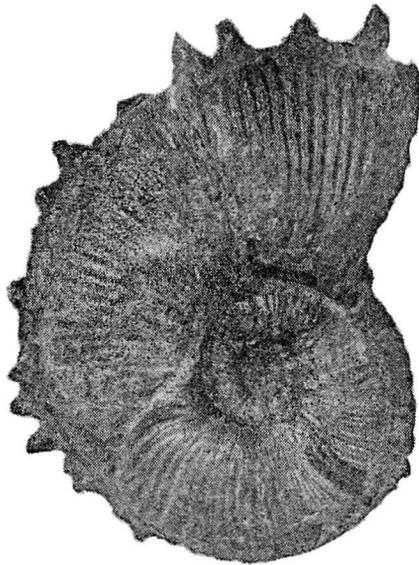


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The fossil on the cover is an adult example (T. TAKAHASHI coll.) of *Mikasaites orbicularis* MATSUMOTO (subfamily Marshallitinae, family Kossmaticeratidae) from the Lower Cenomanian (Cretaceous) of the Mikasa area, central Hokkaido. (photo by M. NODA, natural size)

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737. EARLY JURASSIC PLANTS IN JAPAN. PART 3\*

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**Abstract.** This is the third of our serial papers on the early Jurassic plants in Japan. In this paper we describe *Phlebopteris* sp. A (Matoniaceae), *Coniopteris neiridaniensis* sp. nov. (Dicksoniaceae), *Clathropteris meniscoides*, *Dictyophyllum kotakiense* sp. nov., *Thaumatopteris elongata*, *Hausmannia (Protorhipis)* sp. A (Dipteridaceae) and the following sterile fern leaves: Cfr. *Asterotheca okafujii*, Cfr. *Todites fukutomi*, Cfr. *T. yamanoiensis*, *Sphenopteris* sp. A, *Cladophlebis kurumensis* sp. nov., *C. pseudodelicatula*, *C. raciborskii*, *C. sp. A*, *C. sp. B* and *C. sp. C*.

**Introduction and  
acknowledgements**

In continuation of our previous papers (KIMURA and TSUJII, 1980a, b), we here describe the fern leaves belonging to the families Matoniaceae, Dicksoniaceae and Dipteridaceae, and also other sterile fern leaves from the Lower Jurassic Kuruma Group and Iwamuro Formation. The details of the stratigraphy of plant-bearing formations and fossil localities were given in our first paper (KIMURA and TSUJII, 1980a).

We express our sincere gratitude to Professor Emeritus Thomas M. HARRIS, F.R.S. of the University of Reading for his helpful suggestions and critical reading over the present manuscript. Our thanks are extended to Mr. Gumpei MORI, Mr. Noriyuki SASAKI and Mr. Akihiro KOBAYASHI who helped us in collecting the fossil plants.

**Systematic description**

Family Matoniaceae

Genus *Phlebopteris* BRONGNIART,  
1836: 371

*Phlebopteris* sp. A

Pl. 30, Fig. 1; Text-figs. 1a, b

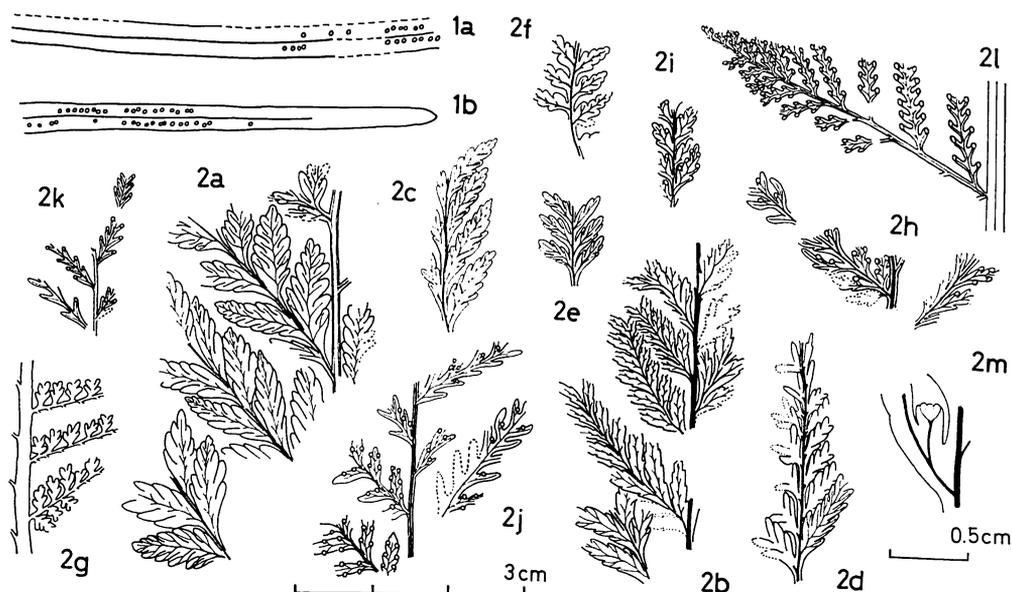
*Material*: NE-046, 123, 134, 146 (Neiridani).

*Description*.—Four detached pinnules were obtained. They are long and narrow, nearly parallel-sided, more than 5.5 cm long and 0.3-0.4 cm wide. The midnerve is distinct but lateral veins are invisible. Sori are on both side of the midnerve, 500  $\mu$ m in diameter, consisting of 6 sporangia of about 200  $\mu$ m in diameter around a placenta, about 75  $\mu$ m in diameter. Details of sporangia are uncertain.

*Distribution and occurrence*.—*Phlebopteris* sp. is rare and known only from the Negoya Formation.

*Remarks*.—Our pinnules are ill-preserved and specifically indeterminable. But they remind us of those of *Phlebopteris polypodioides* BRONGNIART and *Matonia*

\* Received June 13, 1981; Read October 11, 1980 at Toyama.



Text-figs. 1-2 (All natural size, unless otherwise indicated).

1. *Phlebopteris* sp. A. 1a: An incompletely preserved fertile pinnule, open circles indicate the position of placenta (NE-146). 1b: Fertile pinnule (NE-123). In both specimens lateral veins are invisible.
2. *Coniopteris neiridaniensis* KIMURA and TSUJII sp. nov. Sterile leaves (2a-f). 2a: The largest specimen bearing large-sized pinnules with deeply lobed margins (NNW-293, holotype; Pl. 30, Fig. 2). 2b: A penultimate pinna with medium-sized pinnules (NEG-120, paratype; Pl. 30, Fig. 4). 2c: An ultimate pinna (fertile?; sori invisible) with large-sized pinnules (NNW-590, paratype; Pl. 30, Fig. 3). 2d: Ditto (NNW-777, paratype). 2e: A pinna with medium-sized pinnules (NNW-671, paratype). 2f: Ditto (DAI-055, paratype; Pl. 30, Fig. 5). Fertile leaves (2g-m). 2g: (A-0480; sori not drawn). 2h: (NNW-005, paratype). 2i: (NNW-001, paratype). 2j: A penultimate pinna, with small-sized sterile pinnules with entire margins (NNW-765, paratype). 2k: (NNW-561, paratype; Pl. 30, Fig. 6). 2l: (NE-053, paratype; Pl. 30, Fig. 6). 2m: A sorus and venation drawn from 2i.

*braunii* (GOEPPERT) (see HARRIS, 1980).

*Coniopteris neiridaniensis* KIMURA  
and TSUJII sp. nov.

Family Dicksoniaceae

Pl. 30, Figs. 2-7; Text-figs. 2a-m

Genus *Coniopteris* BRONGNIART,  
1849: 26

Dicksoniaceous ferns are rather rare in the Lower Jurassic plant-beds of Japan and *Coniopteris neiridaniensis* is the only one known.

*Material*: Holotype; NNW-292 (Nishi-Neiridani). Paratypes; NNW-590, 671, 777, NEG-120 (Negoya), DAI-055 (Dairagawa) (sterile leaves), NNW-001, 005, 561, 765, NE-053 (Neiridani) (fertile leaves). Other specimens; NNW-293 and other 16 specimens, NEE-307 (Higashi-Neiridani), NE-157, 160, DAI-071, NEG-041, 110, 262, A-0480, 75064, 7207021 (Iwamuro). *Stratum typicum*: Negoya For-

mation, Kuruma Group. *Locus typicus*: Nishi-Neiridani, a branch of the Dairagawa, Asahimachi, Shimo-Niikawa-gun, Toyama Prefecture. *Derivatio nominis*: After the Neiridani Valley where the holotype and most of paratypes were collected.

*Diagnosis*.—Leaves at least tripinnate, partly sterile and partly fertile. Rachis rather slender, up to 2 mm wide, smooth, grooved above and rounded below. (Whole leaf unknown.) Penultimate and ultimate pinnae elongate-ovate in outline, attached to the slender pinna rachis an angle of 55–60 degrees. Pinnules katadromic in order, varied in size and manner of lobing in different part of the leaf. Pinnules elongate-rhomboid or elongate-oblong in outline, asymmetrical, apex obtuse or rounded; lamina decurrent to form a web along the pinna rachis. Large-sized pinnules typically 1.5 cm long and 3.5 mm wide, deeply dissected into lobes; lobes 5–6 pairs, directed forwards and with rounded apex. Medium-sized pinnules typically 0.5–0.7 cm long and 1.5–2.5 mm wide, and with shallowly lobed or undulated margins; lobes or undulations 4 pairs, apices rounded directed forwards. Basal pinnules not specialized. Small-sized pinnules elongate-triangular or rectangular, entire, 3 mm long and 0.5 mm wide, apex obtusely pointed or rounded. Venation appearing sympodially branched; lateral veins corresponding to lobes or undulations. Lateral veins generally simple in medium- and small-sized pinnules but once forked in large pinnules.

Fertility varying from fully fertile to occasionally fertile; fully fertile lamina more or less reduced. Sori borne simply on the apices of lobes, predominantly on the apices of acroscopic lobes, semi-circular, typically 550  $\mu$ m in diameter. (Details of sorus unknown.)

*Distribution and occurrence*.—*Coniopteris neiridaniensis* occurs rarely in the Negoya

Formation of Kuruma Group and the Iwamuro Formation.

*Discussion and comparison*.—Unfortunately it is not clear whether the indusium of *Coniopteris neiridaniensis* is cup-shaped or bivalvate.

*Coniopteris neiridaniensis* is characterized by its sterile pinnules, especially by its large- and medium-sized pinnules deeply or shallowly divided into lobes with a rounded apex and each lobe with a simple or once forked lateral vein.

*Coniopteris neiridaniensis* differs from *C. hymenophylloides* (BRONGNIART) as emended by HARRIS (1961) in its basal pinnules. In *Coniopteris hymenophylloides* the first basicopic lobe of the basal basicopic pinnule develops as filiform processes lying over the rachis, and that of the opposite pinnule also lies over the rachis. Instead, *Coniopteris neiridaniensis* has unspecialized basal lobes.

Among the leaves having been regarded as *Dicksonia*, *Thyrsopteris* and *Coniopteris hymenophylloides* by the previous authors from Japan, Korea and China, the following are rather like *Coniopteris neiridaniensis*:

- 1) The following leaves described by YOKOYAMA (1889) from the Lower Cretaceous Oguchi Formation. They were later determined by OISHI (1940) as *Coniopteris hymenophylloides*:  
*Dicksonia nephrocarpa* BUNBURY; p. 25, pl. 1, figs. 1, 1a (non 1b).  
*Thyrsopteris prisca* EICHWALD; p. 23, pl. 1, figs. 3, 3a, 4: His sterile pinnules are similar in form to ours, but their lateral veins are twice or thrice forking in his fig. 3a.  
*T. murrayana* BRONGNIART; p. 22, pl. 12, fig. 5.
- 2) A sterile leaf described by YOKOYAMA (1906) from the Jurassic of Fang-zi, Shandong, China as *Coniopteris hymenophylloides* (p. 24, pl. 6, fig. 3),

venation not known.

- 3) Sterile leaves described by KAWASAKI from the Daedong Group, Korea as *Coniopteris hymenophylloides* (1925, p. 7, pl. 6, fig. 23; pl. 13, fig. 44, 44a: 1926, p. 14, pl. 4, fig. 13: 1939, p. 22, pl. 2, fig. 11?).

KRASSILOV (1978) placed the well-known species *Coniopteris burejensis* (ZALESSKY) SEWARD in the genus *Dicksonia*, because he found that their indusia were not cup-shaped but bivalvate. He revived HEER's name *Dicksonia concinna* for the leaves formerly regarded as *C. burejensis* in the Bureja Basin, because of its priority. According to him, HEER's *Adiantites nympharum* is conspecific with *Dicksonia concinna* HEER.

*Dicksonia concinna* ('*Coniopteris burejensis*') is distinguished from *C. neiridaniensis* by its acutely pointed lobes.

Sterile pinnules of *Coniopteris vachrameevii* originally described by VASSILEVSKAJA (1967) are similar in form to our large-sized ones. But *Coniopteris vachrameevii* is distinguished from ours by its lobes with further minutely lobed apex.

CHOW and YEH (in SZE et al., 1963) instituted *Coniopteris szeiana* and included SZE's *Coniopteris burejensis* (1931, p. 43, pl. 7, figs. 5-8) and *C. sp.* (? n. sp.) (1933b, p. 79, pl. 11, figs. 4-13, 18, 19) in their *C. szeiana*. *Coniopteris szeiana* is characterized by its pinnules deeply dissected into lobes with rounded apex. However, this Chinese early Jurassic species is distinguished from ours by its roundly rhomboid pinnules with 2-3 pairs of lobes, instead of elongate-rhomboid ones with 4-6 pairs of lobes in ours.

The following leaves appear to be rather similar in form to *Coniopteris szeiana* than to *C. hymenophylloides* and *C. neiridaniensis*: *Thyrsopteris prisca* HEER; of KRASSER (1906) from the Jurassic of NE-China. *Coniopteris hymenophylloides*

(BRONGNIART); of YABE and OISHI (1933) from the Jurassic of NE-China. *Coniopteris sp.*; of HE et al. (1979) from the Jurassic of Qinghai, NW-China.

*Coniopteris embensis* originally described by PRYNADA (1938) from the Jurassic of Emba Basin and later by BARANOVA et al. (1975) from the Jurassic of eastern Caspian Basin shows the pinnules dissected into lobes with rounded apex. But it differs from ours in its smaller number of lobes (2-3 pairs) in each pinnule.

*Coniopteris spectabilis* BRICK illustrated by SIXTEL and KHUDAIBERDYEV (1968, pl. 20; pl. 23, fig. 3) from the Middle Jurassic of Middle Asia resembles our *C. neiridaniensis*, but is also distinguished from ours by its pinnules with small number of lobes.

#### Family Dipteridaceae

##### Genus *Clathropteris* BRONGNIART,

1828: 62

##### *Clathropteris meniscoides* BRONGNIART

Pl. 30, Fig. 8; Text-figs. 3a-e

Japanese specimens:

*Clathropteris meniscoides* BRONGNIART: OISHI and HUZIOKA, 1938, p. 78, pl. 8, fig. 4 (Nariwa Group): OISHI, 1940, p. 214, pl. 5, fig. 4 (Neiridani, Kuruma Group).

*Clathropteris obovata* OISHI: OISHI and HUZIOKA, 1938, p. 78, pl. 9, figs. 1-2 (Nariwa Group).

Chinese specimens:

*Clathropteris meniscoides* BRONGNIART (by some spelt *C. meniscioides*): SZE, 1931, p. 4, pl. 1, fig. 3 (Rhaeto-Liassic of Jiangxi): p. 33, pl. 5, fig. 3 (Jurassic of Fang-zi): 1949, p. 6, pl. 4, fig. 4 (non pl. 1, fig. 5 referable to *C. obovata*) (Lower Jurassic of Hubei): HSÜ (in SZE and HSÜ, 1954), p. 51, pl. 44, figs. 1-2 (Upper Triassic of Yunnan): SZE et al., 1963, p. 85, pl. 26, fig. 5 (non pl. 27, fig. 4 referable to *C. obovata*) (Lower Jurassic of Hubei): LI, P. C., 1964, p. 108, pl. 2, figs.

1, 2a, 3, 4; pl. 3, figs. 1-6; text-fig. 3 (Upper Triassic of Sichuan): LI, P. C. et al., 1976, p. 108, pl. 19, fig. 4 (Upper Triassic of Yunnan): FENG et al., 1977, p. 211, pl. 79, fig. 4 (Upper Triassic of Guangdong): ZHOU, T. S., 1978, p. 101, pl. 18, figs. 7, 7a, 8 (Rhaeto-Liassic of Fujian): YANG, 1978, p. 485, pl. 168, fig. 1 (Upper Triassic of Sichuan): HSÜ et al., 1979, p. 22, pl. 20, fig. 7; pls. 21-25; pl. 26, figs. 1-6; pl. 27, fig. 1 (Upper Triassic of Sichuan): HE et al., 1979, p. 136, pl. 61, fig. 3 (Upper Triassic of Qinghai).

Specimens from other regions and further references, see HARRIS, 1931, pp. 88-89 and VAKHRAMEEV et al., 1980, p. 54.

*Material*: SHI-001, 057, 059 (Shinadani), SAS-005, 014, 016-019 (Sasakomata), NEE-153, 245 (Higashi-Neiridani), NE-065, 084 (Neiridani), Kr-007 (Tsuchizawa), A-2088 (Iwamuro).

*Description*.—Leaf-fragments are medium-sized, but the petiole and 'arms' of its first branch were not found. Pinnae are elongate-lanceolate, gradually tapering distally, and attaining a width of 3.5 cm in Text-fig. 3a (right side). The basal lamina of adjacent pinnae is connected as shown in Text-fig. 3a. Margins are shallowly toothed, length of tooth and that of its supporting lateral vein are, 1 cm and 2.5 cm (Text-fig. 3a), 1 cm and 2.3 cm (Text-fig. 3d), 0.8 cm and 3.7 cm (Text-fig. 3b; irregularly toothed), and 0.3 cm and 1.7 cm (Text-fig. 3c). Marginal teeth are short, triangular, acutely or obtusely pointed and directed forwards. The pinna rachis is rather slender, 0.5 mm-1 mm wide, lateral veins are distinct, arising at angles of 40-50 degrees and at intervals of 10-12 mm. Tertiary veins are also distinct, arising from lateral veins at about a right angle, percurrent and slightly flexuous, by which the interspace between the adjacent secondaries are more or less regularly divided into one series of elongated rectangular meshes, typically 4

mm×8 mm. The finest veins form a net with rectangular meshes, typically 0.75 mm×1.25 mm, usually with long axes parallel to the lateral veins and with occasional blind ending branches. These branches are simple or bifurcate, or sometimes percurrent as shown in Text-fig. 3e. We have no fertile specimens.

*Distribution and occurrence*.—*Clathropteris meniscoides* is rather rare in the Kuruma Group and the Iwamuro Formation, but occurs widely in the Upper Triassic-Lower Jurassic of Europe, Central Asia and China, and the Upper Triassic of SE-Asia and Japan.

*Discussion and comparison*.—Our leaves, though they are all sterile, are characterized by clathrate meshes of the first order formed by lateral and tertiary veins and closely resemble *Clathropteris meniscoides* BRONGNIART first described from Europe. They resemble specimens of HARRIS (1931) in venation.

Minor differences among the leaves of this species are given in detail by KON'NO (1968). According to him, in *Clathropteris*, the tertiary veins are distinguished by their manner of branching into the following three types:

- 1) The tertiary veins are dichotomously branched and percurrent clathrate tertiaries are seldom developed as in *Clathropteris obovata*.
- 2) The tertiary veins branch off in the sympodial ramification, the clathrate tertiaries are developed, but less prominent, zigzag in course, giving off alternately or subalternately relatively thick quaternary veins.
- 3) The tertiary veins give off only very thin quaternaries in the manner of monopodial ramification, and the clathrate tertiaries are definitely developed, thick, straight or slightly arc-shaped in their course.

Thus our leaves may belong to his type-

2 and are close to his *Clathropteris meniscoides* from the Upper Triassic of southeastern border of Sarawak, Borneo. As mentioned by KON'NO (1968), most of leaves from Europe belong to his type-3.

So far as its venation is concerned, *Clathropteris obovata* OISHI described by OISHI and HUZIOKA (1938) from the Nariwa Group is referable to *C. meniscoides*.

Korean leaves regarded by YABE (1922) as *Clathropteris* cfr. *meniscoides* and by KAWASAKI (1925, '39) as *C. meniscoides* are similar in venation to ours, but as pointed out by HARRIS (1931), they have larger marginal teeth than those of European leaves. From China, many leaves were described under *Clathropteris meniscoides* (or *meniscioides*) as mentioned before. They are all similar in venation to ours, although according to KON'NO (1968) LI's leaves from Sichuan are hardly distinguishable from *C. obovata*.

The Tonkin leaves of ZEILLER (1903) named *Clathropteris platyphylla* (GOEP- PERT) are mostly like ours, but some (his pl. 30, figs. 3-8) have very broad pinnae and might be distinct. SREBRODOLSKAJA (1961) included ZEILLER's leaves (pl. 27, fig. 2 and pl. 28, fig. 2) into her *Clathropteris mongugaica*.

*Clathropteris meniscioides* described by STANISLAWSKI (1971) from the Upper Triassic of Donbass is different from ours in its small-sized leaf and non-clathrate venation.

Genus *Dictyophyllum* LINDLEY  
and HUTTON, 1834: 65

*Dictyophyllum kotakiense* KIMURA  
and TSUJII sp. nov.

Pl. 30, Figs. 9-11; Text-figs. 4a-g

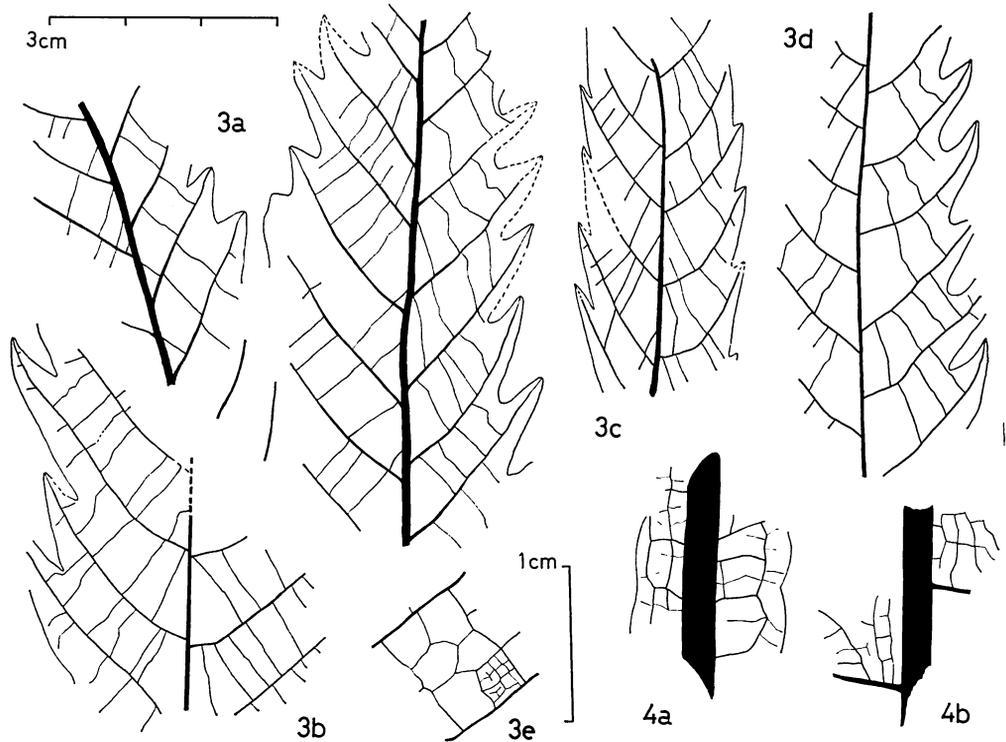
*Dictyophyllum* sp.: OISHI, 1940, p. 219, pl. 5,  
fig. 6 (Neiridani, Kuruma Group). *Dictyo-*

*phyllum*? sp.: KIMURA, 1959b, p. 68, pl.  
2, fig. 4 (Kotaki Coal-Field, Kuruma  
Group).

