupressinocladus sp. C: KIMURA and OHANA, 1987a, p. 22, pl. 1, figs. 5–7; text-figs. 8a–b.

Material: Specimens examined; NSM PP-8592～8606 (Tomari), 8607～8609 (Onagawa).

Occurrence and *localities*: Locally common at Tomari and rare at Onagawa.

Remarks: Many sterile leafy-shoots were obtained. They resemble those of *Cupressinocladus* sp. C described by KIMURA and OHANA (1987a) from the Lowermost Cretaceous Ayukawa Formation, Oshika Group.

Unfortunately the present leafy-shoots are too incomplete to be determined with accuracy.

Genus ***Parasequoia*** KRASSILOV, 1967: 212

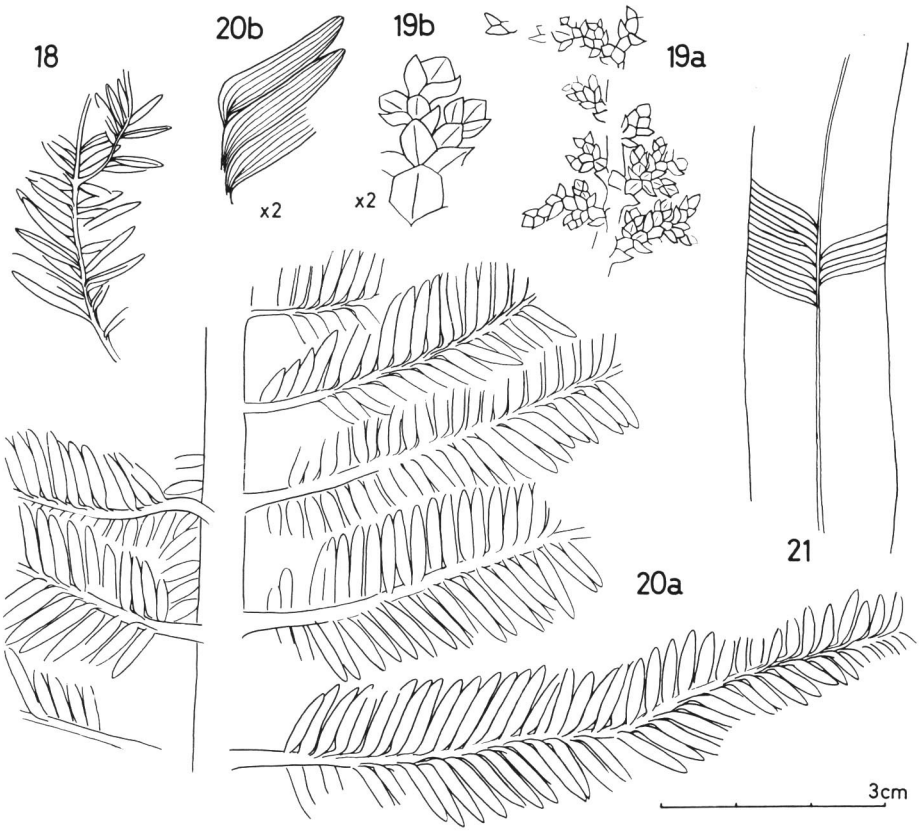
Parasequoia sp. cf. ***P. cretacea*** KRASSILOV

(Pl. 12, fig. 3; Pl. 13, fig. 1; Figs. 20a–b)

Parasequoia sp. cf. *P. cretacea* KRASSILOV; KIMURA and OHANA, 1988b, p. 170, pl. 16, figs. 5–6; Figs. 30a–b. (Tochikubo Formation).

Material: Specimens examined: NSM PP-8610～8622, 8633 and many other broken laefy-branches. *Occurrence* and *locality*: Locally common at Samenoura.

Description: Many leafy-branches were obtained. Fig. 20a shows a part of a



Figs. 18–21 (All natural size, unless otherwise indicated).

