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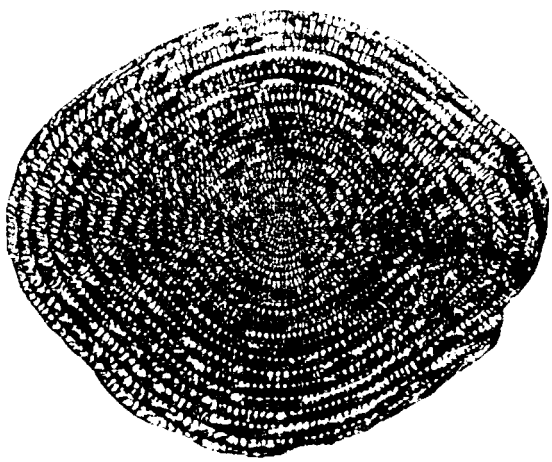

日本古生物學會

Palaeontological Society of Japan

September 20, 1955

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TRANSACTIONS

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PALAEONTOLOGICAL SOCIETY OF JAPAN

Geological Institute, Faculty of Science, University of Tokyo, Japan

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 19, pp. 53-58, pls. 8-9, 2 text-figs., Sept. 20, 1955

268. ELECTRON-MICROSCOPIC FINE STRUCTURE OF FOSSIL DIATOMS. III*

HARUO OKUNO

Kyoto University of Textile Fibers

化石珪藻の電子顕微鏡的微細構造. III: 6 種の珪藻, *Actinoptychus undulatus* (アメリカ, ロンポック産, 市販精製珪藻土 'Hyflo Super-Cel' 中に見出されたもの), *Coscinodiscus elegans* (新潟県佐渡ケ島沢根町産), *Caloneis hitoyosiensis* (新種, 熊本県西瀬村産), *Stauroneis phoenicenteron* (樺太留多加産), *Pinnularia higoensis* (新種, 熊本県西瀬村産), *Gomphonema acuminatum* var. *coronata* (三重県有井村, 大分県野上村産) の微細構造について記した。 奥野春雄

Actinoptychus undulatus (BAILEY) RALFS

Text-fig. 1; Pl. 8, Figs. 1a, b.

Actinoptychus undulatus (BAILEY) RALFS, BOYER, 1926, Synop. North Amer. Diat., pt. 1, p. 64.—HUSTEDT, 1930, Kieselalg., pt. 1, p. 475, fig. 264.—MILLS, 1933, Index, p. 117.—OKUNO, 1952, *Bot. Mag. Tokyo, vol. 65*, p. 161, pl. 1, figs. 3a-3'.

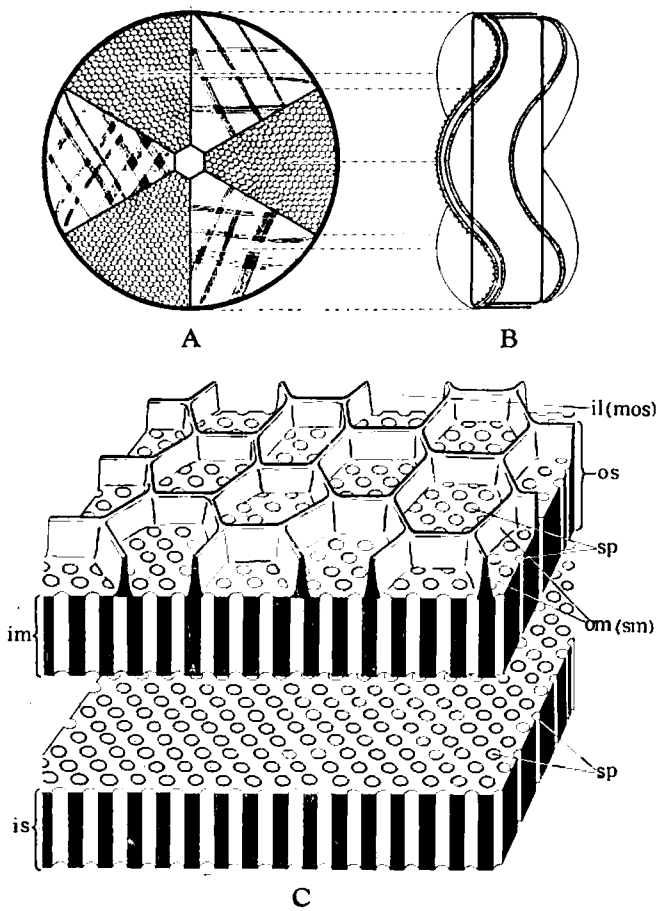
Valves circular, divided into six sectors alternately elevated and depressed. Diameter 60 (20–150) μ. Valves often doubly stratified. In the present specimen the one valve (epitheca?) was double and the other (hypotheca?) was single (Text-fig. 1-B, C). When the frustule is observed in girdle view under the light microscope, it can be clearly seen that the outer stratum of the double valve is further consisted of two membranes, the outer coarsely netveined membrane and the inner finely porous membrane. The inner stratum is the same in its structure as the inner membrane of the outer stratum. Thus the outer stratum forms an incomplete loculi opening freely outwards. Thickness of the netveined membrane is about 0.6 μ, and that of the finely porous membrane is about 1.2 μ. The single valve is the same in its structure as the outer stratum of the double valve. Meshes of the netveined membrane are polygonal, 4–5 in 10 μ, arranged in rows parallel to the median radius of the sector. Pores of the inner membrane and the inner stratum are about 16–18 in 10 μ, arranged in two tangential directions (Text-fig. 1-A, C). By the present electron microscopy, the following details were elucidated: 1. Arrangements of the meshes and the sieve pores are quite independent of each other. 2. Meshes are about 2 μ in diameter, and through a mesh, 4–10 sieve pores of the inner membrane are seen. 3. Sieve pores both in the inner membrane and the inner stratum are round, about 100–300 mμ in diameter (Text-fig. 1-C; Pl. 8, fig. 1b). In the present specimens, the sieve pores were found without closing membranes. (They might possibly have been lost by weathering.) In my previous paper (1952), I described the valve of this species as having a