*Material*: Holotype; KU-9002 (Kotaki Coal-Field). Paratypes; NNW-223, 265 (Nishi-Neiridani), NEE-147, 225, 261 (Higashi-Neiridani), SHI-013 (Shinadani). Other specimens; KU-9001, NEE-263 and other 10 specimens, DAI-056 (Dairagawa), SHI-012 and other 4. *Stratum typicum*: Hodonosawa Formation (KIMURA, 1959b after K. SASAI), Kuruma Group (its corresponding formation in the main distribution of the group uncertain). *Locus typicus*: Kotaki Coal-Field (now not in production), Kotaki-mura, Nishi-Kubiki-gun, Niigata Prefecture. *Derivatio nominis*: After Kotaki where the holotype was collected by K. SASAI in 1949.

*Diagnosis*.—(Petiole and 'arms' unknown.) Pinna rachis stout, 3.5-4 mm wide below, 2.5-3 mm middle and 0.5 mm above. Basal lamina undivided but broadly undulated. Laminae usually developing lateral segments, but incisions not to the pinna rachis. Segments connected by a web of lamina along the pinna rachis, becoming closer towards the pinna apex. Segments in the middle region rectangular, about 5.2 cm long and 1.8 cm wide, with bluntly pointed or rounded apex and attached perpendicularly to the pinna rachis. Apical segments attached obliquely, triangular in form and with bluntly pointed apex. Larger segments having shallowly undulated margins or almost entire; margins of smaller segments entire. Midrib of segment strongly marked, lateral veins arising at intervals of 7 mm at an angle of 55-90 degrees, making rather irregular polygonal meshes. Smaller veins forming polygonal meshes, 1.5 mm wide, enclosing blind vein-endings.

In fertile leaf, blind veins being the placental bundles. Sori 1.1 mm in diameter, consisting generally of 6 sporangia widespread but avoiding the region near



Text-figs. 3-4 (a-b). (All natural size, unless otherwise indicated).

3. *Clathropteris meniscoides* BRONGNIART. Sterile leaves (3a-d); Quaternary and finest veins are excluded. 3a: (NE-065). 3b: (SAS-018; Pl. 30, Fig. 8). 3c: (NEE-153). 3d: (SHI-001). 3e: Final meshes drawn from 3b.
4. *Dictyophyllum kotakiense* KIMURA and TSUJII sp. nov. 4a: Pinna base with a thick rachis (NNW-223, paratype; Pl. 30, Fig. 10). 4b: Basal pinna with lateral segments (NEE-261; paratype).

the midrib. Sporangia almost sessile, about 500  $\mu\text{m}$  in diameter. Annules well developed, probably complete and oblique.

*Distribution and occurrence.*—*Dictyophyllum kotakiense* is common in the Negoya Formation, but rare in the Shinadani and Hodonosawa Formations.

*Discussion and comparison.*—Our material is represented by a series of leaf-fragments of varied size and form. Our leaf-fragments look just like corresponding parts of the leaves figured as *Dictyophyllum nilssoni* (BRONGNIART) GOEPPERT by HARRIS (1931), OISHI (1932) and *D.*

*spectabile* NATHORST by OISHI (1932). Their sori, however, are different. In HARRIS' specimens at least the sporangia are attached singly or in pairs on ultimate veins, or at most in groups of three (according to his information given us in 1981). In our leaf they are in groups of six or more and this is an important difference and precludes a specific identification and for this reason, we describe our material as a new species.

OISHI's *Dictyophyllum nilssoni* and *D. spectabile* from the Nariwa Group are all represented by sterile leaves. *Dictyo-*

*phyllum nilssoni* illustrated by YANG (1978) and *D. cfr. nilssoni* by SZE (1933a, '49), SZE et al. (1963) and FENG et al. (1977) from China are also all represented by sterile leaves. So it is difficult to make the full comparison between ours and these Asian sterile leaves which are similar in external form to ours.

Genus *Thaumatopteris* GOEPPERT,  
1841: 2

*Thaumatopteris elongata* OISHI

Pl. 30, Fig. 12; Pl. 31, Figs. 1-2;  
Text-figs. 5a-e

*Thaumatopteris schenki* NATHORST: OISHI, 1931, p. 239, pl. 1, figs. 7, 7a, 8, 8a (Kuruma, Kuruma Group): 1932, p. 296, pl. 17, figs. 3-4; pl. 18, fig. 1 (Nariwa Group).

Cfr. *Thaumatopteris brauniana* POPP: OISHI, 1932, p. 297, pl. 35, fig. 4 (Nariwa Group).

*Thaumatopteris elongata* OISHI: OISHI, 1932, p. 295, pl. 34, fig. 2; pl. 35, figs. 1-2 (Nariwa Group): OISHI and YAMASITA, 1936, p. 149: OISHI, 1940, p. 223 (general remarks): KIMURA, 1959a, p. 10, pl. 2, figs. 1-8; text-fig. 4 (Iwamuro Formation).

*Thaumatopteris nipponica* OISHI: KIMURA, 1959a, p. 11, pl. 2, figs. 9-10 (Iwamuro Formation).

*Material*: NEE-268 (Higashi-Neiridani), DAI-059 (Dairagawa), Kr-150 (Tsuchizawa), A-2033 and other 16 specimens (Iwamuro).

*Description*.—Our material consists of sterile pinna fragments of varied size and form but no petioles or pinna bases. The pinna rachis attains a thickness of 2.5 mm (Text-fig. 5a) and bears pinnules with bluntly pointed or rounded apex, up to 1 cm wide and more than 4.5 cm long (Text-figs. 5a-c). A short pinnule shown in Text-fig. 5d is possibly on the lower part of pinna. The pinnules arise nearly perpendicularly, closely or remotely set.

The margins are entire or broadly sinuous (Text-figs. 5c-e) but never lobed. At their base, pinnules are not expanded (Text-fig. 5b), but in some specimens the lamina of adjacent pinnule is connected by a web, 0.5 mm wide which runs along the pinna rachis. The midrib is prominent, but the other veins scarcely project from the lamina. The secondary nerves arise at a wide angle, then form polygonal meshes. The first veins form rather elongate-hexagonal meshes, 1.5 mm long and 0.5 mm wide (Text-figs. 5c-e). Blind vein-endings sometimes occur in these meshes.

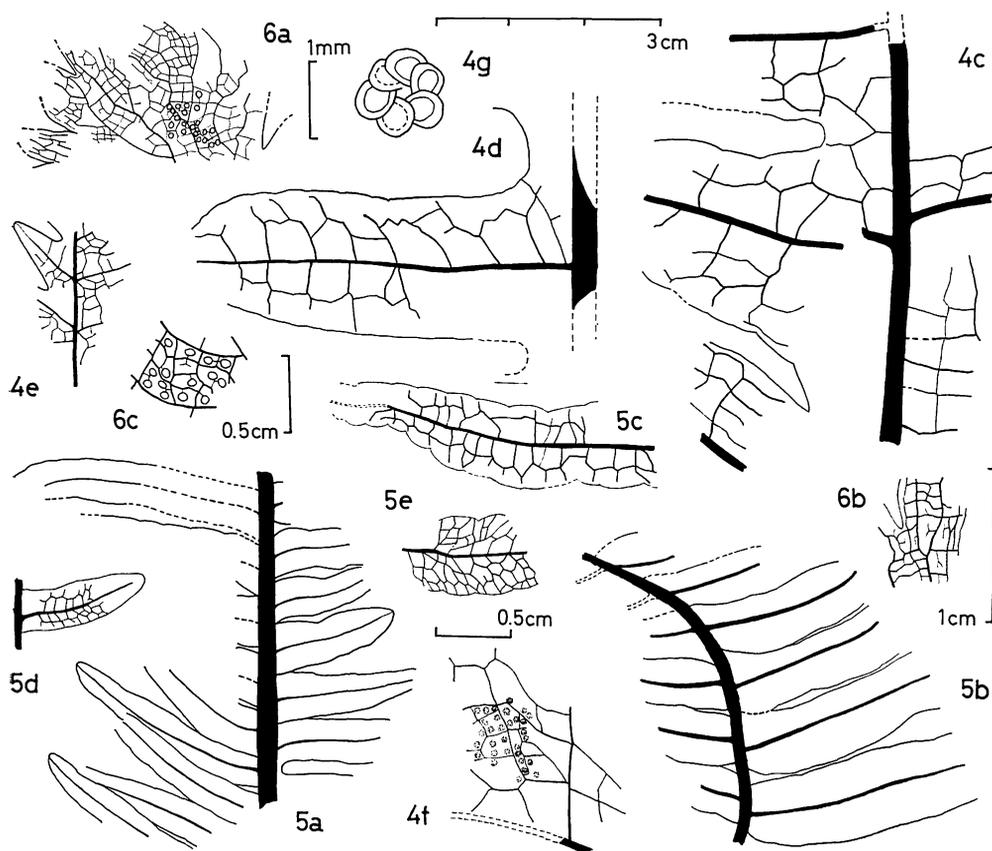
*Distribution and occurrence*.—*Thaumatopteris elongata* is possibly a local species, and occurs rarely in the Iwamuro Formation, Kuruma and Nariwa Groups in Japan.

*Remarks*.—Our synonymy gives the history of Japanese specimens which we determine as *Thaumatopteris elongata*.

Among our leaves, some pinnules with broadly undulated margins remind us of those of European *Thaumatopteris schenki*. But *Thaumatopteris elongata* is distinguished by its pinnules with broadly undulated margins instead of broadly lobed ones in *T. schenki* (HARRIS, 1931, fig. 35).

Our pinnules with entire margins remind us also of the European *Thaumatopteris brauniana*. But *Thaumatopteris elongata* differs from *T. brauniana* in its pinnules both with entire and broadly undulated margins on the same pinna, instead of pinnules unexceptionally with entire margins in *T. brauniana* (HARRIS, 1931, fig. 36).

*Thaumatopteris nipponica* OISHI is distinguished from *T. elongata* by its elongate-triangular or sometimes deltoid pinnules with the secondary nerves occasionally bifurcating at a short distance from their origin.



Text-figs. 4 (c-g)-6. (All natural size, unless otherwise indicated).

4. *Dictyophyllum kotakiense* KIMURA and TSUJII sp. nov. 4c: Middle region of a sterile pinna (NEE-147, paratype; Pl. 30, Fig. 9). 4d: Ditto, with rectangular segment (NEE-255, paratype; Pl. 30, Fig. 11). 4e: Upper region of a sterile pinna (SHI-013, paratype). 4f: A part of a fertile pinna, showing the distribution of sori (KU-9002, holotype). 4g: Sorus consisting of 6 sporangia, drawn from the holotype.
5. *Thaumatopteris elongata* OISHI. 5a: A part of sterile pinna with a rather thick rachis (A-3016). 5b: Ditto (Kr-150; Pl. 31, Fig. 2). 5c: An incompletely preserved sterile pinnule (NEE-215; Pl. 30, Fig. 12). 5d: A small-sized sterile pinnule (A-3021). 5e: An incompletely preserved sterile pinnule, showing the venation (DAI-059).
6. *Hausmannia (Protorhipis)* sp. A. 6a: An incompletely preserved fertile leaf (A-2041) (redrawn from KIMURA, 1959a, p. 12, text-fig. 5). 6b: Detailed venation, drawn from 6a. 6c: Occurrence of sori, drawn from 6a.

Genus *Hausmannia* DUNKER, 1846: 12

*Hausmannia* (*Protorhipis*) sp. A

Text-fig. 6a-c

*Hausmannia* (*Protorhipis*) sp.: KIMURA, 1959a, p. 11, pl. 12, fig. 9; text-fig. 5 (Iwamuro Formation).

*Material*: A-2041 (Iwamuro) (a single leaf-fragment).

*Description*.—Lamina about 4 cm in diameter, petiole not known. Margin shallowly lobed; the number of lobes not known. Primary veins radiating from presumed top of petiole, branching dichotomously at least twice, reaching margin of each lobe. Primary veins slightly sinuous, giving off finer secondary veins perpendicularly to form the first meshes with adjacent primary vein. Tertiary veins uniting into numerous small secondary meshes, typically about 1 mm square, but occasionally ending blindly. Quaternary veins simple or forking, mostly blind-ending in sterile part.

Sori circular, 0.5 mm in diameter, borne at the tip of a blind vein. Details of sorus not visible.

*Remarks*.—No additional specimen has been obtained after the one described by KIMURA (1959a). We limit our specimen to leaves described from East Asia in comparison. Of these *Hausmannia crenata* by OISHI (1932) from the Nariwa Group is distinguished by its secondary veins arising obliquely and forming polygonal or sometimes rhomboidal meshes. *Hausmannia nariwaensis* described by OISHI (1930) from the Nariwa Group has almost entire or broadly undulated margin as does *H. ussuriensis* by KRYSHTOFOVICH (1923).

*Hausmannia dentata* described by OISHI (1932) also from the Nariwa Group resembles ours in its lobed or dentate margin of lamina. But it is distinguished

from ours by its generally unbranched primary veins and obliquely arised secondary veins. *Hausmannia leeiana* originally described by SZE (1933a) from the Lower-Middle Jurassic of Shanxi is easily distinguished from ours by its entire or shallowly undulated margin.

Sterile and unclassified  
fern leaves

We have a large number of sterile fern leaves and a few fertile ones with uncertain affinity. Among them we distinguished the following forms, depending on their external outline of pinnules and venation.

*Key to the sterile and unclassified ferns*:

1. Pinnules small, less than 1 cm long..  
..... *Sphenopteris* sp. A
- 1'. Pinnules often over 1 cm long ....2
2. Pinnules less than twice as long as broad .....*Cladophlebis* sp. C
- 2'. Pinnules more than twice as broad..3
3. Pinnules with once forked lateral veins .....4
- 3'. Pinnules with twice forked lateral veins .....5
- 3''. Pinnules with thrice forked lateral veins.....*Cladophlebis kurumensis*
4. Lateral veins up to 10 pairs .....  
..... *Cladophlebis pseudodelicatula*
- 4'. Lateral veins 10-12 pairs .....  
.....Cfr. *Todites fukutomii*
5. Margins entire .....6
- 5'. Margins dentate at apical half.....  
..... *Cladophlebis raciborskii*
6. Apex acute..Cfr. *Asterotheca okafujii*
- 6'. Apex blunt..Cfr. *Todites yamanoiensis*

This key omits some undeterminable fragments including *Cladophlebis* sp. A (KIMURA, 1959a, p. 20, pl. 4, fig. 1) and C. sp. B (Ibid., pl. 3, fig. 6) from the Iwamuro Formation.

Genus *Asterotheca* PRESL in  
CORDA, 1845: 81

Cfr. *Asterotheca okafujii* KIMURA  
and OHANA

Pl. 31, Figs. 3-4; Text-figs. 7a-d

*Cladophlebis* cfr. *raciborskii* ZEILLER: OISHI,  
1931, p. 234, pl. 16, fig. 6, 6a; pl. 17, fig.  
1 (Tsuchizawa, Kuruma Group).

*Cladophlebis raciborskii* ZEILLER forma *integra*  
OISHI and TAKAHASI: OISHI and TAKAHASI,  
1936, p. 119 (Yamanoi, Habu Group):  
OISHI, 1940, p. 283, pl. 19, fig. 1, 1a  
(Momonoki, Mine Group): KIMURA, 1959a,  
p. 19, pl. 3, fig. 5; pl. 5, fig. 3 (Iwamuro  
Formation). For further references, see  
KIMURA and OHANA, 1980, p. 74.

*Comparable specimens: Asterotheca okafujii*  
KIMURA and OHANA: KIMURA and OHANA,  
1980, p. 73, pl. 1, fig. 1; pl. 2, figs. 1-2;  
pl. 3; pl. 5, fig. 1a; figs. 2a-f (Momonoki  
Formation, Mine Group).

*Material*: NE-034, 035, 042 (Neiridani),  
NNW-061, 068, 234, 428, 511 (Nishi-Neiridani),  
NEE-267 (Higashi-Neiridani), DAI-009, 014  
(Dairagawa), TOB-033, 046B (Tobiiwadani),  
Kr-041, 074, 081 (Tsuchizawa), A-0318, 4065,  
75039, 75119 (Iwamuro).

*Description*.—Frond is bipinnate and  
large-sized. Pinnae are nearly parallel-  
sided for the most part, the largest (Kr-  
081) is 6 cm wide. Pinnules are set  
closely, long and narrow, nearly parallel-  
sided for the most part, then suddenly  
narrowing towards the acutely pointed  
apex, up to 2.9 cm long and 0.6 cm wide,  
attached katadromically to the pinna axis  
at an angle of 70-90 degrees, but the  
angle is reduced near pinna apex, apical  
pinnules are often falcate. Margins are  
entire, midvein is prominent, persisting to  
the tip, typically sending off 15 pairs of  
lateral veins rather obliquely. Basal 8-9  
pairs of lateral veins are usually forking  
twice, others forking once or occasionally

simple.

*Distribution and occurrence*.—This form  
is common in the Kuruma Group and  
Iwamuro Formation. Sterile leaves refer-  
able to this form are widely known in  
the older Mesozoic plant-beds in East Asia.

*Remarks*.—Our leaves agree fully with  
the sterile leaves of *Asterotheca okafujii*  
originally described by KIMURA and OHANA  
(1980) from the Upper Triassic Momonoki  
Formation, based on abundant leaves both  
with sterile and fertile parts. Similar  
sterile leaves had been determined by  
OISHI and TAKAHASI (1936) as *Clado-  
phlebis raciborskii* forma *integra*.

Cfr. *Asterotheca okafujii* resembles  
*Cladophlebis raciborskii* originally described  
by ZEILLER (1903) from the Upper Triassic  
of North Viet-Nam, but it differs from  
ZEILLER's species by its pinnules with  
entire margins.

Genus *Todites* SEWARD, 1900: 86

Cfr. *Todites fukutomii* KIMURA  
and OHANA

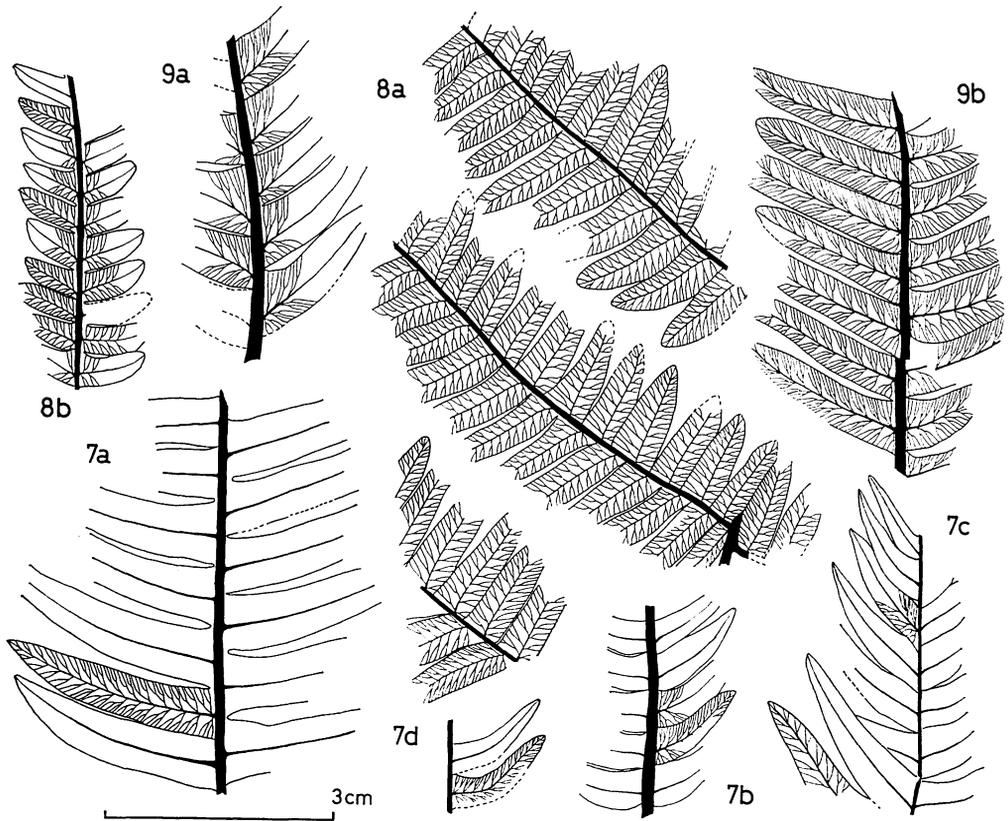
Pl. 31, Figs. 5-6; Text-figs. 8a-b

*Cladophlebis nebbensis* (BRONGNIART) NATHO-  
RTS: OISHI, 1931, p. 231, pl. 16, fig. 4, 4a  
(Tsuchizawa, Kuruma Group). For further  
references, see KIMURA and OHANA, 1980,  
pp. 77-78.

*Comparable specimens: Todites fukutomii*  
KIMURA and OHANA: KIMURA and OHANA,  
1980, p. 77, pl. 3, figs. 1-2; pl. 4, figs. 2-  
3; pl. 6, fig. 1; figs. 3a-c (Momonoki  
Formation, Mine Group).

*Material*: NE-011, 031 (Neiridani), NNW-  
461, 660, 679 (Nishi-Neiridani), NEE-375?  
(Higashi-Neiridani), TOB-027 (Tobiiwadani).

*Description*.—Frond is bipinnate, large-  
sized. Rachis is rather slender, 1.5 mm  
wide. Pinnules are subopposite, arising  
at an angle of 80 degrees, straight and



Text-figs. 7-9. (All natural size).

7. Cfr. *Asterotheca okafujii* KIMURA and OHANA. 7a: A pinna fragment with large-sized pinnules (NNW-061; Pl. 31, Fig. 3). 7b: (NEE-267). 7c: (NE-042). 7d: (DAI-009; Pl. 31, Fig. 4).
8. Cfr. *Todites fukutomii* KIMURA and OHANA. 8a: The largest specimen with a rather slender rachis (NE-031; Pl. 31, Fig. 5). 8b: (NNW-679).
9. Cfr. *Todites yamanoiensis* (YOKOYAMA) KIMURA and OHANA. 9a: (KU-4981202-18). 9b: (A-0405; Pl. 32, Fig. 1).

probably almost uniformly wide up to the apex. Pinnules are set closely, commonly arising at a wide angle, katadromic in order, finger-shaped, with rounded or obtusely pointed apex, typically 1.4 cm long and 0.4-0.6 cm wide; margins are entire. Basal basiscopic margin is often slightly contracted but basal acroscopic margin slightly expanded. Basal pinnules are not specialized. Midvein is distinct, persisting to the tip and sending off

typically 10-12 pairs of once forked lateral veins at a wide angle.

*Distribution and occurrence.*—This form is occasionally found in the Shinadani and Negoya Formations, Kuruma Group. Similar leaves are widely distributed in the older Mesozoic plant-beds in Japan.

*Remarks.*—Our leaves agree in all features with the sterile leaves of *Todites fukutomii* originally described by KIMURA and OHANA (1980) from the Momonoki

Formation. Though we feel nearly sure that our present sterile leaves are sterile *Todites fukutomii*, we prefer not to identify them fully until we find fertile specimens associated with them.

Similar sterile leaves from Japan have been described by OISHI (1931) as *Cladophlebis nebbensis* from Tsuchizawa.

Cfr. *Todites yamanoiensis* (YOKOYAMA)

KIMURA and OHANA

Pl. 32, Fig. 1; Text-figs. 9a-b

*Cladophlebis haiburnensis* (LINDLEY and HUTTON): OISHI, 1931, p. 237, pl. 2, fig. 2, 2a (Tsuchizawa): KIMURA, 1959b, p. 69, pl. 1, fig. 5; pl. 2, fig. 1 (Kotaki Coal-Field). For further references, see KIMURA and OHANA, 1980, p. 82.