18. *Elatocladus* sp. B; drawn from NSM PP-8568 (Tomari).
19. *Cupressinocladus koyatoriensis* OISHI: 19a. Leafy branches, drawn partly from NSM PP-8582 (Tomari). 19b. Showing the arrangement of leaves, enlarged partly from Fig. 19a.
20. *Parasequoia* sp. cf. *P. cretacea* KRASSILOV: 20a. Leafy branches, drawn partly from NSM PP-8610 (Samenoura). 20b. Enlarged partly from Fig. 20a, showing the venation of leaves.
21. *Taeniopteris* sp. F; drawn partly from Pl. 10, fig. 6 (NSM PP-8623; Tomari), showing the venation.

leafy-branch of which preserved main axis is 6 mm wide and sends off ultimate leafy-branches pinnately and oppositely at a wide angle or perpendicularly. The ultimate leafy-branch in this specimen is about 9 cm long and 2 cm wide at the base, gradually narrowed towards the apex. The branch axis is thin, 2 mm wide and sends off about 40 pairs of decussately disposed leaves. The leaves are shortly petioled, but their decurrent petioles are bended and twisted to bring each lamina into the horizontal plane at a wide angle to the branch-axis. Between the ultimate leafy-branches 4–5

opposite pairs of leaves are directly attached to the lateral sides of preserved main axis. The leaves are linear, contracted at the base and with obtusely pointed or rounded apex; typically 1 cm long and 2 mm wide, but those of apical portion of ultimate branch and of directly attached to the preserved main axis are oblong or short elliptical in form 5–7.5 mm long and up to 2 mm wide. Veins are 2 ~ 5 in number at their origin some of which are forked once near the base of leaf, then typically 5 in number at the middle of leaf and are parallel with each other and end at the distal margins; they do not converge at apex.

Pl. 12, fig. 3 shows a splendid specimen of which the preserved main axis is 1 cm wide and sends off two kind of branches; one is the same habit as the ultimate leafy-branches as shown in Fig. 20a, but they are more than 11 cm long in this specimen, and the other is more elongated and developed ones with thick axis, 3–5 mm wide. The latter branch-axis sends off the normal leaf pairs for its proximal one-third of length, but for its apical two-thirds it sends off opposite pairs of shorter and subtended leafy-branches at every 4–5 shorter leaves attached directly to the branch-axis. The shorter leafy-branch is oblong in form, about 4.5 cm long and up to 1.5 cm wide.

Reproductive organs are not known.

Remarks: Similar leafy-branches to that shown in Fig. 20a were already described by us (KIMURA and OHANA, 1988b) from the Tochikubo Formation as *Parasequoia* sp. cf. *P. cretacea*. But the presence of elongated and developed leafy-branches as shown in Pl. 12, fig. 3 is the first finding among our numerous specimens obtained.

Similar branching habit to that shown in Pl. 12, fig. 3 has been noticed in most of extant conifers and taxads. It is, however, difficult to ascertain whether our leafy-branches and leaves are deciduous like those of extant *Metasequoia* and *Taxodium* or not, but among our numerous specimens, the positive proof that our leafy-branches and leaves are deciduous has not been recognized.

As mentioned in our previous paper (KIMURA and OHANA, 1988b), our leafy-branches resemble closely those of *Parasequoia cretacea* originally described by KRASSILOV (1967) from the Lower Cretaceous of Southern Primorye. According to KRASSILOV (1967), his *Parasequoia* is taxodiaceous on the basis of its cuticular features, but so far as our leafy-branches are concerned, there is no proof that they belong to a certain taxodiaceous conifer. In addition, the leaves of extant taxodiaceous conifers are usually uninerved, while our leaves are characterized by their parellel veins, typically 5 in number in each leaf.

Unclassified plant

Form-genus ***Taeniopteris*** BRONGNIART, 1828: 31

Taeniopteris sp. F

(Pl. 10, figs. 5–6; Fig. 21)

Material: Specimens examined; NSM PP-8623～8631. *Occurrence* and *locality*: Rather rare at Tomari.