*Comparable specimens: Todites yamanoiensis* (YOKOYAMA) KIMURA and OHANA: KIMURA and OHANA, 1980, p. 82, pl. 4, fig. 1; pl. 5, fig. 1b; pl. 6, figs. 2-3; figs. 5a-g (Momonoki Formation, Mine Group).

*Material*: NNW-498, 663 (Nishi-Neiridani), SAS-008 (Sasakomata), 4981201-18 (Kotaki Coal-Field), A-0405 (Iwamuro).

*Description*.—Several detached sterile pinnae were obtained. Pinnules are set closely, elongate-triangular or elongate-rectangular, apex obtusely pointed or rounded, and attached to the pinna rachis at a wide angle; typically 2.2 cm long and 0.5 cm wide; margins are entire. Basiscopic basal margin is sometimes distinctly contracted and acroscopic basal margin is usually expanded. Midvein is distinct, persisting to the tip, typically sending off 9-10 lateral veins usually forking twice.

*Distribution and occurrence*.—Cfr. *Todites yamanoiensis* is occasionally found in the Kuruma Group and rare in the Iwamuro Formation. Similar leaves occur in other older Mesozoic plant-beds in East Asia.

*Remarks*.—Our leaves agree in all features with the sterile leaves of *Todites yamanoiensis* described by KIMURA and OHANA (1980) from the Momonoki Formation. Sterile leaves resembling ours had been determined as *Cladophlebis haiburnensis* (LINDLEY and HUTTON) by previous authors.

Our leaves are distinguished from *Cladophlebis aktashensis* TURTANOVA-KETOVA by its shorter pinnules with fewer lateral vein pairs (7-11), instead of more elongated pinnules with 12-15 (or more) pairs of lateral veins in *C. aktashensis*.

We consider the sterile leaves regarded by OISHI (1931) as *Cladophlebis haiburnensis* from Tsuchizawa and by KIMURA (1959b) from the Kotaki Coal-Field are like ours.

As previously mentioned by KIMURA and OHANA (1980), our leaves resemble those of *Cladophlebis asiatica* CHOW and YEH (in SZE et al., 1963) known from the Lower-Middle Jurassic of China.

Form-genus *Sphenopteris*

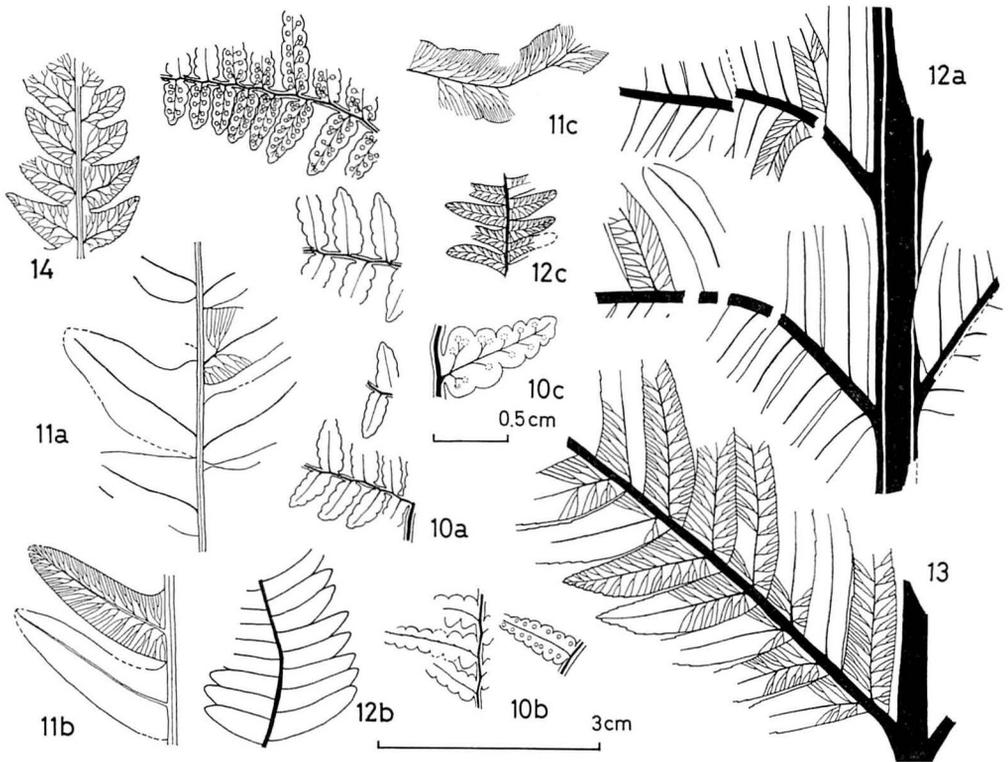
STERNBERG, 1825: 15

*Sphenopteris* sp. A

Pl. 31, Figs. 7-8; Text-figs. 10a-c

*Material*: NNW-704, 784, 786-788, 830, 833, 835, 837, 839 (Nishi-Neiridani).

*Description*.—Leaf probably bipinnate, of small size, partly fertile and partly sterile, but whole leaf unknown. Pinnules set rather remotely, oblong or elongate-triangular, typically 0.9 cm long and 0.4 cm wide, apex rounded, base distinctly contracted. Margins shallowly lobed (Text-fig. 10c); lobes 4-7 pairs. Midvein distinct but not persisting to the tip, sending off lateral veins not reaching the margin. Each lobe receiving a set of lateral vein, basal pair of lateral vein forked once or twice, others mostly simple.



Text-figs. 10-14. (All natural size, unless otherwise indicated).

10. *Sphenopteris* sp. A. 10a: A part of fertile leaf (NNW-282; Pl. 31, Fig. 7). 10b: Two detached fertile pinna fragments (NNW-784). 10c: A pinnule showing the venation and the position of sori, drawn from 10a.
11. *Cladophlebis kurumensis* KIMURA and TSUJII sp. nov. 11a: A pinna fragment bearing large-sized pinnules (TOB-018B). 11b: Two medium-sized pinnules, showing the venation (Kr-068, paratype). 11c: A poorly preserved large-sized pinnule (A-0413).
12. *Cladophlebis pseudodelicatula* OISHI. 12a: A part of a bipinnate frond (A-4068; Pl. 32, Fig. 3) (redrawn from KIMURA, 1959a, p. 12, text-fig. 6, with some emendation). 12b: A poorly preserved pinna, showing the outline of pinnules (NEE-099; Pl. 32, Fig. 4). 12c: A pinna fragment bearing small-sized pinnules (NE-149; Pl. 30, Fig. 13).
13. *Cladophlebis raciborskii* ZEILLER: (A-3048).
14. *Cladophlebis* sp. C: (SHI-015; Pl. 32, Fig. 10).

In fertile pinnules, each lateral vein terminated by a circular sorus, 0.5 mm in diameter (Text-figs. 10a, c). Details of sorus not visible.

*Distribution and occurrence.*—*Sphenopteris* sp. A is rare and occurs at a single locality along the Nishi-Neiridani (Negoya Formation).

*Remarks.*—Owing to our uncertainty of its soral character, we can only determine our leaves as *Sphenopteris* sp. A.

Form-genus *Cladophlebis*  
BRONGNIART, 1849: 105

*Cladophlebis kurumensis* KIMURA  
and TSUJII sp. nov.

Pl. 31, Fig. 9; Pl. 32, Fig. 2;  
Text-figs. 11a-c

*Cladophlebis* sp. a: OISHI, 1931, p. 238, pl. 17,  
fig. 3 (Tsuchizawa).

*Material*: Holotype; Kr-052 (Tsuchizawa).  
Paratypes; Kr-035, 041, 066, 068. Other speci-  
mens; TOB-018B (Tobiiwadani), A-0413 (Iwa-  
muro). *Stratum typicum*: Alternation of  
sandstone and shale (Kr<sub>2</sub>), Kuruma Group  
(see KIMURA and TSUJII, 1980a). *Locus*  
*typicus*: Tsuchizawa, near Kuruma, Kita-  
Otari-mura, Kita-Azumi-gun, Nagano Prefec-  
ture. *Derivatio nominis*: After Kuruma, a  
classical locality where the holotype and para-  
types were collected.

*Diagnosis*.—Fronde bipinnate. (Whole leaf  
unknown.) Pinnules set closely, elongate-  
triangular in form, attached at an angle  
of 60–70 degrees to the slender pinna  
rachis, large-sized, typically 3.6 cm long  
and 1 cm wide at base, tapering gradually  
towards the acutely pointed apex; some-  
times falcate and expanded at acroscopic  
base. Margins entire. Midvein rather  
weak, sending off 12 pairs of lateral  
veins; the acroscopic ones directed for-  
wards. Basal 4–5 pairs thrice forking  
and others forking twice except apical 1–  
2 pairs forking once.

*Distribution and occurrence*.—*Clado-  
phlebis kurumensis* occurs rarely at Tsuchi-  
zawa and Tobiiwadani (Kuruma Group)  
and at Iwamuro (a single specimen).

*Discussion and comparison*.—*Cladophlebis*  
*kurumensis* is characterized by its large-  
sized and elongate-triangular pinnules with  
thrice forked lateral veins. The species  
of *Cladophlebis* known to us with thrice  
forked lateral veins are mentioned below  
for comparison.

The sterile leaf of *Todites fastuosus*  
(KIMURA) KIMURA and TSUJII previously

described (KIMURA and TSUJII, 1980b)  
from the Iwamuro Formation and Kuruma  
Group, is distinguished from *Cladophlebis*  
*kurumensis* by its triangular pinnules with  
finely dentate margins.

*Cladophlebis bitchuensis* originally de-  
scribed by OISHI (1932) from the Nariwa  
Group and recently by KIMURA and  
OHANA (1980) from the Momonoki For-  
mation, is distinguished by its elongate-  
oblong or broadly linear pinnules with a  
rounded or obtusely pointed apex.

*Cladophlebis gigantea* OISHI (OISHI, 1932)  
from the Nariwa Group and *C. gigantea*  
of P'AN (1936) from the Upper Triassic  
of China, and *C. cfr. gigantea* of SZE  
(1956) and of SZE et al. (1963) from the  
Upper Triassic of China all have their  
pinnule margins shallowly crenulated or  
lobed.

Two ferns described from Malaysia by  
KON'NO (1972), *Cladophlebis* cfr. *haiburn-  
ensis* and *C. ishiana*, look just like ours  
but we refrain from identifying our leaves  
with them, because in his *C. cfr. haiburn-  
ensis*, pinnules are more narrower than  
ours and mostly directed forwards, and  
in his *C. ishiana*, pinnules are deltoid or  
triangular, rather resembling the sterile  
pinnules of *Todites fastuosus*.

An incomplete and deformed pinnule  
illustrated in Text-fig. 11c, probably belongs  
to *Cladophlebis kurumensis*, though its  
lateral veins are all thrice forked.

*Cladophlebis pseudodelicatula* OISHI

Pl. 30, Fig. 13; Pl. 31, Fig. 10; Pl. 32,  
Figs. 3-4; Text-figs. 12a-c

*Cladophlebis* sp. b: OISHI, 1931, p. 238, text-  
fig. 2 (Tsuchizawa).

*Cladophlebis pseudodelicatula* OISHI: OISHI,  
1932, p. 288, pl. 11, fig. 2 (Nariwa Group):  
1940, p. 281 (general remarks); SCHORO-  
CHOVA and SREBRODOLSKAJA, 1979, p. 68,  
pl. 11, figs. 1-3 (Upper Triassic of

Primorye).

*Cladophlebis clavatum* KIMURA: KIMURA, 1959a, p. 12, pl. 2, fig. 11; pl. 5, fig. 2; pl. 6, figs. 1-2, 6, 9; text-fig. 6, 7 (Iwamuro).

*Material*: NE-149 (Neiridani), NEE-047, 099 (Higashi-Neiridani), A-4063 and other 8 specimens (Iwamuro).

*Emended diagnosis*.—Frond bipinnate, rachis rather thick, 6 mm wide, sending off pinnae suboppositely at intervals of 3 cm at the middle portion of frond. Pinnae arising at an angle of 40 degrees, then bending outwards, linear lanceolate in outline, tapering very gradually from the base upwards to an acuminate apex. Pinna rachis slender. Pinnules linear to elongate-lanceolate, closely set katadromically, and attached by their whole base to the pinna rachis, borne at a wide angle or often perpendicular, typically 2 cm long and 0.5 cm wide, apex acute.

The first pair of pinnules larger than others. Midvein distinct, straight, persist-

ing to the tip, and sending off typically 9-10 pairs of lateral veins at an angle of 45 degrees. Lateral veins mostly once forking, branches forming a narrow angle.

*Distribution and occurrence*.—*Cladophlebis pseudodelicatula* occurs rarely in the Nariwa and Kuruma Groups and Iwamuro Formation. Similar leaves have been recorded from the Upper Triassic of Primorye.

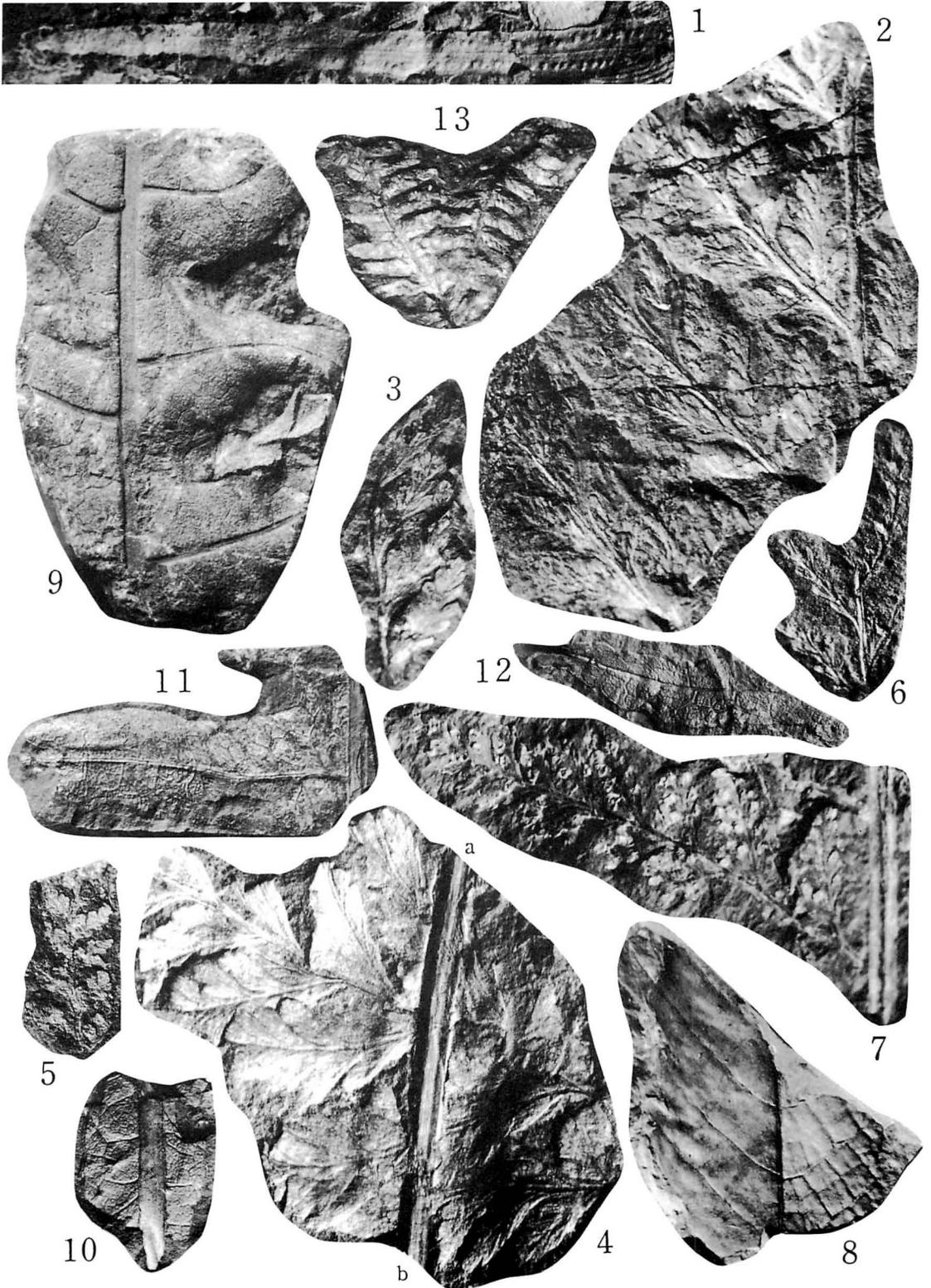
*Discussion and comparison*.—OISHI (1932) based this species on pinna fragments from the Nariwa Group and included his *Cladophlebis* sp. b (1931) from Tsuchizawa in it.

We have reexamined the specimens described as *Cladophlebis clavata* (first spelt 'clavatum') by KIMURA (1959a) and now conclude that they are identical with *C. pseudodelicatula* OISHI.

Additional leaves newly obtained from the Negoya Formation, though they are fragmental, also agree well with OISHI's species.

#### Explanation of Plate 30

- Fig. 1. *Phlebopteris* sp. A; a detached fertile pinnule (NE-123; Text-fig. 1b),  $\times 2$ .  
 Figs. 2-7. *Coniopteris neiridaniensis* KIMURA and TSUJII sp. nov.; all figures,  $\times 2$ . 2. Sterile leaf-fragment with large-sized pinnules (NNW-293, holotype; Text-fig. 2a). 3. A sterile pinna fragment with four large-sized pinnules (NNW-590, paratype; Text-fig. 2c). 4. Sterile leaf-fragment with medium-sized pinnules; a stem-like impression shown by a-b does not belong to this leaf (NEG-120, paratype; Text-fig. 2b). 5. A sterile pinna fragment with medium-sized pinnules (DAI-055, paratype; Text-fig. 2f). 6. A fertile pinna fragment (NNW-561, paratype; Text-fig. 2k). 7. A fertile leaf-fragment (NE-053, paratype; Text-fig. 2l).  
 Fig. 8. *Clathropteris meniscoides* BRONGNIART; a pinna fragment, showing clathrate meshes (SAS-018; Text-fig. 3b, c),  $\times 1$ .  
 Figs. 9-11. *Dictyophyllum kotakiense* KIMURA and TSUJII sp. nov.; all figures,  $\times 1$ . 9. A pinna fragment (NEE-147, paratype; Text-fig. 4c). 10. Basal part of pinna base, with a thick pinna rachis and undivided lamina (NNW-223, paratype; Text-fig. 4a). 11. Two poorly preserved lateral segments; an incision is not to the pinna rachis (NEE-225, paratype; Text-fig. 4d).  
 Fig. 12. *Thaumatopteris elongata* OISHI; a detached sterile pinnule, with broadly sinuous margins (NEE-215; Text-fig. 5c),  $\times 1$ .  
 Fig. 13. *Cladophlebis pseudodelicatula* OISHI; two detached pinna fragments (NE-149; Text-fig. 12c).  $\times 1$ .



*Cladophlebis pseudodelicatula* looks rather like *C. delicatula* of YABE and OISHI (1933) from the Jurassic of NE-China (possibly from the Lower Cretaceous Yushugou Formation, according to the recent knowledge). It is also like *Cladophlebis argutula* (HEER) from the Jurassic-Cretaceous of East Siberia, but its pinnules are more slender.

*Cladophlebis raciborskii* ZEILLER

Pl. 31, Fig. 11, Pl. 32, Figs. 5-9;  
Text-fig. 13

*Cladophlebis raciborskii* ZEILLER: ZEILLER, 1903, p. 49, pl. 5, fig. 1 (Upper Triassic of North Viet-Nam): KAWASAKI, 1925, p. 15, pl. 7, figs. 25-29; pl. 34, fig. 94 (Daedong Group, Korean Peninsula): OISHI (1932) (pars), p. 286, pl. 10, fig. 1 (Nariwa Group; other leaves are referable to Cfr. *Asterotheca okafujii*): 1940, p. 282 (general remarks): LEE, 1955, p. 35, pl. 1, figs. 2-8 (Middle Jurassic of N-Shaanxi): SZE, 1956, pp. 20, 128, pl. 21, fig. 7; pl. 22, fig. 3, 3a; pl. 26, figs. 1-7; pl. 27, figs. 1-5; pl. 53, fig. 3? (Upper Triassic of Shaanxi): CHOW and CHANG, 1956, p. 55, pl. 1, figs. 6-8 (Upper Triassic of Neimeng): KIMURA, 1959a (pars), p. 17, pl. 4, fig. 7; pl. 5, figs. 4, 6; text-fig. 11 (Iwamuro): 1959b, p. 70 (Kotaki Coal-Field): SZE et al., 1963, p. 106, pl. 35, fig. 3; pl. 36, fig. 3; pl. 37, fig. 3 (all reinserted from SZE, 1956): LI, P.C. et al., 1976, p. 113, pl. 27, fig. 6, 6a; pl. 28, figs. 3-5 (Upper Triassic of Yunnan): HE et al., 1979, p. 142, pl. 65, fig. 1, 1a (Upper Triassic of Qinghai): HSÜ et al., 1979, p. 33, pl. 16, figs. 7, 8; pl. 17, fig. 1, 1a (Upper Triassic of Sichuan): ZHOU, H.Q. et al., 1980, p. 78, pl. 2, figs. 1-2; pl. 29, fig. 3; pl. 30, figs. 1-2 (Upper Triassic of Shaanxi and Neimeng).

*Material*: A-0305, 0322, 0496 and other 7 specimens (Iwamuro), Kr-047, 069 (Tsuchizawa), 4981103-2 and other 2 specimens (Kotaki Coal-Field), NE-015 (Neiridani), NNW-

650, 764 (Nishi-Neiridani), SHI-008 (Shinadani), TOB-046A (Tobiiwadani).

*Distribution and occurrence*.—*Cladophlebis raciborskii* is common in the Iwamuro Formation but rather rare in the Kuruma Group. This species is widely distributed in the older Mesozoic plant-beds in East Asia.

*Remarks*.—The sterile pinnules of *Asterotheca okafujii* are of similar size and shape but differ in having entire margins in their distal halves (compare Text-figs. 12c and 13).

*Cladophlebis* sp. described by SZE (1949) from the Lower Jurassic of Hubei also has pinnules of similar size, but their distal margins have not been figured.

Among the leaves regarded by KIMURA (1959a) as *Cladophlebis raciborskii* from the Iwamuro Formation, some were misidentified excluding pl. 2, fig. 12 and pl. 4, 7, 9 which we now determined as Cfr. *Todites denticulatus*.

*Cladophlebis* sp. A

*Cladophlebis* sp. A: KIMURA, 1959a, p. 20, pl. 4, fig. 1 (Iwamuro).

*Material*: A-4073 (a single specimen).

*Cladophlebis* sp. B

*Cladophlebis* sp. B: KIMURA, 1959a, p. 20, pl. 3, fig. 6 (Iwamuro).

*Material*: A-3067 (a single specimen).

*Cladophlebis* sp. C

Pl. 32, Fig. 10; Text-fig. 14

*Material*: SHI-015, 016 (Shinadani).

*Description*.—Two pinna fragments are preserved on a sandstone slab. A part of one is shown in Text-fig. 14. Pinnules closely set, varied in form, deltoid or

oblong, 0.7-1.1 cm long and up to 6 mm wide at base, with obtusely pointed or rounded apex; laminae connected at base; margins entire. Midvein sinuous, sending off 3-5 pairs of twice or once forked lateral veins.

*Distribution and occurrence.*—*Cladophlebis* sp. C is rare and known only from the Shinadani Formation.

*Remarks.*—Our pinnules are characterized by their varied forms with a sinuous midvein and 3-5 pairs of twice or once forked lateral veins, and prominently contiguous laminae at their basal part.

*Cladophlebis grabauniana* and *C. suniana* originally described by P'AN (1936) and by SZE (1956) respectively from the Upper Triassic of Shaanxi show the venation similar to *C. sp. C*. But *Cladophlebis grabauniana* is distinguished from *C. sp. C* by its small oblong pinnules with a straight midvein, and *C. suniana* by its oblong pinnules with mostly simple lateral veins.

Sterile fern leaves described by TESLENKO (1970) as *Cladophlebis nebbensis* from the Middle Jurassic of Southern Siberia resemble ours in the form of pinnule and venation. But TESLENKO's leaves are easily distinguished by their pinnules

with finely denticulated margins.

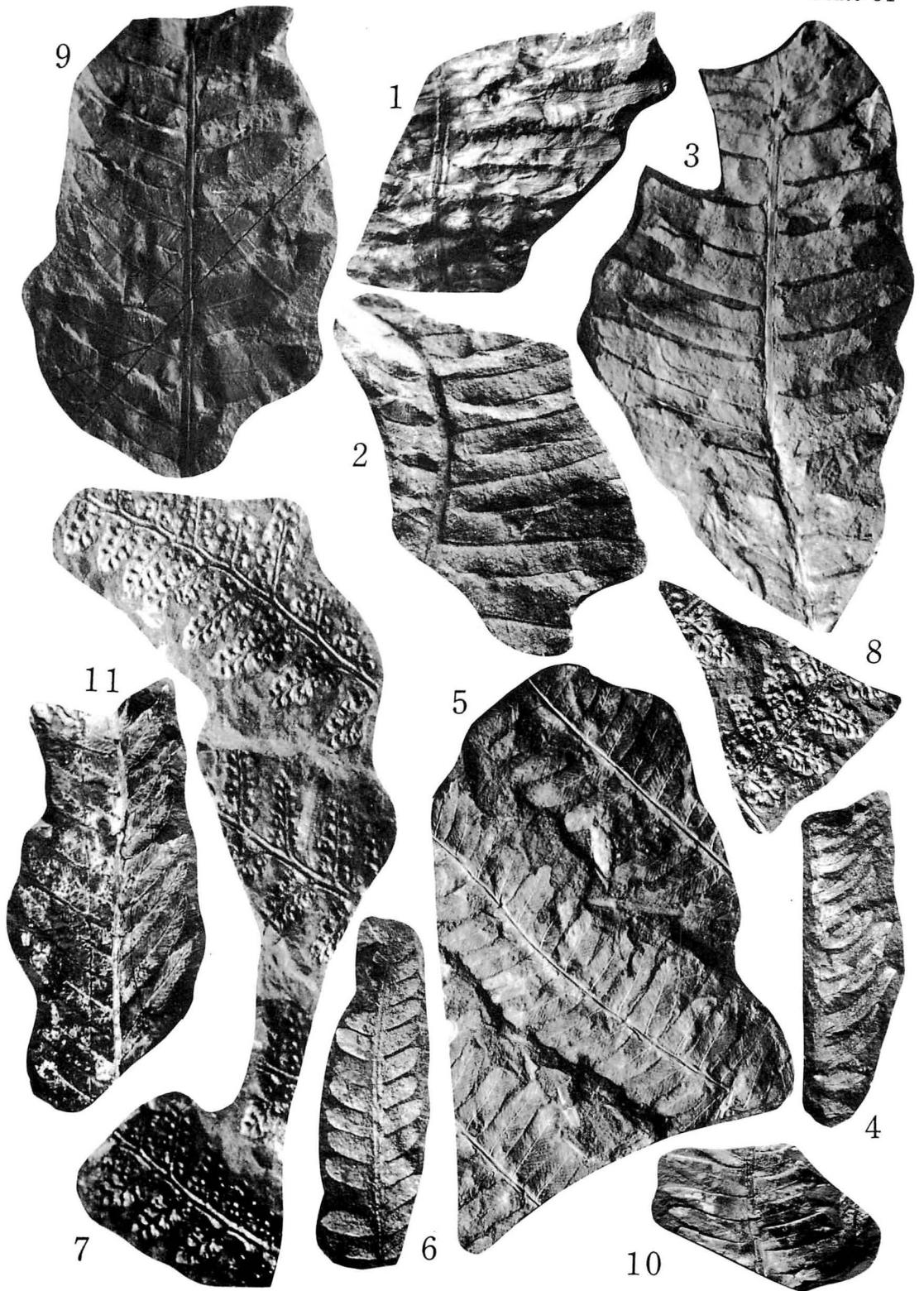
Our leaves appear to be new to science, but here we reserve their specific identity because of their fragmental state.

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### Explanation of Plate 31

- Figs. 1-2. *Thaumatopteris elongata* OISHI; Poorly preserved pinnae, both  $\times 1$ . 1. Reinserted from KIMURA, 1959a, pl. 2, fig. 2 (A-3034). 2. (Kr-150; Text-fig. 5b).
- Figs. 3-4. Cfr. *Asterotheca okafujii* KIMURA and OHANA; both  $\times 1$ . 3. A sterile pinna fragment with large-sized pinnules (NNW-061; Text-fig. 7a). 4. Apical part of a sterile pinna, with small-sized pinnules (DAI-009; Text-fig. 7d).
- Figs. 5-6. Cfr. *Todites fukutomii* KIMURA and OHANA; both  $\times 1$ . 5. A part of sterile leaf (NE-031; Text-fig. 8a). 6. A pinna fragment (NNW-660).
- Figs. 7-8. *Sphenopteris* sp. A; both  $\times 2$ . 7. A part of fertile leaf (NNW-282; Text-fig. 10a). 8. Ditto (NNW-833).
- Fig. 9. *Cladophlebis kurumensis* KIMURA and TSUJII sp. nov.; a pinna fragment (Kr-066, paratype),  $\times 1$ .
- Fig. 10. *Cladophlebis pseudodelicatula* OISHI; a pinna fragment (A-0309),  $\times 1$ .
- Fig. 11. *Cladophlebis raciborskii* ZEILLER; a pinna fragment (A-0496),  $\times 1$ .



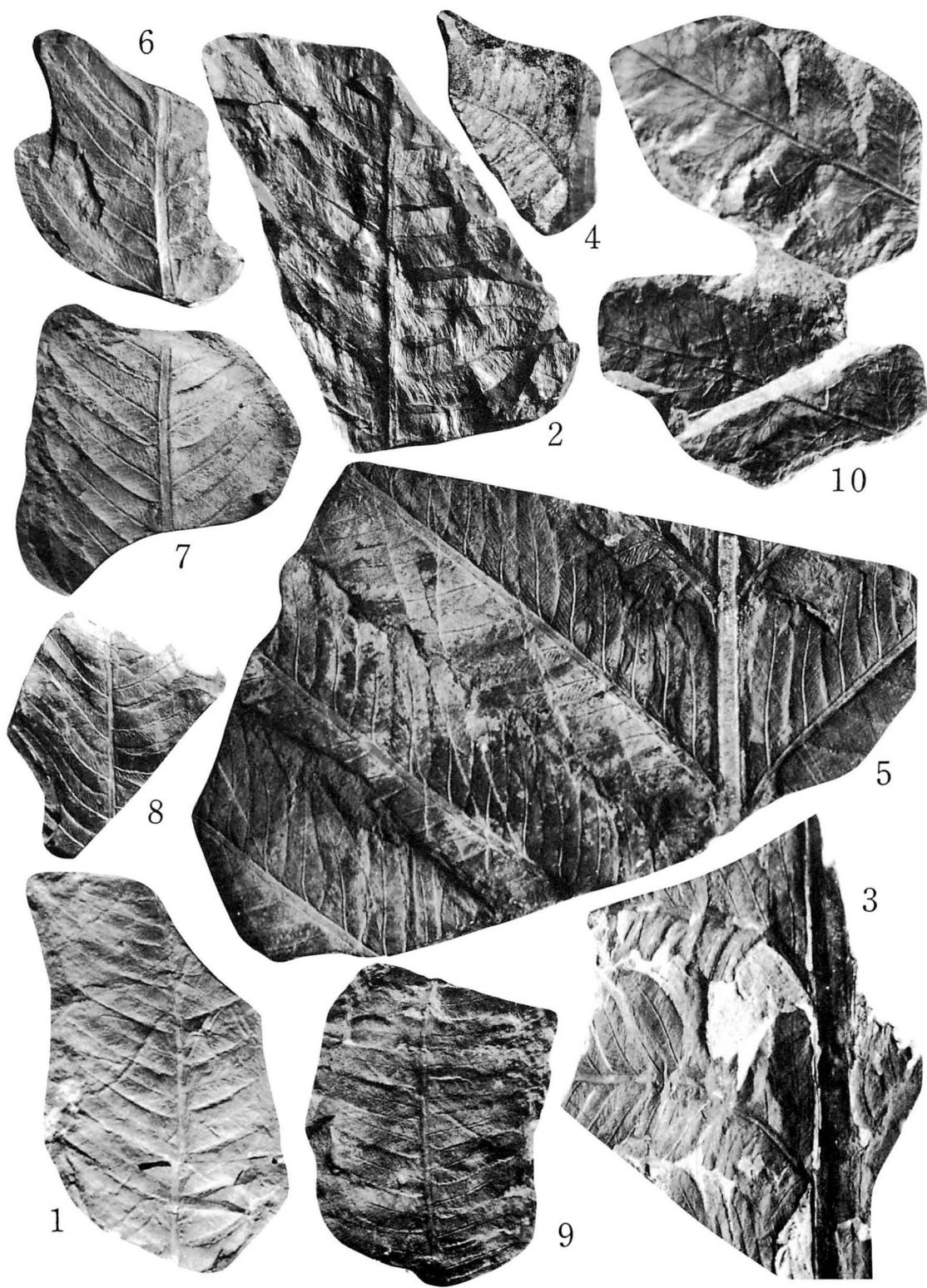
- Phlebopteris braunii* (GOEPPERT) and its reference to *Matonia* R. BR. *Bull. Brit. Mus. (Nat. Hist.), Geol.*, vol. 33, no. 5, p. 295-311.
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### Explanation of Plate 32

- Fig. 1. Cfr. *Todites yamanoiensis* (YOKOYAMA) KIMURA and OHANA; a sterile pinna fragment (A-0405; Text-fig. 9b),  $\times 1$ .
- Fig. 2. *Cladophlebis kurumensis* KIMURA and TSUJII sp. nov.; a pinna fragment (Kr-052, holotype),  $\times 1$ .
- Figs. 3-4. *Cladophlebis pseudodelicatula* OISHI; both  $\times 1$ . 3. A part of leaf, with a thick rachis, reinserted from KIMURA, 1959a, pl. 5, fig. 2 (A-4068; Text-fig. 12a). 4. Ditto (NEE-099; Text-fig. 12b).
- Figs. 5-9. *Cladophlebis raciborskii* ZEILLER; all  $\times 1$ . 5. A part of leaf, reinserted from KIMURA, 1959a, pl. 5, fig. 4 (A-4038). 6-9. Pinna fragments. 6; (A-4006), 7; (A-4016, counterpart of KIMURA, 1959a, pl. 5, fig. 6 regarded formerly as *C. raciborskii* forma *integra*), 8; (TOB-046A), 9; (NE-015).
- Fig. 10. *Cladophlebis* sp. C; a part of leaf (SHI-015; Text-fig. 14),  $\times 1$ .



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Geographical names in Japan: Asahi-machi 朝日町, Dairagawa 大平川, Higashi-Neiridani 東寝入谷, Iwamuro 岩室, Kita-Otari 北小谷, Kotaki 小滝, Kuruma 来馬, Momonoki 桃ノ木, Nagato 長門, Negoya 似虎谷, Nariwa 成羽, Neiridani 寝入谷, Nishi-Neiridani 西寝入谷, Oguchi 尾口, Sasakomata 笹小俣, Shinadani 榎谷, Tobiiwadani 飛岩谷, Tsuchizawa (Tsunzawa) 土沢, Yamanoi 山野井; Geographical names in China (with former expression in parenthesis): Alashan 阿拉善, Baoding 宝鼎, Fang-zi (Fang-tzi) 坊子, Fujian 福建, Guangdong 廣東, Guangyuan (Kwangyuan) 广元, Hubei (Hupeh) 湖北, Jiangxi (Kiangsi) 江西, Neimeng 内蒙, Qinghai 青海, Shandong (Shandung) 山東, Shaan-Gan-Ning 陝甘寧, Shaanxi (Shensi) 陝西, Shanxi (Shansi) 山西, Sichuan (Szechuan) 四川, Xiangxi (Hsiangchi) 香溪, Xujiabe (Hsuchiaho) 須家河, Yanchang (Yenchang) 延長, Yungang (Yunkang) 雲崗, Yunnan 雲南, Yushugou 榆樹溝; Geographical name in Korea (with former expression in parenthesis): Daedong (Taedong) 大同

日本の初期ジュラ紀植物化石。その3: 前編につづき, 来馬層群および岩室累層からつぎのシダ植物化石を記載した。

マトニア科: *Phlebopteris* sp. A, たかわらび科: *Coniopteris neiridaniensis* KIMURA and TSUJII sp. nov., やぶれがさうらぼし科: *Clathropteris meniscoides* BRONGNIART, *Dictyophyllum kotakiense* KIMURA and TSUJII sp. nov., *Thaumatopteris elongata* OISHI, *Hausmannia (Protorhipis)* sp. A, 裸葉もしくは分類上の位置不明のシダ: Cfr. *Asterotheca okafujii* KIMURA and OHANA, Cfr. *Todites fukutomii* KIMURA and OHANA, Cfr. *Todites yamanoiensis* (YOKOYAMA) KIMURA and OHANA, *Sphenopteris* sp. A, *Cladophlebis kurumensis* KIMURA and TSUJII sp. nov., *C. pseudodelicatula* OISHI, *C. rachiborskii* ZEILLER, *C. sp. A*, *C. sp. B*, *C. sp. C*.

シダ植物の構成から, この植物群は, いわゆる, やぶれがさうらぼし植物群であるが, たかわらび科のシダおよび *Ptilophyllum* (ベネチテス目, 後述) を含む。このことは, 当時の植物地理区の問題を考察する上で重要な資料となる。 木村達明・辻井正則

738. A NEW PERMIAN RADIOLARIAN GENUS FROM THE  
TAMBA BELT, SOUTHWEST JAPAN

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**Abstract.** An Upper Permian radiolarian assemblage which includes more than 10 species has been found in the Tamba Belt, Southwest Japan. A new genus *Neoalbaillella* belonging to the family Albaillellidae DEFLANDRE emend. HOLDSWORTH is proposed from this assemblage. Genus *Neoalbaillella* is characterized by its curved apical cone, winged pseudothorax and pseudoabdomen with windows and trabeculae. 4 species (of which 2 are new) belonging to this new genus are described.

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### Introduction

An interesting form was found by DEFLANDRE (1952) from Carboniferous deposits of Europe, which was described as *Albaillella*. It is characterized by a cone-shaped chamber with an open base and a very marked bilateral symmetry of the frame. Recently, research on radiolarian remains from Paleozoic strata has increased a great deal in connection with biostratigraphic study by means of radiolarians. Consequently, forms related to *Albaillella* were found in several places in the world.

The Permian radiolarian genus, *Follicucullus* was described by ORMISTON and BABCOCK (1979) from the Guadalupian Lamar Limestone of West Texas. HOLDSWORTH and JONES (1980) proposed two

new genera, *Pseudoalbaillella* and *Parafollicucullus*, and established nine radiolarian biozones for an interval from the Upper Devonian to Permian. In Japan, ISHIGA and IMOTO (1980) carried out a detailed biostratigraphic study on the *Pseudoalbaillella* Assemblage (HOLDSWORTH and JONES, 1980) from a chert in the Tamba Belt, Southwest Japan.

In our own study, TAKEMURA found a well-preserved radiolarian assemblage including more than 10 species from the Tamba Belt. Most of the Albaillellarians which have been reported have imperforate shells. New radiolarians we report in the present paper have shells with curiously shaped wings and windows arranged in several transverse lines. We propose for them a new name, *Neoalbaillella* which belongs to the family Albail-

lellidae DEFLANDRE, emend. HOLDSWORTH.

We wish to express our sincere thanks to Professor Keiji NAKAZAWA of the Department of Geology and Mineralogy, Faculty of Science, Kyoto University and Miss Akiko NISHIMURA of the Institute of Geological Sciences, College of General Education, Osaka University for their valuable advice and kind assistance. We also thank Dr. Nobuhiro IMOTO and Mr. Hiroaki ISHIGA of the Department of Earth Sciences, Kyoto University of Education for their valuable assistance. We are particularly grateful to Professor Tsunemasa SAITO of the Institute of Earth Sciences, Faculty of Science, Yamagata University for reading manuscript.

#### Geological Setting, Material and Method

The Tamba Belt is located in the Inner zone of Southwest Japan (Text-fig. 1) and consists of Mesozoic and Paleozoic strata which are mainly made up of sandstone, shale, chert and basic volcanic rocks. These strata have been dated as ranging from late Paleozoic to Jurassic mostly based on fusulinids occurring in a lenticular limestone, conodonts in a chert and radiolarians in chert and shale (SAKAGUCHI, 1961; Tamba Belt Research Group, 1979, etc.).

TAKEMURA (1980) surveyed the southern part of Kameoka City in Kyoto Prefecture, located in the southern part of the Tamba Belt, and recovered late Paleozoic to Jurassic radiolarians from 13 sites in the area. The fossil locality which is discussed by us in the present paper is AT26 situated at about 300 m east of Mt. Kurogara-dake (Text-fig. 1). Locality AT26 is a small outcrop within a 300–500 m thick, massive or bedded chert sequence.

Samples from AT26 are composed of a

light gray bedded chert with many quartz veins. One bed of the chert is about 10 cm thick and eight beds are exposed at this outcrop.

We used a dilute hydrofluoric acid (about 1%) and immersed samples in it for 12–24 hours. Delicate parts of radiolarians, including wings or spines of *Neobaillella*, would have been destroyed by a more concentrated acid. Residues obtained by that process were sieved (200 mesh), picked up by a thin brush and observed. We also observed etched surfaces of the rock samples (Pl. 33, Figs. 4a, b). In this case, an acid of about 10% concentration was used.

#### Radiolarian Assemblage and its Age

The radiolarian assemblage from AT26 includes more than 10 species, but most of the species have structures which have not been described so far. They are identified as: Palaeoactinommids or Entactiniids, *Angulobracchia*(?) sp., *Paronaella*(?) sp., *Follicucullus ventricosus* ORMISTON and BABCOCK, *Follicucullus scholasticus* ORMISTON and BABCOCK, Albaillellidae with one spine, *Neobaillella ornithoformis*, n. gen. n. sp., *Neobaillella gracilis*, n. gen. n. sp. *Neobaillella* sp. A and *Neobaillella* sp. B.

*Angulobracchia*(?) sp. (Pl. 34, Fig. 11) as mentioned above has two external beams along the axis of ray on both top and bottom sides of each ray. *Paronaella*(?) sp. (Pl. 34, Fig. 12) resembles *Paronaella* sp. A of BAUMGARTNER (1980) in shape, but rays are imperforate except tips and have spines. Internal structures of *Angulobracchia*(?) sp. and *Paronaella*(?) sp. have not been observed.

Albaillellidae (Pl. 34, Fig. 9–10) has one spine on the ventral side and two rods or flaps under its aperture. The ventral rod is weak and short, but the dorsal one

is strong and platy. Its internal structure is indeterminate.

From this site, no conodont has been found. This assemblage includes, however, *Follicucullus ventricosus* (Pl. 34, Fig. 7) and *Follicucullus scholasticus* (Pl. 34, Fig. 6) and is devoid of *Pseudoalbaillella* and *Parafollicucullus*. Following HOLDSWORTH and JONES (1980), the Follicucullus Assemblage is dated to range from Wordian to upper Guadalupian and they state: "*Pseudoalbaillella* and *Parafollicucullus* probably disappeared before latest Guadalupian time." Also, in the Sasayama area of ISHIGA and IMOTO (1980), the *Follicucullus* Assemblage is younger than the *Pseudoalbaillella* Assemblage, although *Nealbaillella* has not been reported there. So, the

age of this "*Nealbaillella* Assemblage" is late Permian, probably Guadalupian or younger.

### Systematic Paleontology

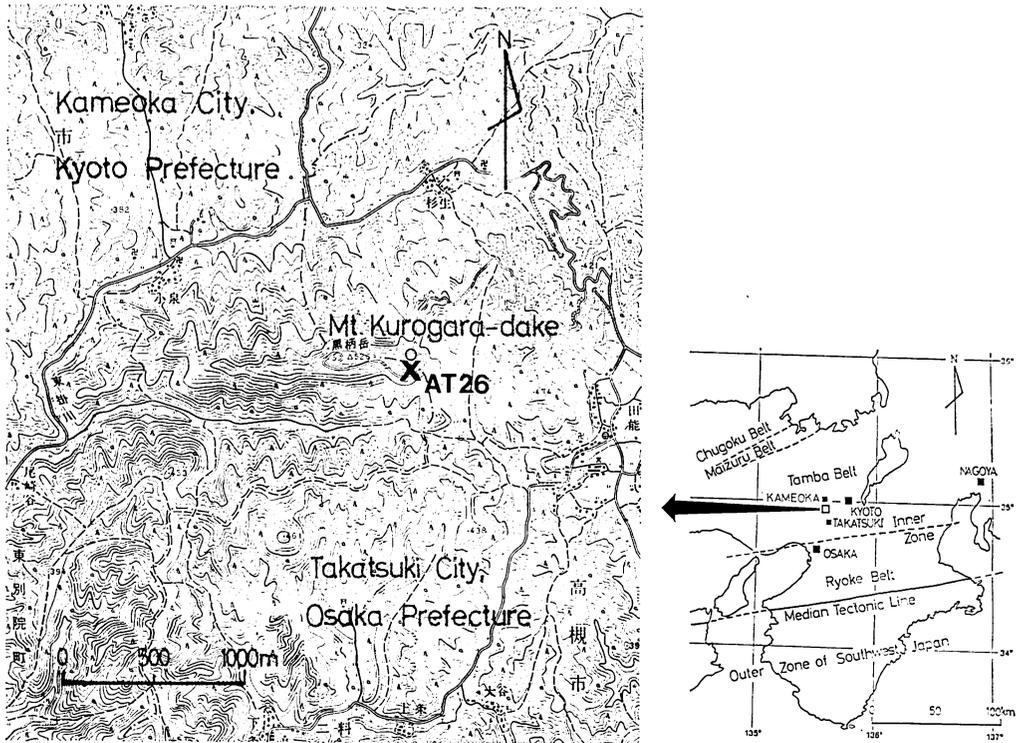
Subclass RADIOLARIA MÜLLER, 1858

Order POLYCYSTINA EHRENBERG,  
1838, emend. RIEDEL, 1967

Suborder ALBAILLELLARIA DEFLANDRE,  
1953, emend. HOLDSWORTH, 1969

Family ALBAILLELLIDAE DEFLANDRE,  
1952, emend. HOLDSWORTH, 1977

Genus *Nealbaillella* TAKEMURA and  
NAKASEKO, new genus



Text-fig. 1. Locality map (site plotted on Geographical Survey Institute of Japan topographical map "Hōki" of scale 1 : 25000).

Type-species: *Neoalbaillella ornithoformis* TAKEMURA and NAKASEKO n. sp.

*Diagnosis*.—Nearly bilaterally symmetrical, conical or subcylindrical shells of which upper part is winged and imperforate and of which lower part has windows. The lower part of the shell possessing trabeculae and windows arranged in transverse lines, but the upper part having an unknown internal structure. Apical cone bended in a bilaterally symmetrical plane. Two longitudinal rods with three or more spines lying at the dorsal and ventral sides of the lower shell part under the wings and protruding posteriorly from around the aperture.

*Remarks*.—The apical cone of the shell belonging to this new genus is more or less curved. We consider the outer side of this curve as a dorsal surface and the inner side as a ventral one. Each surface has a wing and a longitudinal rod (Text-fig. 2). The dorsal rod is more or less stronger than the ventral one. When the apical cone can be observed at the upper part of the shell with the cone curving to the left, we are seeing the "left side" of the shell. If the cone curves to the right, we are seeing the "right side".