Description: Small-sized leaves (or pinnae) were obtained. They are belt-like, nearly lanceolate in outline, more than 6.5 cm long and up to 4 cm wide and narrowed gradually towards possibly rounded apex; basal part is missing. The laminae are attached to the lateral sides of a thin rachis and with entire margins, not dividing into segments. Veins are mostly forked at the base, but some are forked near the base or simple and at an angle of 65–70 degrees to the rachis; density is 11 per cm at the margin.

Remarks: Our leaves (or pinnae) are too insufficiently preserved to make specific identity and detailed comparison with other species. Therefore, we describe them provisionally as *Taeniopteris* sp. F.

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Explanation of plates

(All natural size, unless otherwise indicated)

Plate 9:

Figs. 1–4. *Ptilophyllum linearifolium* KIMURA et OHANA sp. nov.: 1. Middle part of a leaf (paratype; HIRATA's collection, Reg. no. 12488, kept in the MAKINO Botanical Garden, Kochi City: Loc. Higashi-Kuma, Kochi City; Upper Monobegawa Formation). 2. Ditto (holotype; ibid.; Reg. no. 12489). 3. Ditto (NSM PP-8522; Tomari). 4. Ditto (MMA-0073; Moné Formation, collected by H. AIBA; at present kept in Tokyo Gakugei University).

Figs. 5–8. *Ptilophyllum oshikaense* KIMURA et OHANA sp. nov.: 5. Middle-lower part of a leaf (paratype; NSM PP-8528; Samenoura). 6. Apical part of a leaf (NSM PP-8529; Samenoura). 7. Ditto (paratype; NSM PP-8527; Samenoura). 8. Proximal part of a leaf with petiole (paratype; NSM PP-8526; Samenoura).

Plate 10:

Figs. 1–3. *Ptilophyllum oshikaense* KIMURA et OHANA: 1. Middle part of a leaf (paratype; NSM PP-8524; Samenoura). 2. Ditto (NSM PP-8532; Tomari). 3. Lower part of a leaf (paratype; NSM PP-8525; Tomari).

Fig. 4A. *Weltrichia* sp.: In association with lower part of a leaf of *Zamites densipinnatus* (Fig. 4B) (NSM PP-8536; Samenoura).

Figs. 5–6. *Taeniopteris* sp. F: 5. Upper part of a leaf (NSM PP-8624; Tomari). 6. Middle part of a leaf (NSM PP-8623; Tomari).

Plate 11:

Fig. 1. *Williamsonia* sp. (NSM PP-8537; Oginohama).

Fig. 2. *Pseudoctenis* sp. cf. *P. lanei* THOMAS: A broken leaf (NSM PP-8538; Samenoura).

Figs. 3–4. *Nilssonia* sp. cf. *N. densinervis* (FONTAINE) BERRY: 3. Middle part of a leaf (NSM PP-8542; Tomari). 4. Ditto (NSM PP-8634; Tomari).

Fig. 5. *Cupressinocladus koyatoriensis* OISHI; showing a part of leafy-branch (NSM PP-8571; Tomari).

Plate 12:

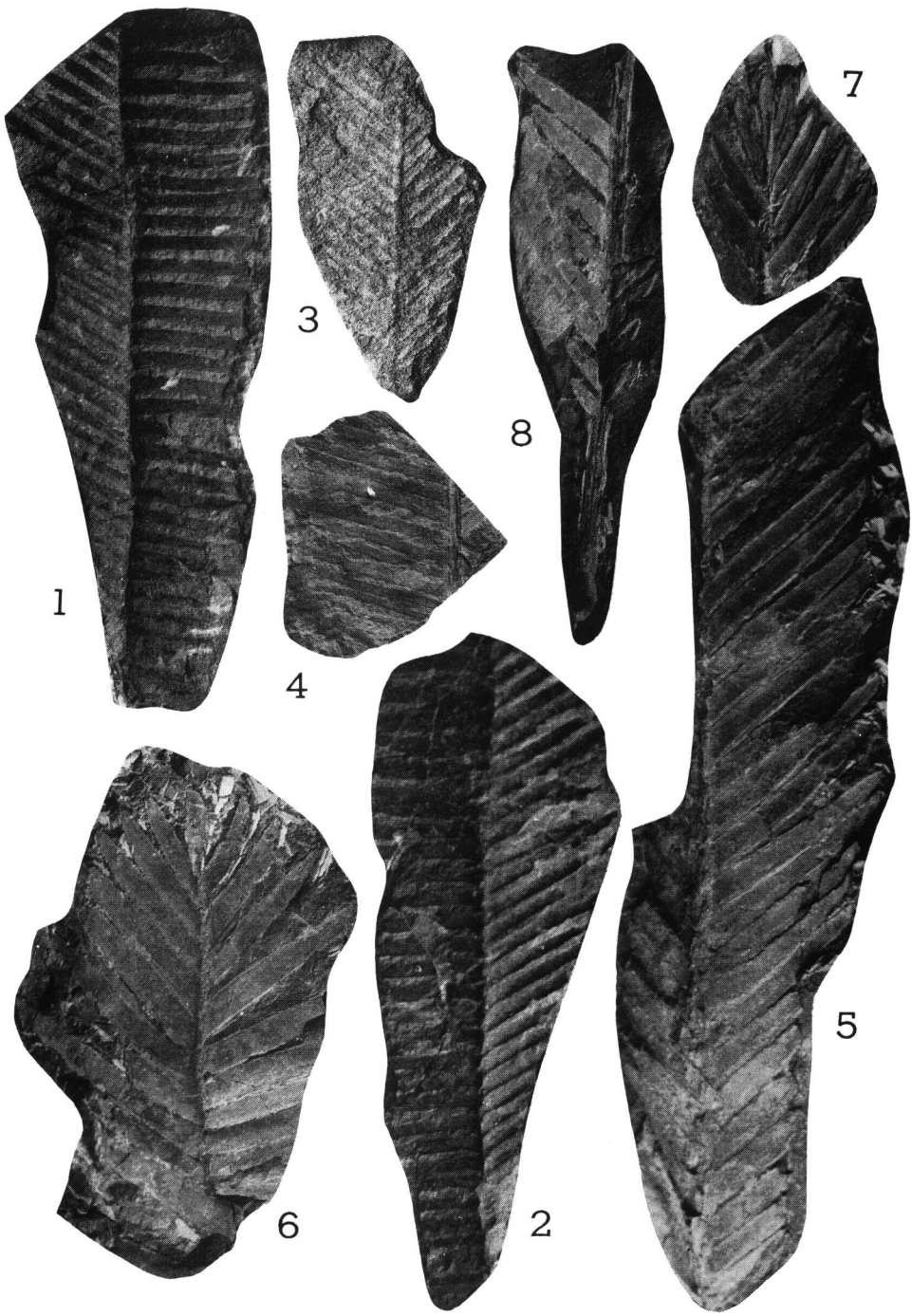
Fig. 1. *Ptilophyllum oshikaense* KIMURA et OHANA sp. nov.: showing the middle-lower part of a leaf (NSM PP-8543; Tomari).

Fig. 2. *Nilssonia* sp. cf. *N. oblique-truncata* KIMURA et OHANA; showing a broken leaf (NSM PP-8564; Samenoura).

Fig. 3. *Parasequoia* sp. cf. *P. cretacea* KRASSILOV; showing the main and lateral leafy-branches and leaves directly attached to both axes (reduced in 1/2; NSM PP-8633A; Samenoura).