In this new genus, there are neither distinctive segmentations nor constrictions. The upper part of the body, however, may correspond to a combination of an apical cone and a pseudothorax of *Pseudoalbaillella* HOLDSWORTH and JONES, and the lower part to a pseudoabdomen.

The overall shape of the shell resembles that of *Pseudoalbaillella* HOLDSWORTH and JONES, but the latter genus and other Paleozoic genera belonging to Albaillellaria are not known to possess windows (DEFLANDRE, 1952; FOREMAN, 1963; ORMISTON and BABCOCK, 1979; HOLDSWORTH and JONES, 1980). The trabeculae in the lower part of the shell of this genus (Pl. 33, figs. 4a, b) may indicate affinity of this

new genus to the Albaillellidae DEFLANDRE but we have seen no transverse cross bar. Because of the possession of trabeculae and windows, therefore, Follicullidae ORMISTON and BABCOCK is not suitable to assign this genus.

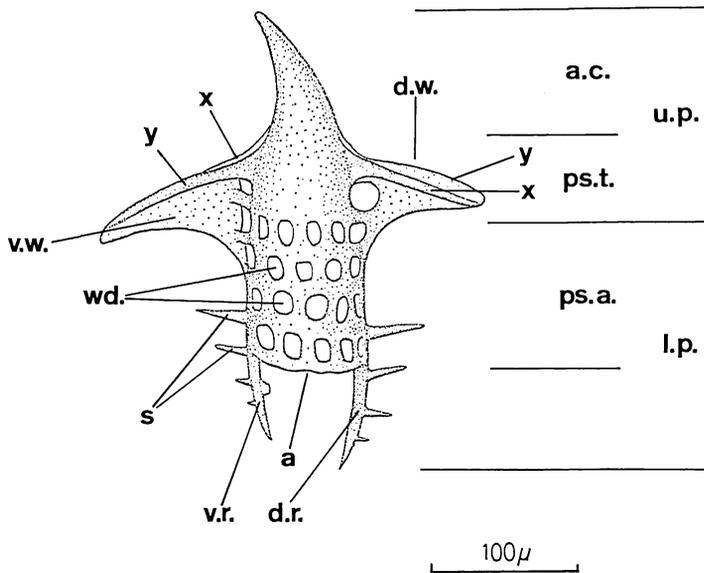
These windows forming transverse lines in the lower part of the shell seem to have some similarity to the Triassic *Dictyomitrella* and other Cyrtoids. In order to understand the taxonomy of Paleozoic and Mesozoic radiolarians adequately, it is very important to elucidate relationships of these resembling taxa.

*Neoalbaillella ornithoformis* TAKEMURA  
and NAKASEKO, n. sp.

Pl. 33, Figs. 1-6; Text-fig. 2

*Description*.—Pseudothorax and pseudoabdomen cylindrical, with four or five, rarely more than six transverse lines of windows. Wings triangular in shape, platy and bilaterally asymmetrically attached to the main body of the shell, but two wings symmetrical to each other with respect to a longitudinal two-fold axis through the center of the body. Two rods, X-rod and Y-rod, lying along the anterior sides of the two wings. The X-rod situated on the left side of the dorsal wing and the right side of the ventral one, and Y-rod conversely the right side of the dorsal wing and the left side of the ventral one. Two wings bordered at their upper edges by Y-rods which are slightly curved posteriorly. X-rods extended in straight lines from the just side of Y-rods to a little below Y-rods. Trabeculae circular and lying on the inner surface of the shell wall. Dorsal and ventral rods arising under wings.

*Measurements*.—Length of shell (exclusive of dorsal and ventral rods), 190-230  $\mu\text{m}$ ; Width of shell (including two wings),



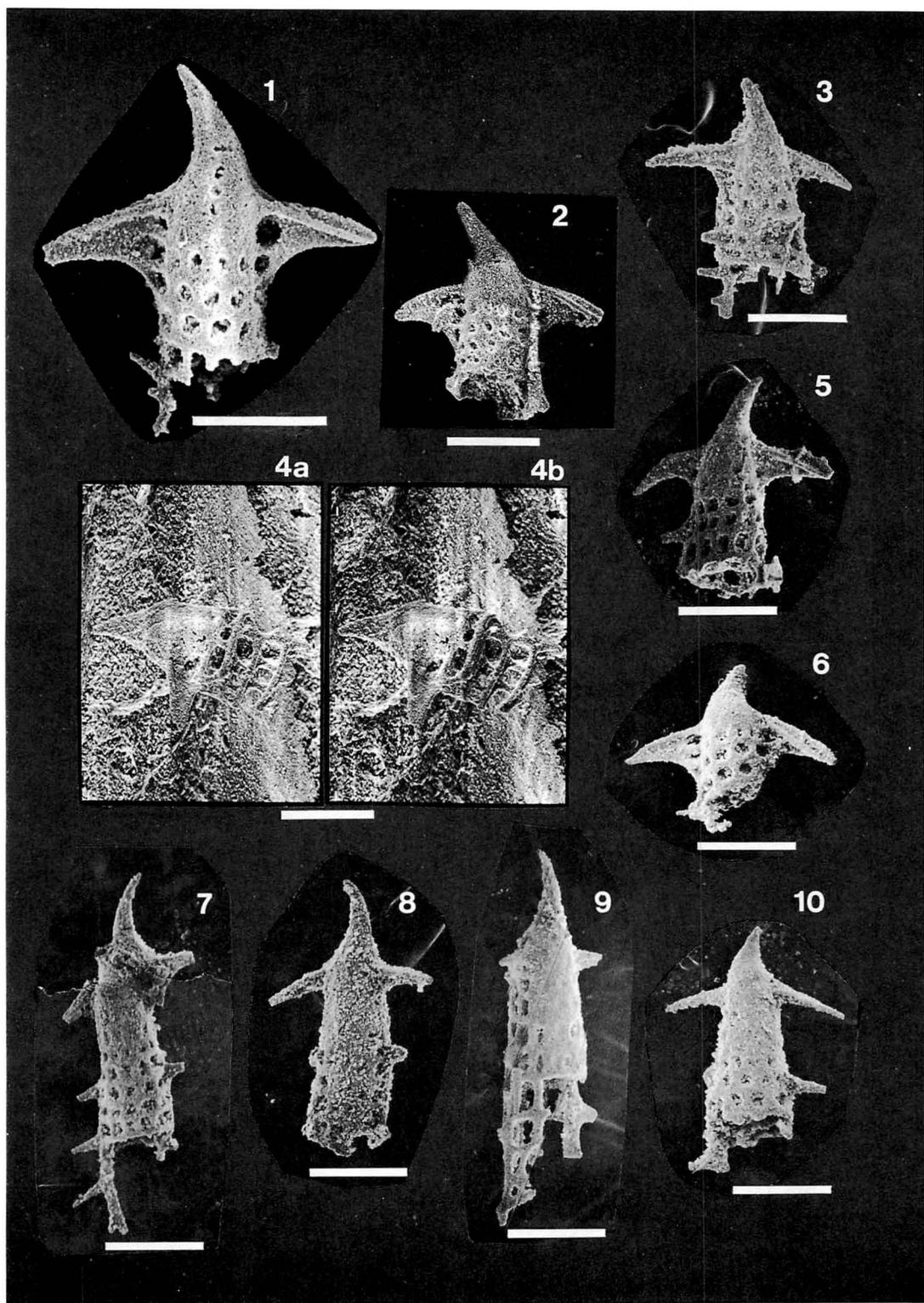
Text-fig. 2. *Neoalbaillella ornithoformis* TAKEMURA and NAKASEKO n. sp.  
(left side of the shell)

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| u. p. : the upper part of the shell | l. p. : the lower part of the shell |
| a. c. : apical cone                 | ps. t. : pseudothorax               |
| ps. a. : pseudoabdomen              | v. w. : ventral wing                |
| d. w. : dorsal wing                 | x : X-rod                           |
| y : Y-rod                           | wd. : window                        |
| s : spine                           | v. r. : ventral rod                 |
| d. r. : dorsal rod                  | a : aperture                        |

### Explanation of Plate 33

(scale = 100  $\mu$ m)

- 1-6. *Neoalbaillella ornithoformis* n. sp.
  1. Holotype (left side) ATPMTB-1103-1
  2. Paratype (left side) ATPMTB-1103-2
  3. Paratype (left side) ATPMTB-1201-1
  - 4a, b. Paratype (left side, stereophotograph) ATPMTB-1102-1
  5. Paratype (right side) ATPMTB-1201-2
  6. Paratype (right side) ATPMTB-1204-1
- 7-10. *Neoalbaillella gracilis* n. sp.
  7. Holotype (right side) ATPMTB-1203-1
  8. Paratype (left side) ATPMTB-1202-1
  9. Paratype (left side) ATPMTB-1203-2
  10. Paratype (right side) ATPMTB-1203-3



210-270  $\mu\text{m}$ ; Diameter of the lower part of the shell, 80-95  $\mu\text{m}$ .

*Remarks*:—This species differs from other species of *Neoalbaillella* in that distinctive feature of the wings. Observation of a dissolved specimen seems to indicate that one wing comprises a combination of at least four rods including X- and Y-rods. The species name, ornithoformis, is given because of the bird-shaped appearance of this species.

*Occurrence*:—Upper Permian in the Tamba Belt.

*Neoalbaillella gracilis* TAKEMURA  
and NAKASEKO, n. sp.

Pl. 33, Figs. 7-10; Pl. 34, Fig. 1

*Description*:—Apical cone slender, pseudothorax and pseudoabdomen long and cylindrical. Wings slender and possessing X- and Y-rods, with both rods together bordering the upper edge of the two wings; wings being bilaterally symmetrical and simple. Windows forming more than five or six transverse lines but those of upper two or three lines being relict. Dorsal rod stronger than ventral one.

*Measurements*:—Length of shell (exclusive of dorsal and ventral rods), 260-280  $\mu\text{m}$ ; Width of shell (including two wings), 180-200  $\mu\text{m}$ ; Diameter of the lower part of the shell, 75-90  $\mu\text{m}$ .

*Remarks*:—This species differs from *Neoalbaillella ornithoformis*, n. sp. in having the bilaterally symmetrical wings and slender body and wings. The species name, gracilis, means slender.

*Occurrence*:—Upper Permian in the Tamba Belt.

*Neoalbaillella* sp. A

Pl. 34, Figs. 2-3

*Description*:—Apical cone inflated and dorm-shaped with apical horn. Pseudothorax and pseudoabdomen cylindrical, possessing four to five transverse lines of windows. Wings bilaterally symmetrical, simple and slender. Dorsal rod stronger than ventral one.

*Remarks*:—Though the wings of this species are similar to that of *Neoalbaillella gracilis* n. sp., this species is distinguished from other species by the shape of the apical cone. No species name is given because of its poor state of preservation and scarcity.

*Occurrence*:—Upper Permian in the Tamba Belt.

*Neoalbaillella* sp. B.

Pl. 34, Figs. 4-5

*Description*:—Pseudothorax trapezoidal, pseudoabdomen trapezoidal or barrel-shaped; body conical or spindle-shaped. Windows forming more than six lines and relict in upper two or three lines. Platy wings and lower three or more platy spines complexly connected with longitudinal platy rods.

*Remarks*:—This species is distinguished from other species of *Neoalbaillella* by its complicated wings. The body shape of this species resembles that of Mesozoic Nasselarians, but at present there is no evidence to substantiate their relationship.

*Occurrence*:—Upper Permian in the Tamba Belt.

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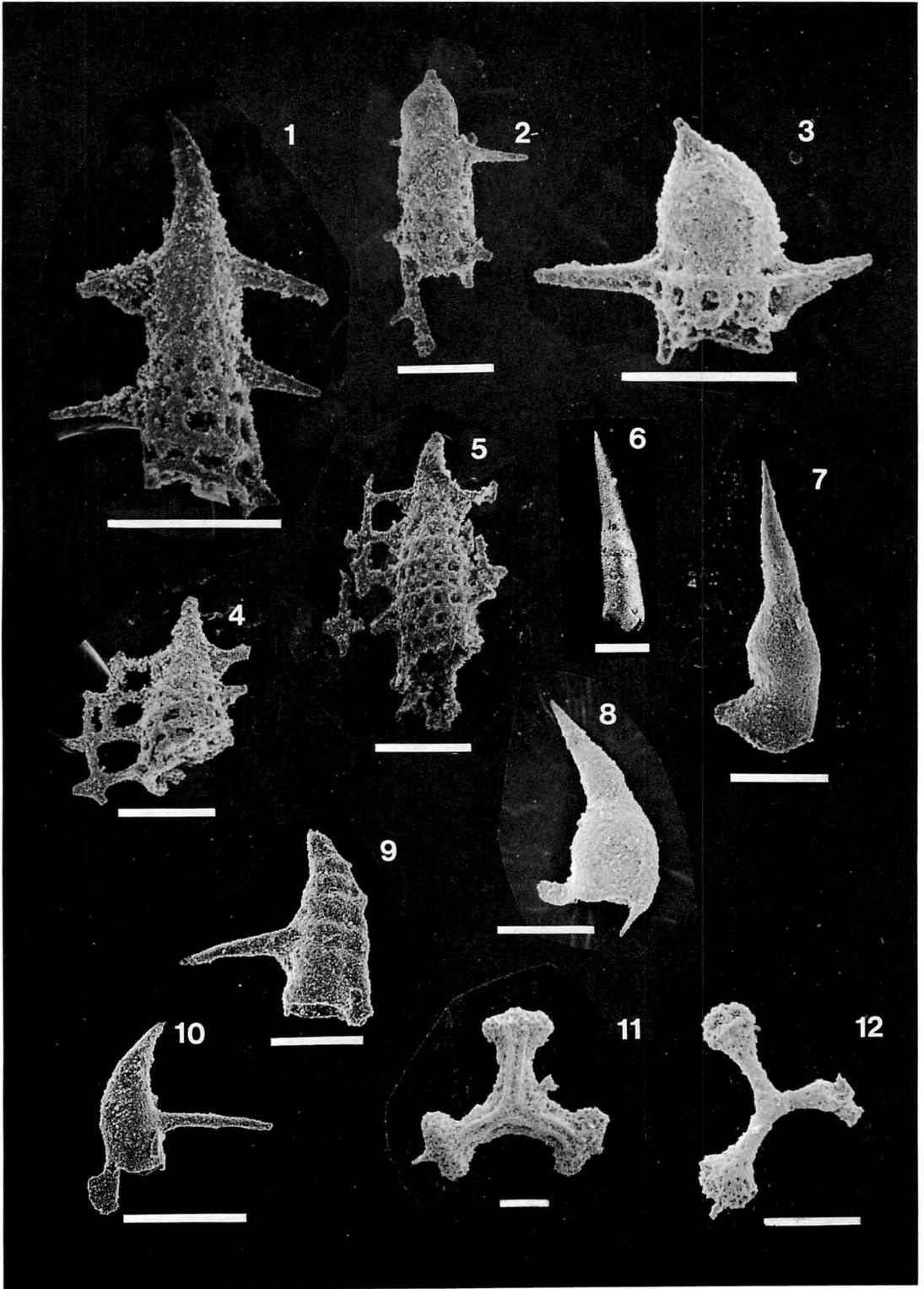
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丹波帯から産出したペルム紀放射虫化石の新属：京都府亀岡市黒柄岳にはチャートが分布し、ペルム紀の放射虫群集を産出する。その中から *Albaillellidae* 科に属する *Neoalbaillella* 属を新設した。この属は、湾曲した apical cone、翼のある pseudothorax、window のみられる pseudoabdomen を持つのが特徴である。ここでは、本属に属する 4 種 (内、2 種は新種) を記載した。  
竹村厚司・中世古幸次郎

### Explanation of Plate 34

(scale=100  $\mu$ m)

1. *Neoalbaillella gracilis* n. sp.  
Paratype (left side) ATPMTB-1203-4
- 2-3. *Neoalbaillella* sp. A
  2. ATPMTB-1203-5
  3. ATPMTB-1204-2
- 4-5. *Neoalbaillella* sp. B
  4. ATPMTB-1203-6
  5. ATPMTB-1203-7
6. *Follicucullus scholasticus* ORMISTON and BABCOCK, 1979 ATPMTB-1103-3
7. *Follicucullus ventricosus* ORMISTON and BABCOCK, 1979 ATPMTB-1202-2
8. *Follicucullus* cf. *ventricosus* ORMISTON and BABCOCK, 1979 ATPMTB-1201-3
- 9-10. *Albaillellidae* gen. et sp. indet. ATPMTB-1101-1, 2
11. *Angulobracchia*(?) sp. ATPMTB-1201-4
12. *Paronella*(?) sp. ATPMTB-1201-5



739. EARLY SHELL MORPHOLOGY IN SOME UPPER  
CRETACEOUS HETEROMORPH AMMONITES\*

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**Abstract.** This paper describes the early shell morphology in some Upper Cretaceous heteromorph ammonites (five nostoceratids and three diplomoceratids) on the basis of well-preserved specimens from Hokkaido. The ontogeny of the species examined may be divided essentially into the planispiral ammonitella first stage and the uncoiled or abnormally-coiled post-ammonitella second stage, both of which are bounded by a nepionic constriction. The surface ornament first appears at some phase of the second stage. These lines of evidence support the interpretation that an ammonitella was formed within an egg capsule.

The three diplomoceratids are clearly distinguished from the five nostoceratids in the presence of well-marked, prorsiradiate constrictions in the earliest post-ammonitella stage. The mode of coiling of the examined species is roughly classified into the three types (planispiral, helical and repeating U-turn coiling types) by means of RAUP's (1966) parameters. We postulate that all of the examined species might have passed a planktonic life for a limited period of the earliest post-ammonitella (=post-embryonal) stage. However, a benthonic life can be inferred as to their middle to later growth-stages, because of the loss of bilateral symmetry of the shells and other various indirect evidence.

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### Introduction

We formerly summarised the internal shell structural characteristics in the early growth-stages of some Upper Cretaceous

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\* Received June 23, 1981; Contribution to the early ontogeny of modern and fossil chambered Cephalopoda, III.

ammonites (TANABE *et al.*, 1979, 1980a). In those papers we stressed the significance of early internal shell structures to the researches of major taxonomy and phylogeny of the Mesozoic Ammonoidea. Most of the species examined in our previous papers belong to the Phylloceratina, Ammonitina and normally-coiled

Lytoceratina, besides selected scaphitids.

Although early ontogeny in the Cretaceous heteromorphs has been studied on some genera (e. g. *Ptychoceras*, *Hypoturrilites*, *Acrioceras*, *Ammonitoceras*, *Baculites*, *Scaphites* and *Otoscapites*) (BRANCO, 1879-80; SMITH, 1901; BIRKELUND, 1967, 1979, 1980; BIRKELUND and HANSEN, 1968; ATABEKYAN and MIKHAYLOVA, 1976; DRUSHCHITS *et al.*, 1977; TANABE *et al.*, 1979), details of the Nostoceratidae and the Diplomoceratidae have not yet been realized to our satisfaction. Species of the above two families are found abundantly in the particular sedimentary facies of the Upper Cretaceous in Hokkaido, and they have been already studied taxonomically by several authors, e. g., YOKOYAMA (1890), JIMBO (1894), YABE (1904), WRIGHT and MATSUMOTO (1954), MATSUMOTO (1963, 1967, 1977), MATSUMOTO and MURAMOTO (1967) and MATSUMOTO and KANIE (1967). Nevertheless, the characteristics of the early growth-stages of the species described previously have long been uncertain, owing much to difficulty in separating delicate young whorls from host rock.

Recently we have successfully observed the external shell morphology in the early stages of five nostoceratid and three diplomoceratid species. This paper summarizes the results of the observation and considers their implications for major taxonomy and mode of life.

The species utilized were collected from Turonian to Santonian rocks of Hokkaido. Their locations, horizons etc. are described elsewhere in the text. The repositories of the examined specimens are as follows: Department of Geology, Kyushu University for specimens with prefix, GK.; Department of Paleontology, National Science Museum for specimens with prefix, NSM.; Department of Earth Sciences, Ehime University for specimens with prefix, EE.

Observations and tracing of external shell morphology and sutures were made using a binocular microscope with a tracing mirror (Nikon Co., Model SMZ-10), with magnifications of six to twenty times.

### Observation

Superfamily Turrilitaceae GILL, 1871

Family Nostoceratidae HYATT, 1894

Genus *Eubostrychoceras*

MATSUMOTO, 1967

*Eubostrychoceras japonicum* (YABE)

Pl. 35, Figs. 1a-e; Text-fig. 1

*Material*.—One specimen, NSM. PM6593 from the Nakakinembets River, Obira area, northwestern Hokkaido. Details for its location and horizon are unknown. T. MAEHARA coll.

*Description*.—The shell is made of a planispiral ammonitella (=nepionic shell) and subsequent helically coiled free whorls of more than four volutions. The ammonitella, about 2 mm in diameter, probablys consisting of a protoconch and a first whorl, is involute with round venter. It is followed by two widely open, slightly helical whorls with large diameters in the next growth stage. At the end of the second helical whorl the coiling axis shifts abruptly at 180 degrees, and thereafter, the coiling begins to change from dextral to sinistral. The sinistral stage is represented by two or more whorls with a narrow umbilical perforation, which are helically coiled around the coiling axis. The whorls of this stage are more elongated longitudinally than those of the earlier stage. The above ontogenetic changes in mode of coiling can be easily expressed by RAUP's (1966) parameters

for shell geometry; *i.e.* T (whorl translation) tends to increase from the dextral to the sinistral stages, in contrast to the gradual decrease in D (distance of generating curve from coiling axis). W (whorl expansion rate) increases with growth in a constant rate.

The whorl of the ammonitella is smooth without any trace of ornamentation, but in the subsequent growth stage numerous simple ribs with regular space begin to appear. The interspace is wider on the ventral side than on the dorsal, and the rib density increases with growth. Flared ribs are not present in the earlier stage of less than 3 mm in whorl height, but afterwards they are common or frequent. Constrictions without tubercle irregularly occur along the flared ribs. Whorl section is subcircular throughout the post-ammonitella stage.

The siphuncle is marginal at least in the post-ammonitella stage, and is running at or somewhat above the mid-flank.

Sutures in the early stages are characterized by bifid L, as in other nostoceratids.

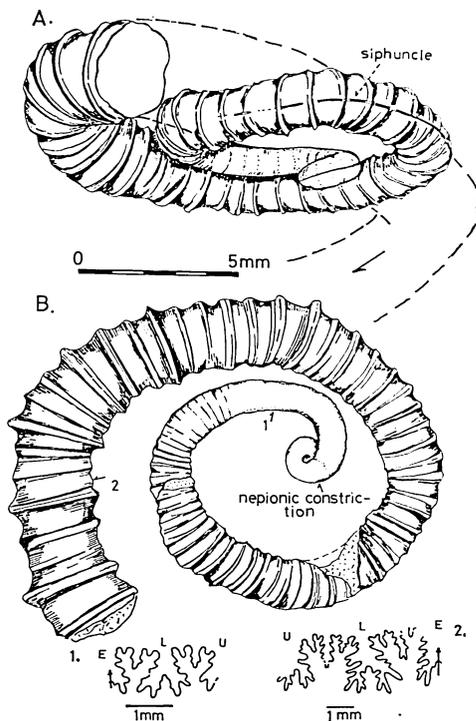
*Remarks*.—The diagnosis of the present species, except for the earliest stage, has already described in detail by MATSUMOTO (1977). Our observation essentially coincides with that of MATSUMOTO. According to him, the present species shows a fairly wide variation in the mode of coiling (especially in whorl translation) in the early stage, and the dextral coiling is more frequent than the sinistral in the later stage.

*Eubostrioceras cf. E. saxonicum*  
(SCHLÜTER)

Pl. 36, Figs. 1a-d; Text-fig. 2

*Material*.—One specimen, NSM. PM7127 from loc. SN2001, upper stream of the

*Eubostrioceras japonicum* (Yabe)  
NSM. PM 6593



Text-fig. 1. *Eubostrioceras japonicum* (YABE). Diagrammatic sketch of NSM. PM 6593, showing the mode of coiling and sutures in the early growth-stages. A. lateral view, B. upper view.