Plate 13:

Fig. 1. *Parasequoia* sp. cf. *P. cretacea* KRASSILOV: Enlarged partly from the specimen illustrated in Pl. 12, fig. 3 (natural size).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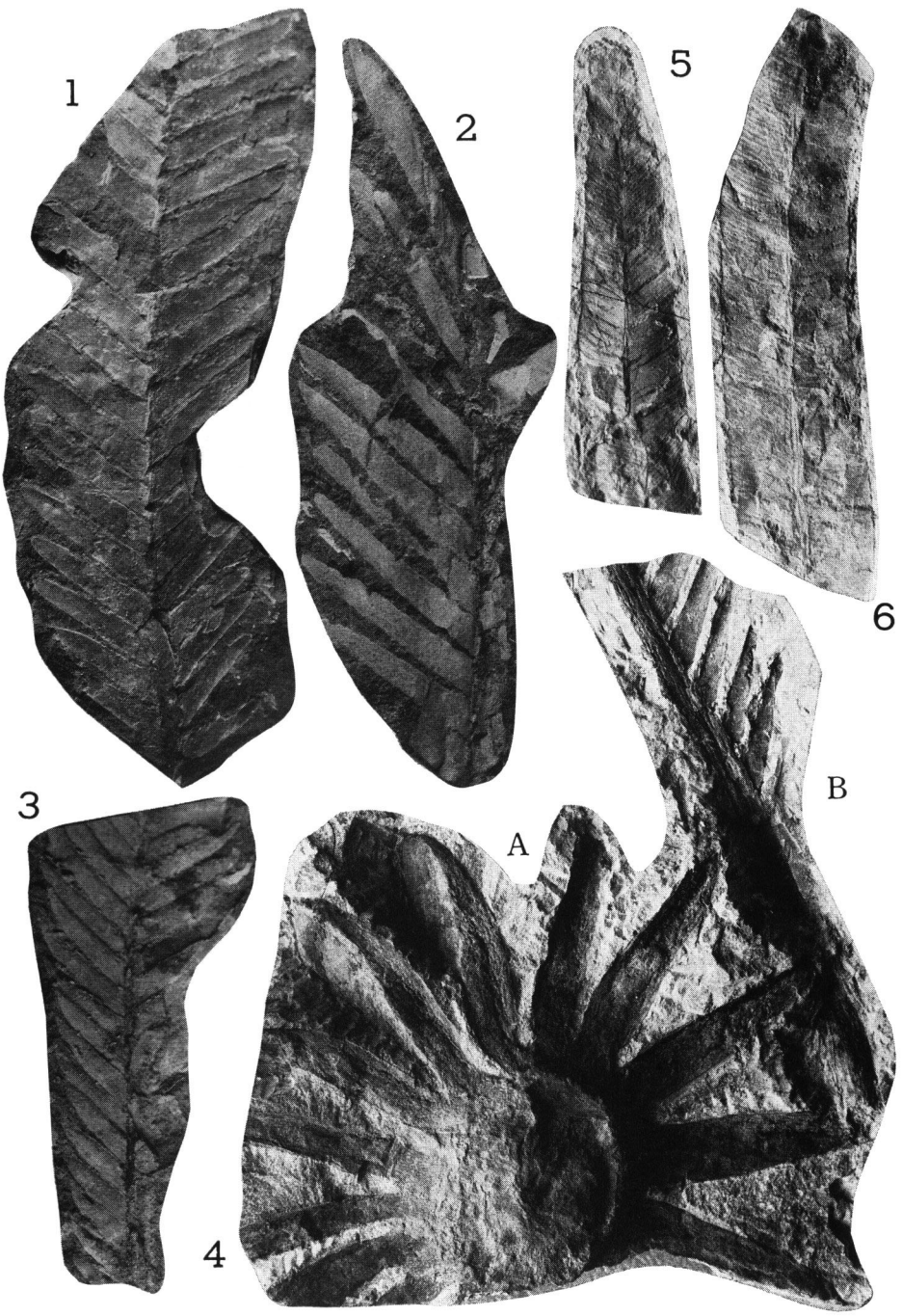
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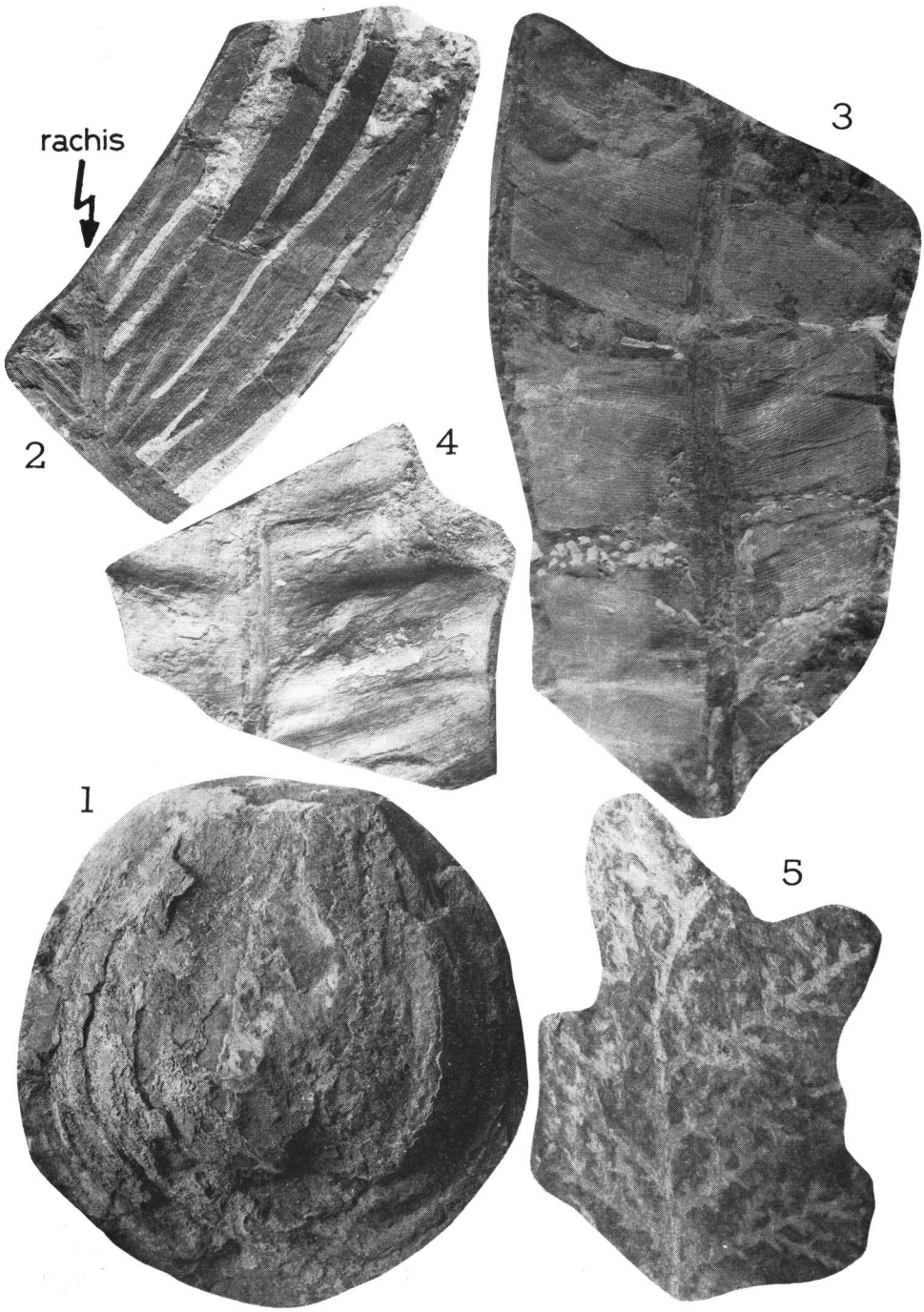