Sannosawa, the tributary of the Horomui River, Manji area, central Hokkaido (same specimen as in fig. 1 on pl. 2 of OBATA and FUTAKAMI, 1975). Upper Turonian. M. FUTAKAMI coll.

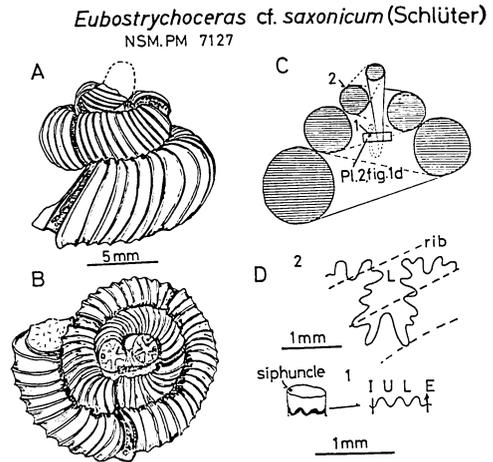
*Description*.—The shell is rather small, consisting of two subparallel shafts in the earliest stage and succeeding at least three helically coiled whorls in the later one. A planispiral ammonitella is not preserved in the specimen examined, but it is probably small in size, judging from the dimension of the initial shaft (about 0.4 mm in the cross section), which might

be connected with the ammonitella. The initial shaft slowly increases its diameter with growth, and by an abrupt U-curve it is connected with a much longer second shaft. The second shaft is never in contact with the first. It grows upward, and then it passes to an abrupt bent, forming an inverse J form. Subsequently the J-formed whorl changes to the succeeding helically coiled whorls. The mode of coiling of the first helical whorl is partly irregular with a slight deviation of the coiling axis. The main helical whorls, whose coiling axis is in parallel with the preceding second shaft, are contiguous, somewhat embracing each other. The apical angle, about 90 degrees, does not change with growth. The umbilicus is rather wide, about 30% of basal diameter at the end of the third helical whorl. Whorl section is more or less circular throughout the whole stages preserved.

The initial shaft is smooth, but numerous fine ribs can be observed on the second shaft. The main helical whorls are ornamented with numerous, oblique, gently flexuous ribs. The periodic constriction is well-marked (the earlier two are especially conspicuous), and bordered by a somewhat more raised rib. Its frequency is three or four per a helical whorl. From the end of the first helical whorl the ribs begin to change in the direction of their obliquity at a constriction.

The siphuncle is located at the ventral side at least in all stages preserved. It is nearly at or somewhat above the mid-flank. Details of sutural ontogeny are not observed in our specimen.

*Discussion*.—OBATA and FUTAKAMI (1975) compared the present species with *Heteroceras woodsii* KITCHIN (1922, p. 49) from the Upper Turonian Chalk Rock of England in the change in the obliquity of ribs, the shape of helical whorls and the



Text-fig. 2. *Eubostrychoceras* cf. *saxonicum* (SCHLÜTER). Diagrammatic sketch of NSM. PM 7127. Lateral (A) and upper (B) views, mode of coiling (C) and sutures (D) in the early growth-stages are illustrated. Read Pl. 36, Fig. 1d for Pl. 2, fig. 1d.

absence of bifurcate ribs on the umbilical margin. *H. woodsii* is, however, a junior synonym of *Turrilites saxonicus* SCHLÜTER (1875, p. 30), as WRIGHT (1979, p. 296) has already pointed out. WRIGHT (1979) included SCHLÜTER's *saxonicus* in *Didymoceras*, HYATT, 1894. *Didymoceras* is a better defined helically coiled, "*Bosstrychoceras*" like heteromorph with two rows of tubercles (MATSUMOTO, 1977). The simple ribs without tubercles and periodic constrictions in WRIGHT's (1979) *saxonicum* seem to match well with diagnostic features of *Eubostrychoceras* MATSUMOTO, 1967. We, therefore, treat the present species under *E. cf. E. saxonicum* (SCHLÜTER), because the characters in the adult stage are not seen in our specimen. It is similar to *E. muramotoi* MATSUMOTO (1967, p. 335, pl. 19, figs. 1-2) from the Coniacian of Japan in the mode of coiling and surface ornament, but is easily distinguished in the larger height-breadth ratio of the entire helical whorls, broader

umbilicus and the absence of bifurcate ribs.

Genus *Madagascarites* COLLIGNON, 1966

*Madagascarites ryu* MATSUMOTO  
et MURAMOTO

Pl. 36, Figs. 2-3; Text-figs. 3-4

*Material*:—Two specimens, GK. H8086 from loc. Ik 946, Katsurazawa, Ikushumbets area, central Hokkaido (Upper Turonian, T. MATSUMOTO coll.), and EE1013 from loc. R4020F, the middle reach of the Obirashibe River, about 400 m north from the junction with the Nakakinembets River, Obira area (Upper Turonian, I. OBATA and others coll.). For the detailed locations of both specimens see location maps of MATSUMOTO (1965) and TANABE *et al.* (1977).

*Description*:—The early-stages, except for the ammonitella, are favourably preserved in the two specimens examined, especially in GK. H8086. The ammonitella of this species is probably connected directly with a long shaft, the preserved earliest stage, as illustrated diagrammatically in Fig. 3. The shaft grows upward to become slightly sigmoidal, or gently curved, like an inverse J-form. In the succeeding stage the initial shaft is encircled by two loose, helical whorls through an abrupt U-form, which is vertical to the shaft. After this stage the whorl is descending down with a loosely spiral twisting, and then repeats a narrow U-turn at four times on a plane nearly vertical to the coiling axis (see Pl. 36, Fig. 3; Text-fig. 4). The coiling axis in this stage, therefore, transforms regularly at about 90 degrees, as if the preceding whorls are surrounded by U-turns. The fourth U-shaped whorl is connected with another more opened,

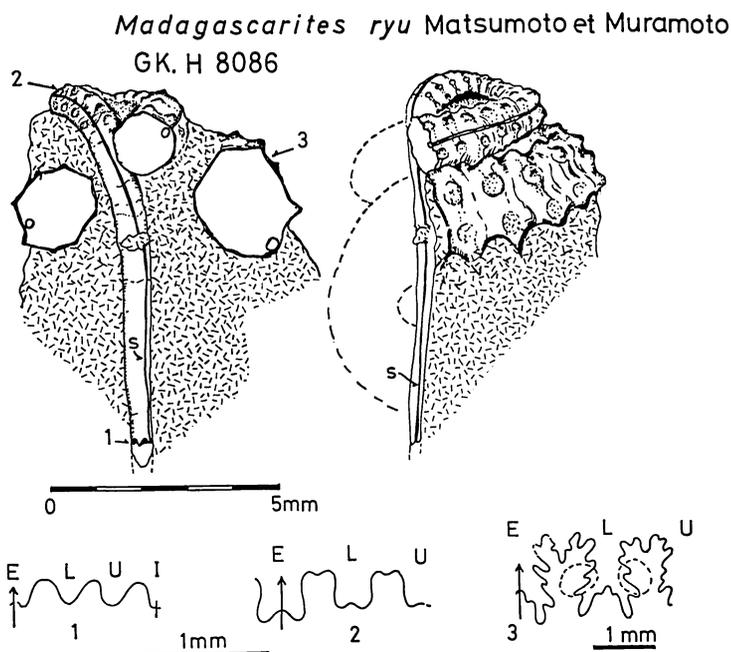
long U-turned whorl. The body-whorl in the adult stage is not preserved in our specimens. The first shaft is circular in the cross section, but the succeeding helical and U-shaped whorls are polygonal in the costal section and subcircular in the intercostal section.

The initial shaft is ornamented with numerous fine, annular ribs only. Quadri-tuberculated, flared major ribs and dense, fine minor ribs first appear in the earliest part of the first helical whorl, and thereafter they occur regularly and fairly frequently. The latter are present on the interspaces of and/or on the former. The tubercles are sharp, spinose, especially two on the ventrolateral portions.

The position of siphuncle is marginal in all stages observed. It is running nearly at or somewhat above the mid-flank.

Sutures are expressed by the formula, E, L, U and I. L and external saddles are bipartite after the helically coiled stage, and they tend to be deeply incised in the late growth-stages.

*Remarks*:—The peculiar, but regular ontogenetic changes in the mode of coiling in the present species have already described by MATSUMOTO and MURAMOTO (1967). They interpreted that the peculiar mode of shell growth is not of pathologic nature, but a diagnosis of this species. Our observation supports their interpretation. As MATSUMOTO and MURAMOTO (1967) have already pointed out, the mode of shell growth in the present species is fairly similar to that in *Nipponites mirabilis* YABE, 1904. The early stage also resembles those of *Muramotoceras* (MATSUMOTO, 1977) and *Eubostrychoceras* cf. *E. saxonicum* in the ontogenetic change from a straight form to a helical form.



Text-fig. 3. *Madagascarites ryu* MATSUMOTO et MURAMOTO. Diagrammatic sketch of GK. H 8086, showing the mode of coiling and sutures in the preserved earliest growth stage. s. siphuncle.

Genus *Muramotoceras*

MATSUMOTO, 1977

*Muramotoceras yezoense* MATSUMOTO

Pl. 37, Figs. 1a-b

*Material*:—One specimen, NSM. PM 7215 from a rollen nodule in the Sato-nosawa, the tributary of the Kamikinembets River, Obira area. Middle Turonian. T. MURAMOTO coll.

*Remarks*:—The specimen examined is one of the paratypes of the present species, and has already described with illustrations by MATSUMOTO (1977, pl. 54, figs. 1a-b). As MATSUMOTO (1977) mentioned, during ontogeny the mode of spiral growth of this species changes from a straight or a slightly sinuous form

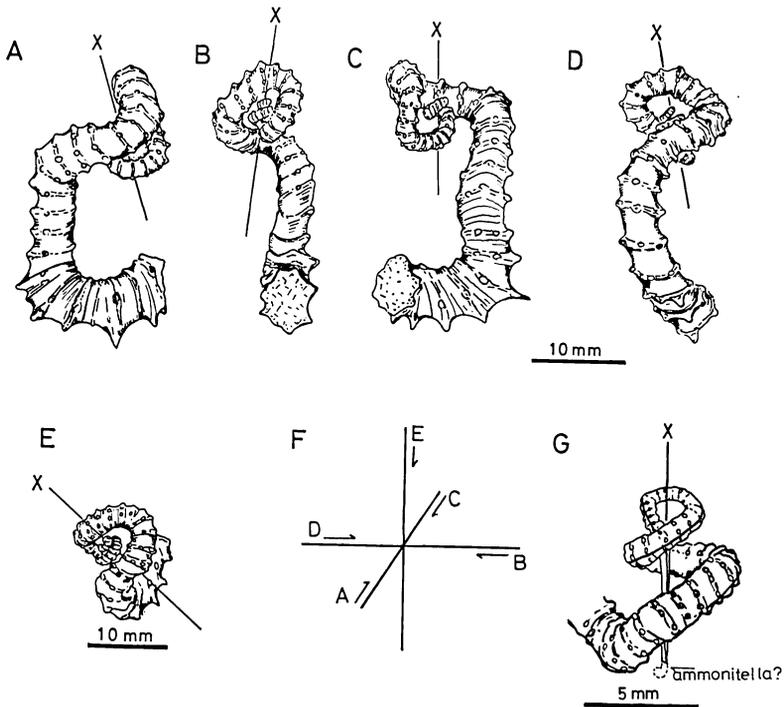
to a free, helical coiling via an abrupt J-shaped whorl growth with a loosely spiral twisting. In this respect this species somewhat resembles *Madagascarites ryu* and *Eubostriyoceras* cf. *E. saxonicum*, but differs in that the coiling axis in the helical stage is not in parallel with the initial straight arm, unlike the latter two species.

Genus *Neocrioceras* SPATH, 1921

*Neocrioceras spinigerum* (JIMBO)

Pl. 37, Figs. 2a-b; Text-fig. 5

*Material*:—NSM. PM 9491 from the Upper Cretaceous of Hokkaido or south Sakhalien. Details of its locality, horizon and collector are unknown.



Text-fig. 4. *Madagascarites ryu* MATSUMOTO et MURAMOTO. Diagrammatic sketch of EE 1013. Six different views of the entire shell, showing the peculiar U-turn coiling in the early to middle growth-stages.

*Description*.—The specimen is of moderate size, about 44 mm in diameter. The observable earliest portion is a part of a whorl with about 0.5 mm in height. The imperfect whorl probably corresponds to a first planispiral whorl of an ammonitella, because of the presence of a conspicuous nepionic constriction at its base (see Pl. 37, Fig. 2b). The whorls following the nepionic constriction initially show a very shallow, open helical, sinistral coiling, but thereafter a loose coiling in a plane. The initial whorl is circular in the cross section, but later depressed to subcircular in the intercostal section or polygonal in the costal section.

The initial whorl of an ammonitella is smooth. Prorsiradiate major ribs, which are present in the post-ammonitella stage,

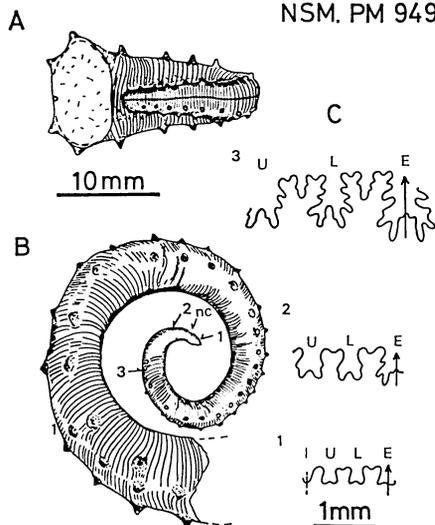
are dense, with regular intervals, associating lateral and ventrolateral tubercles. Both tubercles occur periodically, but the former ones are more frequent and weaker than the latter. Fine riblets are on the interspaces and/or on the major ribs, and they are looped even in the early stage.

The siphuncular position is marginal (ventral) in all the stages observed. Sutures are expressed as E, L, U and I. Lobes L and U, and other saddles are bifid throughout the post-ammonitella stage.

*Discussion*.—WRIGHT (1979, p. 293) attributed *Neocrioceras* to the Anisoceratidae, but he did not mention the reason. *Neocrioceras*, indeed, resembles *Anisoceras* of the Anisoceratidae in the almost

*Neocrioceras spinigerum* (Jimbo)

NSM. PM 9491



Text-fig. 5. *Neocrioceras spinigerum* (JIMBO). Diagrammatic sketch of NSM. PM 9491, showing the lateral (A) and ventral (B) views, and sutures (C) in the early growth stages. nc. nepionic constriction.

planispiral growth pattern of whorls with tubercles. The surface ornament of *Neocrioceras* is also similar to that of *Hyphantoceras* of the Nostoceratidae. In connection with this problem, *N. (?) undulosum* MATSUMOTO, described by MATSUMOTO (1977, p. 343, pl. 47, fig. 1) from the Turonian of the Obira area, is interesting in that the mode of coiling and surface ornament suggest a transition from *Hyphantoceras* to "typical" *Neocrioceras*. In this paper we follow MATSUMOTO (1977), who referred *Neocrioceras* to the *Hyphantoceras* origin.

Family Diplomoceratidae SPATH, 1926

Genus *Scalarites* WRIGHT et  
MATSUMOTO, 1954

*Scalarites scalaris* (YABE)

Pl. 38, Figs. 1a-b; Text-fig. 6

*Material*:—One specimen, EE 1010 from loc. R 6733a, the northern branch of the Sannosawa, the tributary of the Shimokinemets River, Obira area (for its detailed location see TANABE et al., 1977, fig. 8). Middle Turonian. K. TANABE coll.

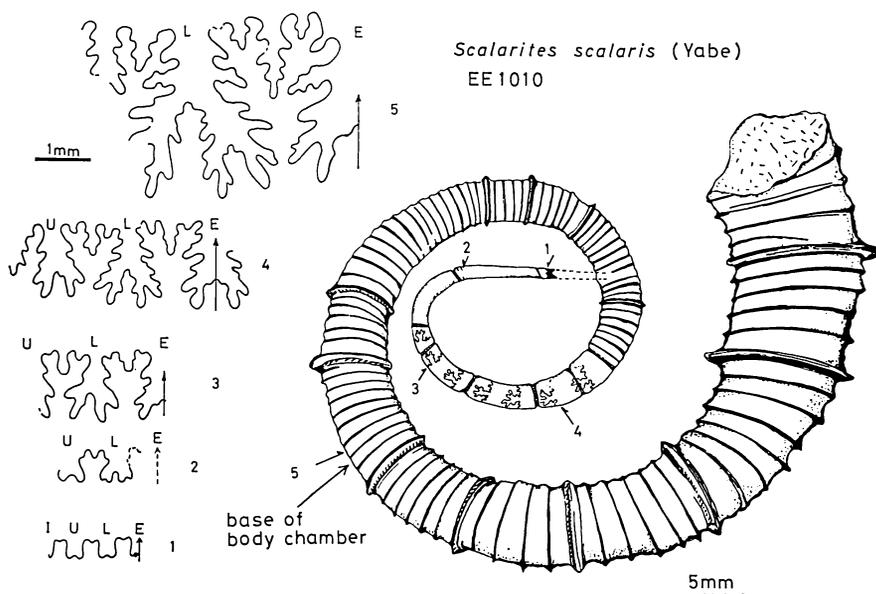
*Description*:—The specimen examined is an imperfect, immature shell of about 38 mm in maximum size. The preserved earliest stage is a straight arm of about 6 mm in length. It was probably connected directly with an ammonitella, judging from the dimension of the smallest part (ca. 1 mm in diameter of the cross-section). The straight arm is followed by later two whorls of broadly elliptical open coiling. The elliptical whorls are not strictly in a plane, but form a very low, variable helical coils with different spiral axes. The whorls are circular or subcircular in the cross section.

The initial arm is smooth with at least two well-marked, prorsiradiate constrictions. The succeeding whorls are ornamented with simple annular ribs with regular intervals. Untuberculated flared ribs occur periodically in elliptical whorls except for the earliest part.

The siphuncle occupies a marginal position throughout all the stages observed. The sutural formula is ELUI. All of the elements other than I are bifid. They are deeply incised and narrowed at their stems on the first helical whorl.

*Remarks*:—According to WRIGHT and MATSUMOTO (1954), the present species shows a considerable variation in the mode of coiling in the early stage; but in the later stage the loose, elliptical whorls grow roughly in one plane.

The early stage of this species is fairly similar to those of other diplomoceratids such as *Polyptychoceras*, *Subptychoceras* and *Ryugasella* in the presence of an



Text-fig. 6. *Scalarites scalaris* (YABE). Diagrammatic sketch of EE 1010, showing the lateral view and sutures in the early growth-stages.

initial straight stage with well marked, prorsiradiate constrictions (cf. figs. 1-8 of WRIGHT and MATSUMOTO, 1954).

*Scalarites mihoensis* WRIGHT  
et MATSUMOTO

Pl. 38, Fig. 3; Text-fig. 7

*Material*.—One specimen, EE 1011 from a rollen nodule, probably derived from loc. R 2020, middle reaches of the Obirashibe River (about 400 m north from the junction with the Nakakinembets River). Upper Turonian. I. OBATA and others coll.

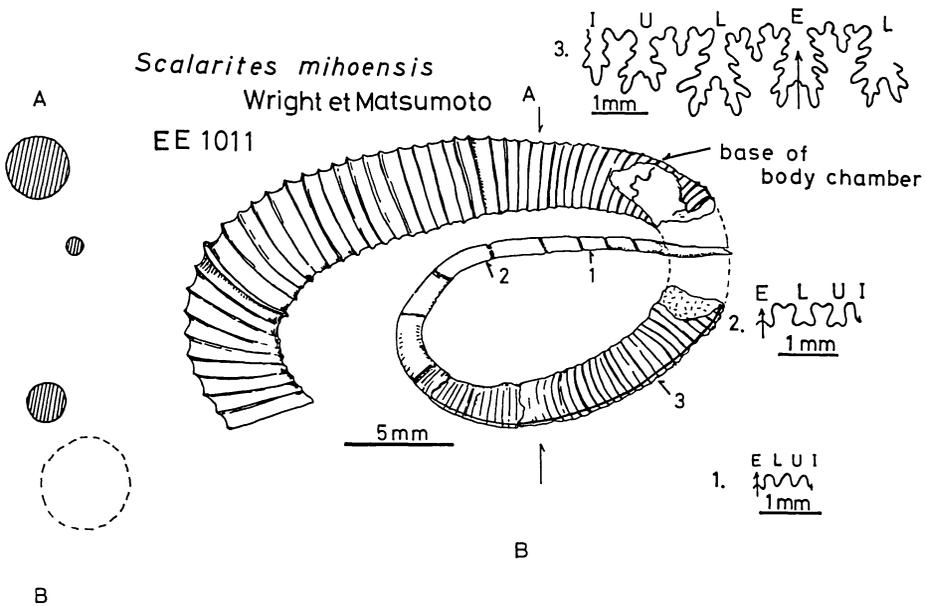
*Description*.—The shell is small, about 23 mm in the preserved maximum dimension. A planispiral ammonitella is missing in the specimen examined, but it was probably followed by a straight arm of at least 10 mm in length, which is the actually preserved earliest part. At the

next stage the straight arm is curved to form a U, and thereafter changes to elongated elliptical whorls in nearly one plane. The whorl section is circular or subcircular in all the stages observed.

The initial shaft is smooth, but with well-marked, somewhat prorsiradiate periodic constrictions. The elongated elliptical whorls are ornamented with numerous narrow, annular ribs, which are separated by broader interspaces. The ribs are never flared at least in the early stage. There are three weak constrictions on the elliptical whorls of the preserved 1.5 volutions.

The siphuncle is marginal (ventral) in all the stages observed. The suture is of E L U I type. Except for the earliest stage, E, L and U are bifid.

*Remarks*.—According to WRIGHT and MATSUMOTO (1954, p. 118-119) this species suggests a progression from the typical *Scalarites scalaris* to *Polyptychoceras* in



Text-fig. 7. *Scalarites mihoensis* WRIGHT et MATSUMOTO. Diagrammatic sketch of EE 1011, showing the lateral view, cross-section of whorls along A-B line, and sutures in the early growth-stages.

the more elongated elliptical whorls with nearly straight arms and very infrequent flared ribs. These characteristic features of the present species are already present in our specimen of the immature stage.

*Scalarites* (?) aff. *S. scalaris* (YABE)

Pl. 38, Figs. 2a-b; Text-fig. 8

*Material*:—One specimen, EE 1012 from loc. R 4016F, middle reaches of the Obirashibe River, near the junction with the Nakakinembets River, Obira area. For its detailed location see TANABE *et al.* (1977, fig. 9). Middle Turonian. I. OBATA and others coll.

*Description*:—The shell is small, about 18 mm in the maximum diameter, although the body chamber is incomplete. An ammonitella has already broken away during fossilization, but it probably

existed and is followed by a long straight arm of the preserved earliest stage. In the next stage the long arm forms a U curve, and thereafter changes to later whorls of loose and broadly elliptically coiling. In our specimen the elliptical whorls are partly broken, but they show very low, variable open helical coilings (see restored sketch of Text-fig. 8). The whorls are circular or subcircular in section throughout the preserved stages.

The initial arm is smooth, but possesses at least five, well-marked constrictions. Simple, sharp-headed annular ribs first appear at the beginning of the first elliptical whorl. They occur regularly and fairly frequently, but their interspaces tend to be broaden as the shell grows. Ribs are never tuberculated. Flared ribs and constrictions occur periodically on the septate whorl, but are on the body-chamber.

The position of the siphuncle is marginal

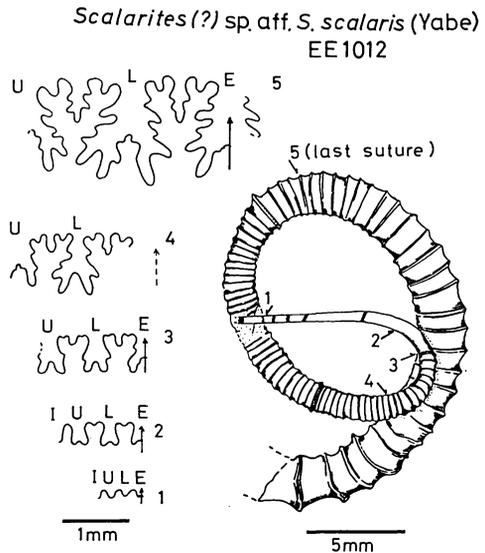
(ventral) in all the stages observed. The suture is expressed as E L U I. Except for the earliest stage, E, L and U are bifid.

*Discussion*.—Our specimen is probably immature, because of its small size. It is, therefore, rather difficult to determine its taxonomic position exactly. However, the distinctly constricted straight arm in the initial stage and the succeeding open, elliptical whorls nearly in one plane seem to be the diagnostic characters of the Diplomoceratidae. The mode of coiling and surface ornament of this species actually suggest us an affinity with species of *Scalarites*, especially *S. scalaris*. In the typical form of *S. scalaris* the whorls are more numerous and accordingly the periodic constrictions and flared ribs are more numerous than in this form.

*Trianglites* MATSUMOTO, 1977, which is represented by a single species, *T. antiquus* MATSUMOTO (1977, p. 350, pl. 58, fig. 1; text-fig. 10), forms a roughly triangular shape in one plane in the later growth-stages. Its spirally coiled shell with simple annular ribs in the earlier stage are somewhat similar to those of the present species in the same stage, but the exact comparison is difficult, because the initial stage of *Trianglites* remains uncertain. In this paper we provisionally treat this species under *Scalarites* (?) aff. *S. scalaris*.

### Consideration

*Taxonomic implications*.—Phylogenetic relationships of the Nostoceratidae and the Diplomoceratidae have hitherto been discussed by some authors (e. g. HYATT, 1894, 1900; SPATH, 1953; WRIGHT and MATSUMOTO, 1954; WRIGHT, 1957, 1979; WIEDMANN, 1962, 1969; HOWARTH, 1965; MATSUMOTO, 1967, 1977; WARD, 1976). Nevertheless, the schemes by previous



Text-fig. 8. *Scalarites* (?) aff. *S. scalaris* (YABE). Diagrammatic sketch of EE 1012, showing the lateral view (restored) and sutures in the early growth-stages.

authors differ considerably from one another with respect to the ancestor-descendant relations at generic level. The reason for this may be due to the wide inter- or intraspecific variation in the mode of coiling and the frequent appearance of parallelism and homeomorphism among evidently different lineages.

We discuss here the taxonomic value of the morphologic characters observed in the early stages of the examined species. The results of this work may be summarized in Text-fig. 9. In all species the suture is expressed by the formula, E, L, U and I: each element is simple in the earliest stage, but thereafter E, L and U become to be bifid and florid, being deeply and narrowly incised at the stem. Thus, it is rather difficult to classify the examined species above the generic level on the basis of sutural patterns only.

FAMILY	GENUS	SPECIES	NORMALLY-COILED STAGE	ABNORMALLY-COILED STAGE	SHAPE OF WHORL SEC.	CONstrict.	RIBS	TUBERCLES	SIPHUNCLE	SIPHUNCLE POSITION
DIPLOMOCERATIDAE	<i>Scalarites</i>	<i>S. mihoensis</i>	small ammonitella? (1st stage)	straight arm → loose, elliptical (2nd stage) nearly in a plane (3rd stage)	circular or sub-circular in all stages	strong in 2nd stage	annular simple ribs	absent in all stages		
		<i>S. scalaris</i>	ditto? (1st stage)	ditto → loose, subcircular (2nd stage) low helical coiling (3rd stage)						
		<i>S.?</i> sp. aff. <i>S. scalaris</i>	ditto? (1st stage)	ditto → ditto (2nd stage) (3rd stage)						
DIPLOMOCERATIDAE	<i>Eubostriochoceras</i>	<i>E. japonicum</i>	large ammonitella of ca. 2mm in diam. (1st stage)	loose, subcircular → helical with low helical coiling narrow umbilic. (2nd stage)	circular or sub-circular in all stages	strong in 3rd stage	annular simple ribs sometimes flared	absent in all stages		
		<i>E. cf. saxonicum</i>	small ammonitella? (1st stage)	two parallel shafts → contiguous helical coiling (3rd stage)						
NOSTOCERATIDAE	<i>Madagascarites</i>	<i>M. ryu</i>	small ammonitella? (1st stage)	straight arm loose helical repeating (2nd stage) → coiling → U-turns* (3rd stage) (4th st.) * coiling transforms repeatedly at 90°	circular (2nd st) polygonal (3rd-4th)	not conspicuous	irregularly flared ribs	present in 2nd		
	<i>Nuzamotoceras</i>	<i>N. yezoense</i>	unknown	straight arm → loose helical coiling (2nd? stage) (3rd? stage)	subcircular		radiate	absent		
	<i>Neocrioceras</i>	<i>N. spinigerum</i>	small ammonitella (1st stage)	loose subcircular coiling in a plane (2nd stage)	circular (1st st.) elliptic. (2nd st.)		radiate	present in 2nd		

Text-fig. 9. Diagram showing the diagnostic characters in the early growth-stages of the examined nostoceratids and diplomoceratids.

According to the early ontogenetic study on some Upper Cretaceous ammonites by TANABE *et al.* (1979) in the normally-coiled Lytoceratina and the heteromorph Scaphitidae, the siphuncle attains to the ventral position in the early half of the first whorl in the ammonitella stage, while in the Ammonitina and Phylloceratina its position gradually shifts from subcentral to ventral at some phase (between the end of the second whorl and the middle of the third one) in the post-ammonitella stage. In this respect, the Nostoceratidae and the Diplomoceratidae are more similar to the coiled Lytoceratina than the Phylloceratina and the Ammonitina. We, however, do not intend to discuss the major taxonomic positions of the above two families in detail, because of insufficient data for this problem.

It seems important that the three diplomoceratids studied (*S. scalaris*, *S. mihoensis*, *S. (?)* aff. *S. scalaris*) have a straight or J-shaped arm with several well-marked, prorsiradiate constrictions

in the earliest post-ammonitella stage, as in other diplomoceratid genera such as *Polyptychoceras*, *Subptychoceras*, *Ryugasella*, *Solenoceras*, etc. A straight arm or shaft is also present in the early stage of some nostoceratids (e. g. *Madagascarites ryu* and *Eubostriochoceras cf. saxonicum*), but it is smooth without constriction. This fact indicates that the above three diplomoceratids are clearly distinguished from the nostoceratids examined. We, therefore, regard that the constricted straight shell in the early stage may be a diagnostic feature of the Diplomoceratidae, as are the almost planispiral shell growth in the later stage and the presence of sharp, annular nontuberculate ribs.

According to MATSUMOTO's (1967) scheme for the phylogenetic relations of the nostoceratid and diplomoceratid genera (here reproduced in Text-fig. 10, with revision of MATSUMOTO, 1977), *Scalarites*, the probable first-appeared genus of the Diplomoceratidae, may have been derived from *Eubostriochoceras* of the Nosto-

ceratidae in the early Turonian. Indeed, the Middle Turonian *S. scalaris* is more or less similar to *E. japonicum* of the approximately same age in the presence of annular, occasionally flared simple ribs in rather early stage, but the latter differs from the former in the absence of prorsiradiate constrictions in the earliest post-ammonitella stage.

The early stage of the Upper Turonian *E. cf. E. saxonicum* is quite different from that of *E. japonicum* in the presence of two parallel shafts. This fact may indicate the morphological plasticity of this genus. Even in a single species, MATSUMOTO (1977) reported a remarkable variation in the early-stages in a sample of *E. japonicum* from the Obira area, north-western Hokkaido. *Eubostrychoceras* is a long-ranging genus from late Albian to Campanian, and has been regarded as one of the main stocks of evolution, in parallel with another long-ranging genus, *Hyphantoceras* (MATSUMOTO, 1967, 1977).

Taking all of the facts mentioned above into account, it is postulated that the plasticity in *Eubostrychoceras* may predict the characters of its offshooted specialized genera such as *Nipponites* and *Muramotoceras*.

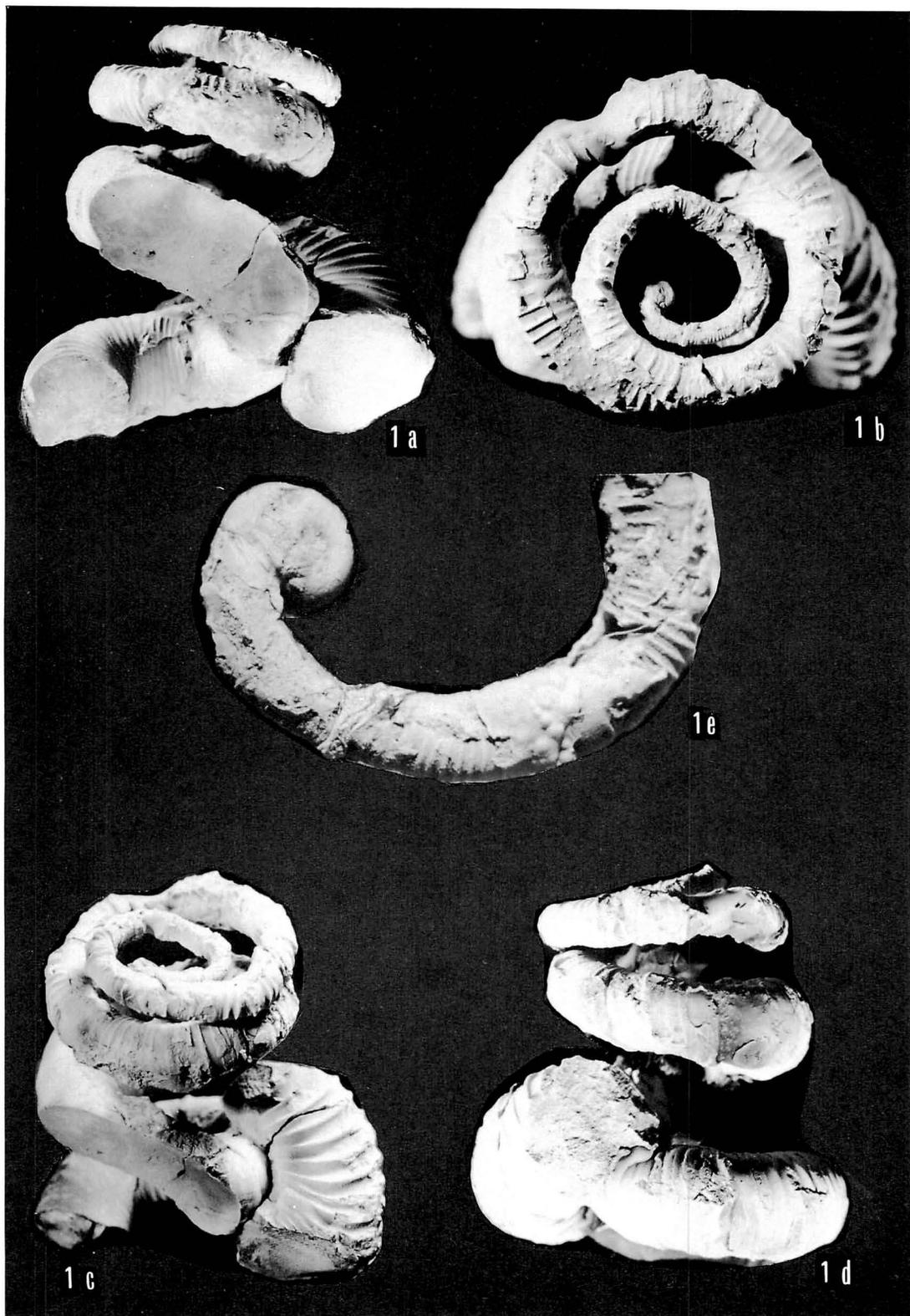
It may be a hard problem for us to determine whether the remarkable variation in mode of coiling in the Cretaceous heteromorphs is taxonomically significant or not. For examples, a peculiar U-turn coiling is the common feature in *Madagascarites ryu* and *Nipponites mirabilis* (MATSUMOTO and MURAMOTO, 1967). The surface ornament of the former species, however, quite differs from that of the latter in having ventral and ventrolateral tubercles, and in this respect it is more similar to the species of *Hyphantoceras*. Based on this evidence, MATSUMOTO (1967) interpreted that some tuberculated genera

including *Madagascarites* may have been derived from *Hyphantoceras* while non-tuberculated genera including *Nipponites* from *Eubostrychoceras*. If this interpretation is correct, the mode of coiling may be more variable in the Nostoceratidae than the other characters. In other words, the fairly large variation in mode of coiling in this family may have been affected more strongly by an ecological factor than a historical one.

*Ontogenetic and ecologic implications.*— It has made clear from our study that the examined specimens of *Eubostrychoceras japonicum* and *Neocrioceras spinigerum* have a planispiral ammonitella in the earliest growth-stage. As has been already described, in both species the ammonitella is smooth without any trace of ornament, terminating at the nepionic constriction. It is followed by the succeeding straight or J-shaped arm and/or loosely-coiled open whorls in the post-ammonitella stage. Judging from the above fact as well as the dimensions of the preserved earliest stage in all of the other specimens examined, it is presumed that the shells of the Nostoceratidae and the Diplomoceratidae are essentially divided into two stages, namely the "normal" ammonitella first stage and the uncoiled or abnormally-coiled post-ammonitella second stage. In most species studied, ribs and/or tubercles first appear at some phase of the post-ammonitella stage.

The presence of an ammonitella consisting of a protoconch and a first planispiral whorl has already been confirmed in some Jurassic and Cretaceous heteromorph ammonites, *i. e.* *Parapatoceras*, *Epistrenoceras*, *Spiroceras* (DIETL, 1976, 1978), *Acrioceras* (BRANCO, 1879-80), *Baculites* (SMITH, 1901; BIRKELUND, 1979, 1980), *Paraspiticeras*, *Leptoceras* (WIEDMANN, 1969), *Hypoturrilites* (ATABEKYAN and MIKHAYLOVA, 1976), *Ammonitoceras*, *Ptyhoceras* (DRUSH-





as guide fossils for international correlation (MATSUMOTO, 1973, 1977; KENNEDY and COBBAN, 1976). Such differences in geographic distributions among Cretaceous heteromorphs are a result of one or a combination of several factors; *i. e.* degrees in dispersal of eggs by ocean currents and post-embryonal planktonic or nektonic life habits. The latter factor might be correlated with the size of normally coiled stage. More concrete data on the earliest growth-stage over various heteromorph taxa are, however, needed to ascertain the above hypothesis.

With respect to the examined nostoceratids and diplomoceratids in the later growth-stages, a benthonic mode of life can be inferred in view of their shell form with abandonment of bilateral symmetry and the characteristic mode of occurrence in the fine-grained bottom sediments, in which drifted plant and wood remains occur frequently (MATSUMOTO, 1977; TANABE, 1979). The occasional accompaniments of jaw apparatus within a rather long body-chamber *in situ* in some diplomoceratids (TANABE *et al.*, 1980b and our unpublished data) may also support the above interpretation.

As has been already pointed out in the previous papers (*e. g.* MATSUMOTO and OBATA, 1963; MATSUMOTO and OKADA, 1973; TANABE, 1979), in the Upper Cretaceous of Hokkaido the heteromorph ammonites occur commonly or abundantly in a particular biofacies (so-called *Baculites* facies or *Scaphites* facies), which suggests an offshore, labile shelf paleoenvironment. In all probability most nostoceratids and diplomoceratids examined in the adult stage might have been adapted in various niches as bottom dwellers.

The mode of coiling in the species examined is roughly classified into the three types (loose planispiral, helical and repeating U-turn coiling types, (*see* Text-fig.

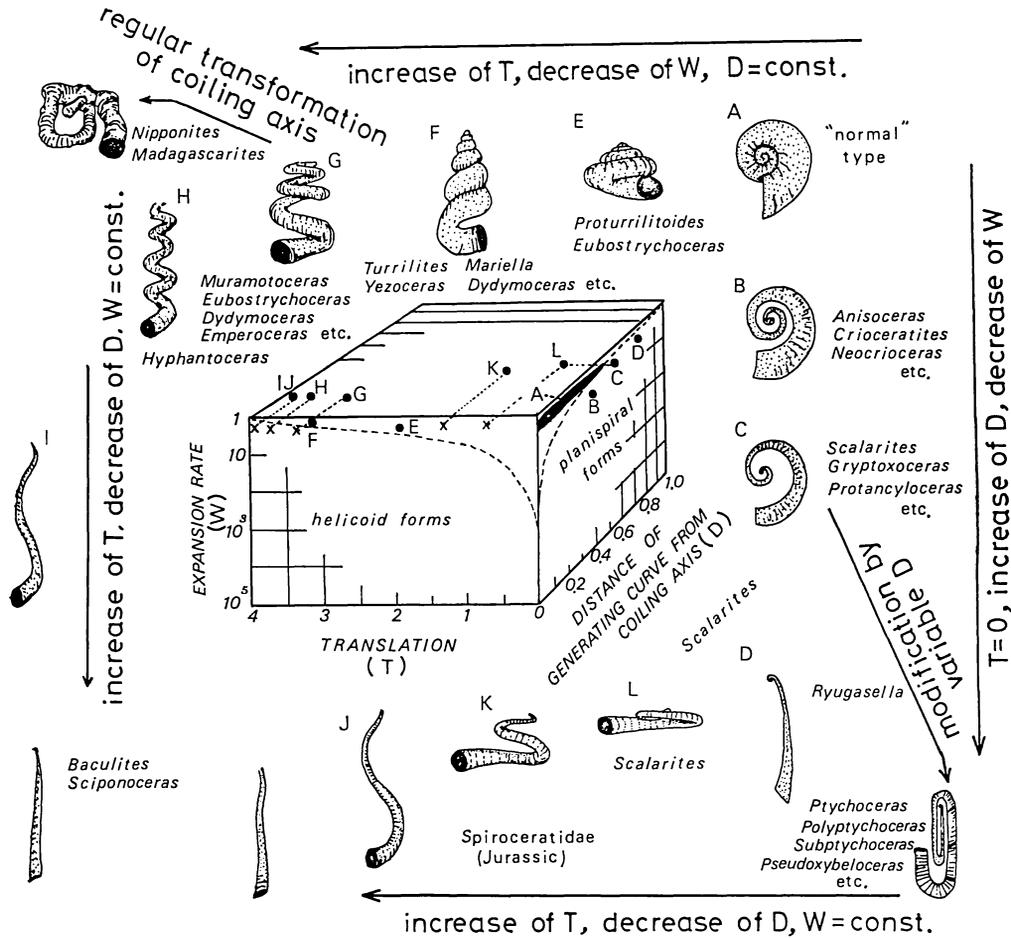
11)), although the details for RAUP's (1966) parameters may be quite variable even in a sample of a single species. It seems interesting that the range of variation in the mode of coiling of Cretaceous heteromorph ammonites almost coincides with that of modern gastropods. This suggests us an analogy in mode of life between the above two taxonomically different groups. As has been already described, in the examined three helically-coiled nostoceratids (*Madagascarites ryu*, *Eubostrychoceras japonicum* and *E. cf. E. saxonicum*), the preserved earliest stage is encircled by the succeeding helical whorls, as if it is protected from destruction. This fact may lead to an interpretation that the siphuncle and camera were still functional in the middle to adult stages. More concrete data on the mode of occurrence, functional morphology and comparative anatomy are, however, required to discuss the ecological aspects of Cretaceous heteromorph ammonites.

### Summary

The early growth-stages of some Upper Cretaceous heteromorph ammonites (five nostoceratids and three diplomoceratids) have been studied from the taxonomic, ontogenetic and ecologic points of view on the basis of well-preserved specimens from Hokkaido. The results of this study are summarized as follows.

1. The shells of the species examined essentially consist of the planispiral ammonitella and succeeding abnormally-coiled whorls.

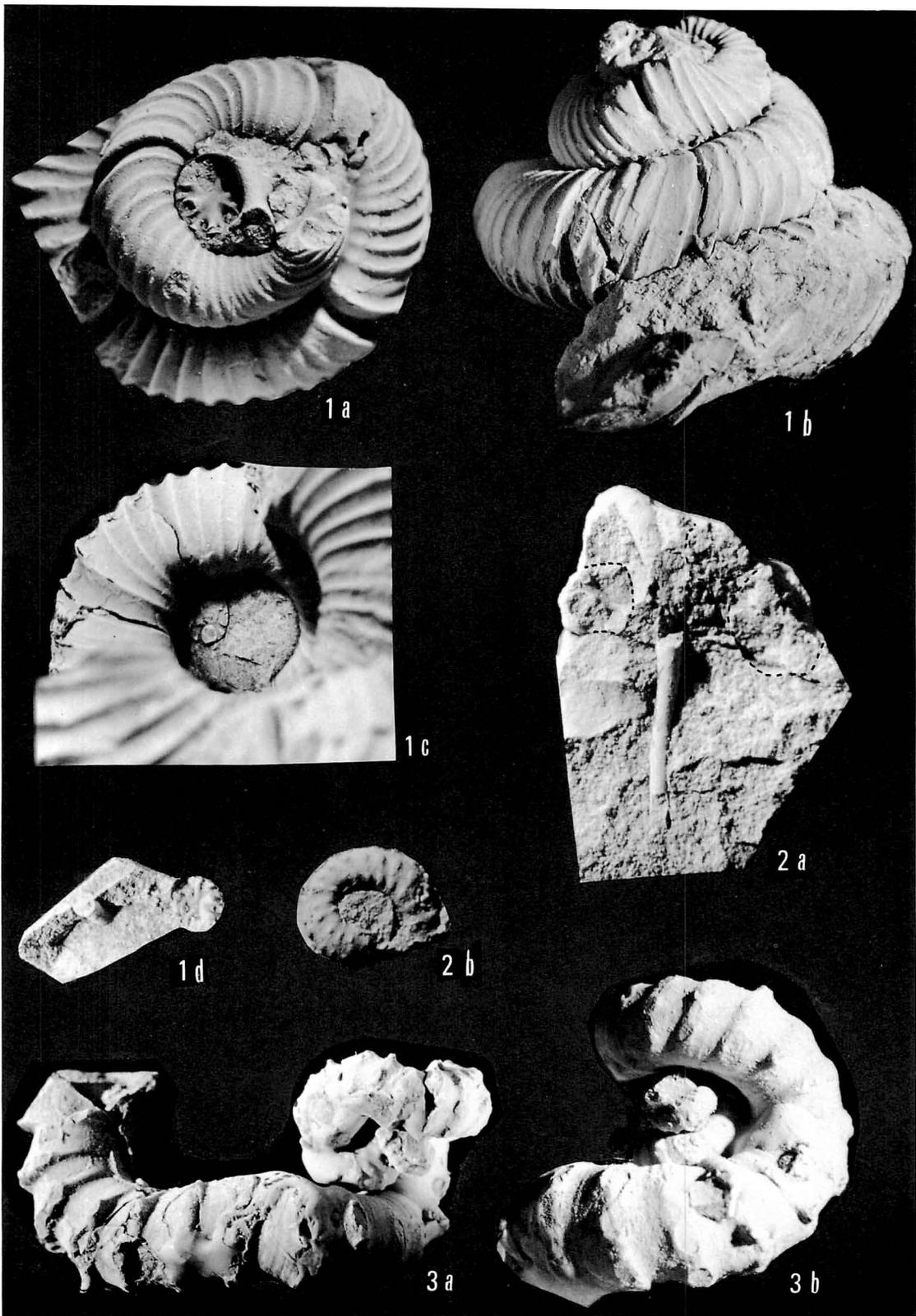
2. Their suture is expressed by the formula, ELUI. Each element is simple in the observed earliest stage, but thereafter saddles and lobes, except for I, become to be bifid and florid. In every species the siphuncle position is marginal throughout the post-ammonitella stage, as in



Text-fig. 11. Three dimensional block diagram using RAUP's (1966) parameters for shell geometry, showing the range of variation in the mode of coiling of the Cretaceous heteromorph ammonites. Dotted lines in the diagram show the boundary between the whorl-overlapping and open whorl fields. The range almost coincides with that of gastropods. Read *Didymoceras* for *Dydimoceras*.