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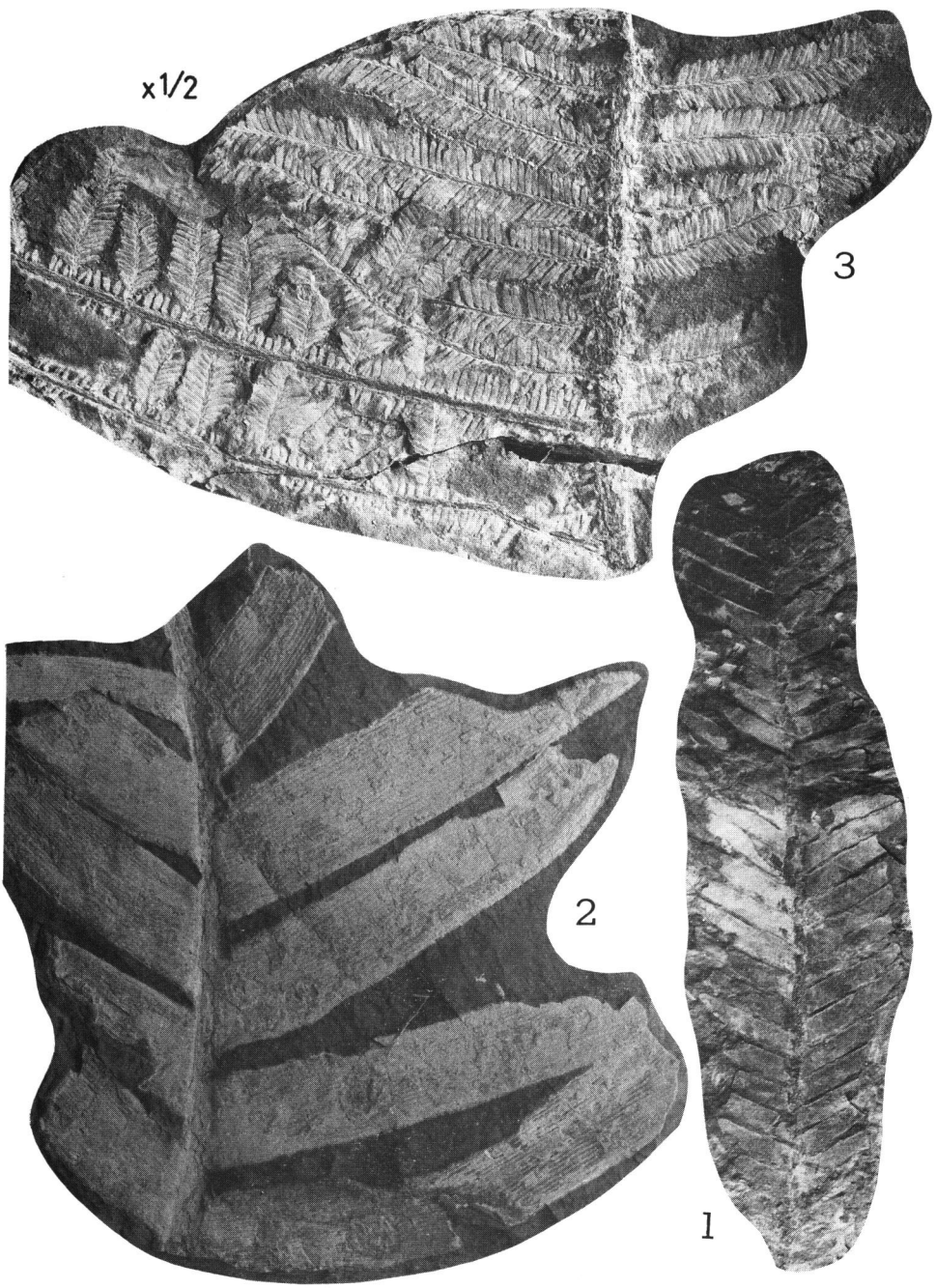
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