Explanation of Plate 36

- Fig. 1. *Eubostrychoceras* cf. *saxonicum* (SCHLÜTER). NSM. PM 7127. Upper (a), lower (c) and lateral (b) views, and freehand cross section of the preserved earliest growth-stage (d). a ( $\times 6$ ), b ( $\times 4$ ), c ( $\times 7$ ), d ( $\times 10$ ).
- Fig. 2. *Madagascarites* *ryu* MATSUMOTO et MURAMOTO. GK. H 8086. Axial section of the initial helical coils (a), and upper view of the first helical whorl (b). Both  $\times 7$ .
- Fig. 3. *Madagascarites* *ryu* MATSUMOTO et MURAMOTO. EE 1013. Two different views of the middle growth-stage. a ( $\times 2$ ), b ( $\times 4$ ).



normally-coiled Lytoceratina.

3. The three diplomoceratids, *Scalarites mihoensis*, *S. scalaris* and *S. (?)* aff. *S. scalaris* are distinguished from the five nostoceratids examined in the presence of several well-marked constrictions on the straight arm of the earliest post-ammonitella stage. This characteristic feature in the early stage may be a diagnosis of the Diplomoceratidae, because it is also present in other genera of the same family.

4. The abrupt change from a normal to an abnormal coiling at the nepionic constriction, and the succeeding first appearance ornament and the increasing of whorl dimensions after the constriction are observed in the specimens of *E. japonicum* and *N. spinigerum*. The same feature has been reported in many genera of Jurassic and Cretaceous heteromorphs, and furthermore, the presence of an ammonitella with similar internal structures has been confirmed in all ammonites known to us. All of these facts support the previous interpretation that an ammonitella was formed within an egg capsule (BIRKELUND and HANSEN, 1968; DRUSHCHITS and KHIAMI, 1969; KULICKI, 1974; TANABE *et al.*, 1980a; BIRKELUND, 1980). It is presumed that a very young, post-embryonal animal of heteromorph ammonites might have passed a planktonic life at least for a limited period. A benthonic mode of life can be inferred as to their middle to later stages, because of the loss of bilateral symmetry of the shells and other indirect evidence.

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with their interesting specimens. Messrs. Tomoki KASE (National Science Museum) and Yuichiro MIYATA (Kyushu University) kindly cooperated us in the field. This is a contribution of the cooperative research on evolutionary paleontology of the Ammonoidea, supported by the Science Research Fund of Japanese Ministry of Education, Science and Culture (*Monbusho*) (Project leader, I. OBATA, No. 56340041 for 1981).

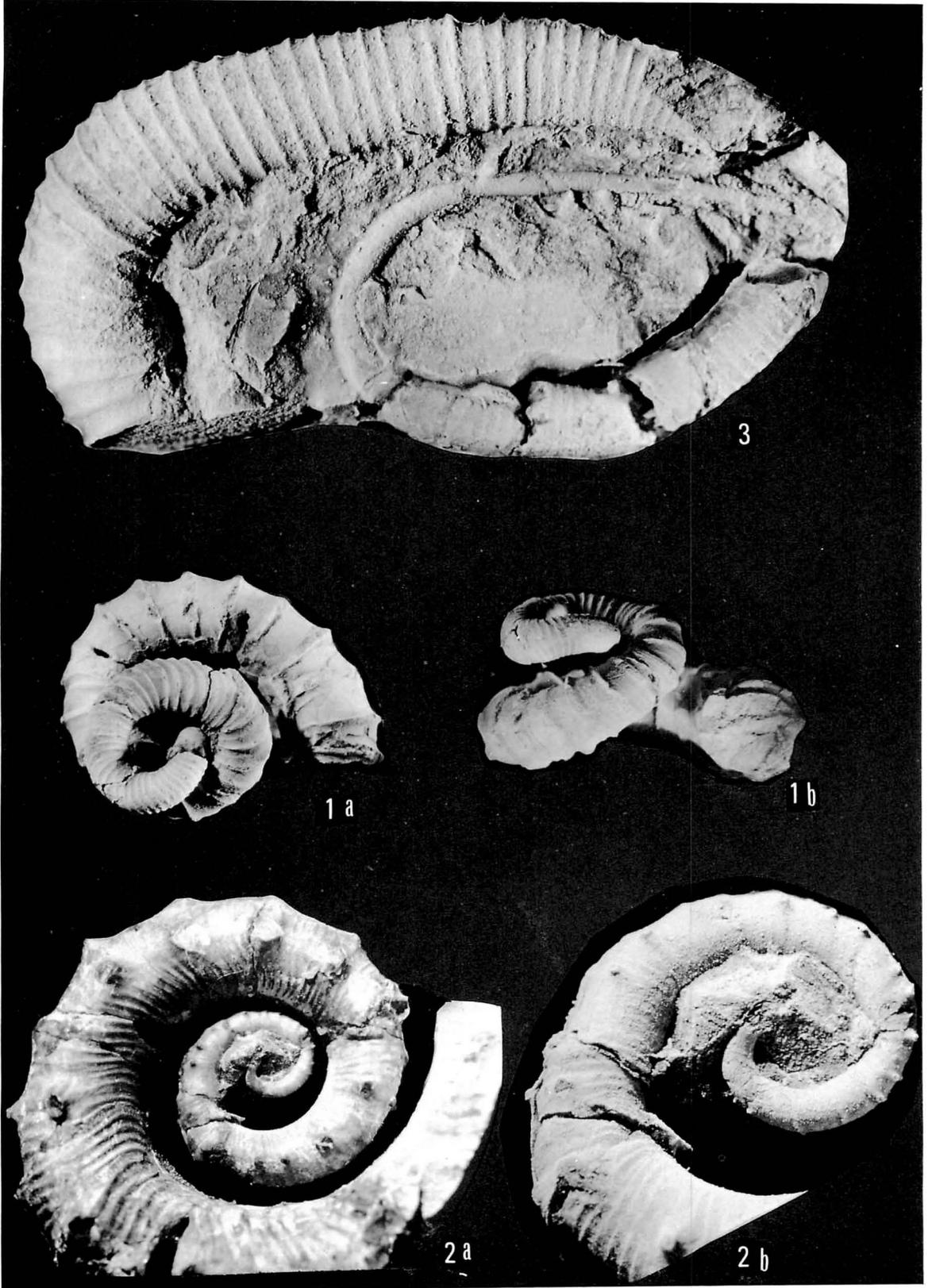
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#### Explanation of Plate 37

- Fig. 1. *Muramotoceras yezoense* MATSUMOTO. NSM. PM 7215. Upper (a) and lateral (b) views. Both  $\times 1.5$ .
- Fig. 2. *Neocrioceras spinigerum* (JIMBO). NSM. PM 9491. Lateral views of the entire shell (a) and the preserved earliest growth-stage (b). a ( $\times 2$ ), b ( $\times 6$ ).
- Fig. 3. *Scalarites mihoensis* WRIGHT et MATSUMOTO. EE 1011. Lateral view.  $\times 5$ .



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Horomui 幌向, Ikushumbets 幾春別, Kamikinembets 上記念別, Katsurazawa 桂沢,  
 Manji 万字, Nakakinembets 中記念別, Obira 小平, Obirashibe 小平藪, Sannosawa  
 三の沢, Sato-no-sawa 佐藤の沢, Shimokinembets 下記念別

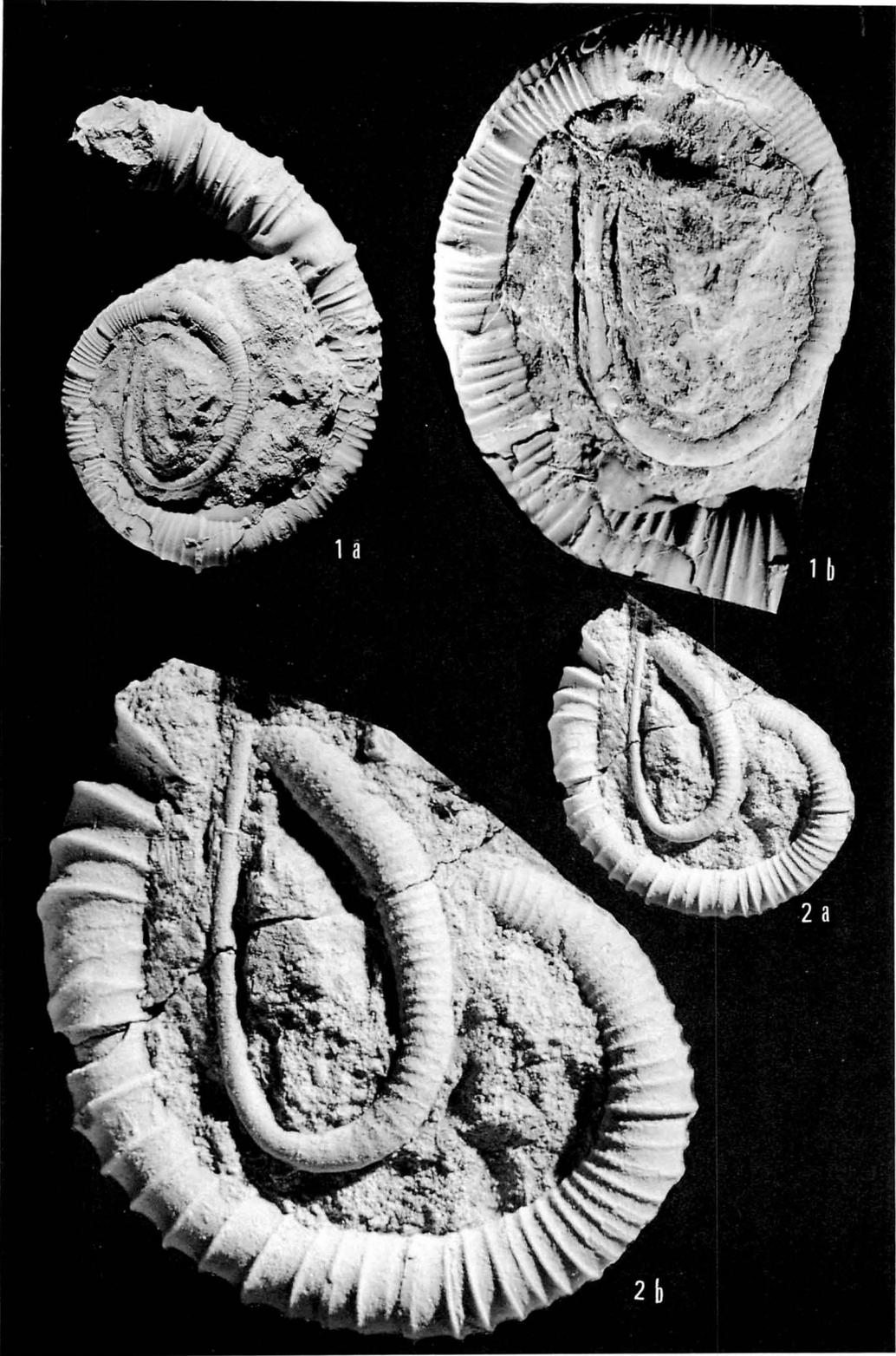
後期白亜紀異常巻アンモナイト類の初期殻形態：北海道の上部白亜系産の Nostoceratidae, Diplomoceratidae 両科に属する異常巻アンモナイト 5 属 8 種の成長初期の殻形態を記載し、その古生物学上の意義を考察した。諸形質のうち、縫合線と連室細管の位置は初期段階でも安定し、どの種も前者は式 ELUI で、後者は外殻側に存在する。また Diplomoceratidae 科の *Scalarites* 3 種 (うち 1 種は *S.?* sp.) は成長初期に強い prorsiradiate なくびれを伴った直線状の殻を有する点で、幼期に同様なくびれない Nostoceratidae 科の類とは区別できる。この特徴的な初期殻は Diplomoceratidae 科の他の類にも存在する (WRIGHT and MATSUMOTO, 1954) ことから、同科の属性の 1 つとみなせる。他の形質のうちでは、特に螺環の巻き方が変異に富み、同一種の個体発生中でも複雑に変化する。その変異幅は巻貝類のそれに比較でき、RAUP (1966) のパラメータを用いることにより (1) 平巻型 (2) 旋回型 (3) 旋回軸変換型の 3 群に区分できる。しかし記載種と似た巻きを示す類は別の系統の類にも存在する。*Eubostrioceras japonicum* と *Neocrioceras spinigerum* に同定した個体では、ごく初期に胚殻と約 1 巻の螺環からなる正常巻のアンモネテラが識別された。アンモネテラは明瞭なくびれ (nepionic constriction) を境に異常巻の螺環に続く。他の種においても、観察結果から同様のアンモネテラの存在が示唆される。なお表面装飾は異常巻段階に入って出現する。以上の事実や他の正常巻・異常巻類にも類似の内部構造を持つアンモネテラが認められていることから考えると、アンモネテラは卵中で形成された可能性が高い。おそらく異常巻類の孵化直後の“正常型”幼体は一時的な浮遊生活を営み、以後底生型の生活に適応していったと想像される。

棚部一成・小島郁生・二上政夫

#### Explanation of Plate 38

Fig. 1. *Scalarites scalaris* (YABE). EE 1010. Two lateral views. a ( $\times 3$ ), b ( $\times 6$ ).

Fig. 2. *Scalarites* (?) aff. *S. scalaris* (YABE). EE 1012. Two lateral views. a ( $\times 3$ ), b ( $\times 7$ ).



PROCEEDINGS OF THE PALAEOLOGICAL  
SOCIETY OF JAPAN

日本古生物学会第 128 回例会

日本古生物学会第 128 回例会 および 討論会「白亜紀非海成層の対比」が1981年10月3, 4日に広島大学理学部で開催された。(参会者 127 名)

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 同上。海成層との関連による対比 .....  
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 ..... 松尾秀邦・香西 武  
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 比..... 木村達明  
 アジア東部における 後期白亜紀陸成植物群とそ

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 ..... 三本健二  
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 て ..... 小笠原憲四郎・八島省己  
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 ..... 田代正之・松田智子・香西 武  
 西南日本白亜系の三角貝 (*Acanthotrignonia*) に  
 関する一考察..... 田代正之・松田智子  
 Phylogeny of the superfamily Trigonioidea  
 (Non-marine Cretaceous bivalves) .....

- ..... 郭 福祥(代読)  
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CONSTITUTION  
 of the  
 PALAEOONTOLOGICAL SOCIETY OF JAPAN

(Jan. 20, 1978 amended)

- Article 1. The Society shall be known as the Palaeontological Society of Japan.  
 Article 2. The object of the Society is to promote the study and popularization of palaeontology and related sciences.  
 Article 3. The Society, to execute Article 2, shall undertake the following business:  
 1. Issue the Society journal and other publications.  
 2. Hold or sponsor scientific lectures and meetings.  
 3. Popularize the science by field trips, scientific lectures and other projects.  
 4. Aid and encourage research work; award outstanding contributions to the Society; carry out the objectives stated in Article 2.  
 Article 4. To attain the object of the Society, the Society may, by decision of the General Meeting, establish within it research committees.  
 Article 5. The Society shall be composed of members who are active or interested in palaeontology or related sciences.  
 Article 6. The members shall be known as Regular Members, Fellows, Patron and Honorary Members.  
 Article 7. Persons desiring membership in the Society are requested to fill out the necessary application forms and receive the approval of the Council.  
 Article 8. Fellows are persons who have held Regular Membership in the Society for more than ten years, have contributed to the science of palaeontology, have been nominated by five Fellows and approved by the Council.  
 Article 9. Patrons are organizations supporting Article 2 and recommended by the Council.  
 Article 10. Honorary Members are persons of distinguished achievement in palaeontology. They shall be recommended by the Council and approved by the General Meeting.  
 Article 11. The members of the Society shall be obliged to pay the annual dues stated in

- Article 12. Members shall enjoy the privilege of receiving the Society journal and participating in the activities stated under Article 3.
- Article 12. The rates for annual dues shall be decided by the General Meeting. Rates for annual dues are: Regular Members, Yen 4,500; Fellows, Yen 6,000; and Foreign Members, Yen 6,000 or its equivalent in U.S. dollars; Patrons are organizations donating more than a share (Yen 10,000) annually; Honorary Members are free from obligations.
- Article 13. The budget of the Society shall be from membership dues, donations and bestowals.
- Article 14. The Society, by decision of the Council, may expel from membership persons who have failed to pay the annual dues or those who have disgraced the Society.
- Article 15. The officers of the Society shall be composed of one President, fifteen Councillors and several Executive members. The term of office is two years and they may be eligible for re-election without limitation. The President may appoint several persons who shall be Secretaries and Assistant Secretaries. An Executive Council shall be nominated and approved by the Council. If necessary, several Executive members, who must be Fellows, may be added with the Council's approval. Councillors shall be elected from Fellows by vote of returned mail unsigned ballot.
- Article 16. The President shall be a Fellow nominated and approved by the Council. The President shall represent the Society and supervise the business affairs. The President may appoint a Vice-President when he is unable to perform his duties.
- Article 17. The Society may have the Honorary President. The Honorary President shall be recommended by the Council and approved by the General Meeting. The Honorary President may participate in the Council.
- Article 18. The Society shall hold regularly one General Meeting a year. The President shall be Chairman and preside over the administrative affairs. The program for the General Meeting shall be decided by the Council. The President may call a Special Meeting when he deems it necessary. The General Meeting requires the attendance of more than one-tenth of the members. The President shall call a Special Meeting at the written request of more than one-third of the members. The request shall be granted only if the written statement fully explains the reasons for assembly and items for discussion.
- Article 19. Members unable to attend the General Meeting may give as attending member a written statement signed by himself trusting the bearer with the decision of business matters. Only one attending member may represent one absentee.
- Article 20. The decision of the General Meeting shall be by majority vote. When the number of votes is equal, the President shall cast the deciding vote.
- Article 21. The President and Councillors shall compose the Council. The decision of the General Meeting concerning administration shall be considered and implemented by the Council.
- Article 22. The Executive Council shall carry out the decisions of the Council.
- Article 23. An auditor shall be elected by the Council from Fellows excluding Councillors and Secretaries. The term of office is two years and he may be eligible for re-election.
- Article 24. The fiscal year of the Society shall begin on the first of January each year and end on the thirtyfirst of December of the same year.
- Article 25. The amendments to the Constitution of the Society shall be decided at the General Meeting and must be approved by more than two-thirds of those members who are in attendance.

Addendum 1) Voting in the Council shall be by unsigned ballot.

## 日本古生物学会特別号の原稿募集

PALAEONTOLOGICAL SOCIETY OF JAPAN, SPECIAL PAPERS, NUMBER 26 を 1983 年度に刊行したく、その原稿を公募します。適当な原稿をお持ちの方は、次の事項に合わせて申込書を作成し、原稿の写しを添えて、〒812 福岡市東区箱崎 九州大学理学部地質学教室気付、日本古生物学会特別号編集委員会（代表者首藤次男）宛に申し込んで下さい。

- (1) 古生物に関する論文で、欧文の特別出版にふさわしい内容のもの。同一の大題目の下に数篇の論文を集めたもの（例えばシンポジウムの欧文論文集）でもよい。分量は従来発行の特別号に経費上ほぼ匹敵すること。学会以外からも経費が支出される見込のある場合には、その金額に応じて上記よりも分量が多くてよい。
- (2) 内容・文章ともに十分検討済みの完成した原稿で、印刷所に依頼して正確な見積りを算出できる状態にあること。申込書とともに必ず原稿の写しを提出して下さい。（用済の上は返却致します）。
- (3) 申込用紙は自由ですが、次の事項を明記し、[ ] 内の注意を守って下さい。
  - (a) 申込者氏名；所属機関または連絡住所・電話番号。〔本学会員であること〕。
  - (b) 著者名；論文題目。〔和訳を付記すること〕。
  - (c) 研究内容の要旨。〔800～1,200 字程度、和文で可〕。
  - (d) 内容ならびに欧文が十分検討済であることの証明。〔校閲者の手紙の写しでもよい〕。
  - (e) 本文の頁数（刷上り見込頁数または原稿で欧文タイプ25行詰の場合の枚数一ただし、パイカーカエリート字体かを添記すること）；また本文中小活字（8 点組み）に指定すべき部分があるときは、そのおよその内訳（総頁に対するパーセント）；挿図・表の各々の数と刷上り所要頁数；写真図版の枚数。
  - (f) 他からの印刷経費支出の見込の有無、その予算額、支出源。〔その見込の証明となる書類またはその写しを添えて下さい〕。
  - (g) その他参考事項。
- (4) 申込及び原稿提出締切 1982 年 5 月 31 日（必着）。採否は編集委員会が必要に応じレフェリーと相談の上内定し、1983 年 1 月の評議員会で審議決定の上、申込者に回答の予定です。ただしその前または後に、申込者との細部の交渉を、編集委員から求めることがあるかもしれません。
- (5) 上記（f）の他からの印刷経費支出の見込みがない場合は、1983 年度の文部省刊行助成金（「研究成果刊行費補助金」）を申請いたしますので、上記（2）の条件が満たされている場合にのみ考慮されます。
- (6) 論文が完全な場合には、評議会での決定後できるだけ早く印刷にとりかかる予定です。文部省の刊行助成金の申請は、学会から行ない（例年は 11 月末に申請締切）、その採否・金額など決定後印刷にとりかかります。その場合は文部省との約束により、その年の秋（前例では 10 月 20 日）までに初校が全部出なければ、補助金の交付が中止されることになっています。
- (7) 特別号の原稿は会誌に準じ、前例を参考として作成して下さい。不明の点は編集委員会に問い合わせして下さい。経費がかかるので、特別な場合を除き、別刷は作成せず、本刷 25 部を著者に無料進呈します。それ以上は購入（但し著者には割引）ということになります。いくつかの論文を集めて 1 冊にするときには、世話人の方から指示して、体裁上の不統一のないようにして下さい。印刷上の指示事項が記入できるよう、原稿の左右両側・上下に十分空白をとって、タイプで浄書して下さい。

○文部省出版助成金が得られなかった場合には、出版を繰延べることがあるかもしれません。

行事予定

	開催地	開催日	講演申込締切
1982年総会・年会	千葉大学	1982年1月23, 24日	1981年11月23日
第129回例会	北海道大学	1982年6月	1982年4月

1982年総会・年会ではシンポジウム「アンデスの地質と古生物」が予定されている。(世話人：前田四郎・坂上澄夫)

講演申込先：〒113 東京都文京区弥生2-4-16 日本学会事務センター 日本古生物学会行事係

お知らせ

○日本古生物学会特別号 No. 24 Igo, Hisaharu: Permian Conodont Biostratigraphy of Japan (Dec. 15, 1981) がこのほど出版されました(定価3,900円, 送料300円)。購入申込は特別号の他の号と同じく日本古生物学会特別号編集委員会首藤次男・柳田壽一(福岡市東区箱崎九州大学理学部地質学教室)(送金先: 三和銀行福岡支店普通預金口座12172, または振替口座福岡19014)にお願いします。郵送によらない直接販売は東京大学総合研究資料館(速水格気付)および国立科学博物館分館(藤山家徳気付)でも取扱っています。

○昭和53年末に文部省が大学関係者の協力を得て実施した“大学所蔵標本等実態調査<自然史関係>”の結果が、日本学術振興会から「自然史関係 大学所蔵標本総覧 (B5・452ページ, 3,400円, 発売所: 丸善株式会社)」として刊行された。この中には全国の大学が保有する自然史関係(動物・植物・人類・古生物・岩石鉱物)の標本点数が部局別・分類別に表示され、401の特色あるコレクション(うち古生物学関係72)が一部写真入りで解説されている。

◎ 文部省科学研究費補助金(研究成果刊行費)による。

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