* Read Dec. 19, 1954; received Jan. 8, 1955.

finely porous outer membrane and a coarsely netveined inner membrane. But by the result of the present observation, the description must be corrected as detailed above.

Habitat: Marine, littoral, often planktonic.

Occurrence: In diatomite. Specimen. nos. m 830, E 231. Lompoc, California, U.S.A. Miocene. (In refined commercial diatomite 'Hyflo Super-Cel' of Johns-Manville Products.)



Text-fig. 1. *Actinoptychus undulatus*. A, Valve view, showing the meshes of the outer stratum and the directions of rows of sieve pores. B, Girdle view; note the double epitheca. C, Diagram of the electron-microscopic fine structure of a part of the double valve. il, Incomplete loculus. im, Inner membrane of the outer stratum. is, Inner stratum. mos, Mesh of the outer stratum. om, Outer membrane of the outer stratum. os, Outer stratum. sm, Side membrane of the incomplete loculus. sp, Sieve pore. (Cf. Pl. 8, Figs. 1a, b)

Coscinodiscus elegans GREVILLE

Pl. 8, Figs. 2a, b.

Coscinodiscus elegans GREVILLE, OKUNO, 1953, *Bot. Mag. Tokyo, vol. 66*, p. 123, pl. 1, fig. 15; 1954, *Trans. Proc. Palaeont. Soc. Japan, N.S., No. 13*, p. 128, pl. 14, figs. 1a–c.

In the above-mentioned papers, I reported some electron-microscopic structure of the loculus of this species based upon fossils[1] from Hirosaki Basin, Oki and Sado Islands. In almost every case of those specimens, the outer membranes of the loculi were lost. And I found only in a few specimens a sort of non-porous membrane which I presumed and reported at that time as likely to be the outer membrane of the loculus. Recently in fossils which I collected from Sado Island in 1953, I could find undamaged loculi of distinctly *Coscinodiscus* type. The loculus was rounded or angular, with an outer porous sieve membrane and an inner closing membrane. The outer sieve membrane has many round sieve pores about 100–170 mμ in diameter. The inner closing membrane, photogrammetrically about

1) The years of collection are: Oki specimen, 1942; Sado specimen, 1944; Hirosaki specimen, 1948.

150 mμ thick, had a central opening about 1 μ in diameter. Judging from their frequency of safe presence in fossils, the outer sieve membranes are likely to be more delicate and fragile than the inner membranes. In the previous paper, I put the loculus of this species in "Type No. 15"[2], but now by the discovery of the porous outer membrane, it must be transferred to "Type No. 22"[3] (cf. OKUNO, 1953, pp. 123–124).

Habitat: Marine, planktonic.

Occurrence: In diatomite. (Specimen, no. m 877, E 249) Sawane-chô, Sado Island, Niigata Prefecture. Upper Miocene, Nakayamatôge Formation.

Caloneis hitoyosiensis OKUNO, sp. nov.

Pl. 8, Figs. 3a–d.

Valvis elongato-ellipticis, cum polis subrostratis. Ca. 75 μ longis, ca. 28 μ latis. Area axillaris lineari-lanceolata. Area centralis asymmetrice dilatata, subrhomboideo-elliptica. Striis radiantibus, 14–16 in 10 μ, ad medium abbreviatis, ad submarginem a linea longitudinali interruptis.

The present new species is allied to *Caloneis amphisbaena* BORY var. *subsalina* (DONKIN) CLEVE and *C. formosa* (GREG.) CLEVE, from which it differs in the following points:

In its electron-microscopic fine structure the loculus of this species is nearly akin to that of *Pinnularia*. The loculus is transversely long, with an outer finely porous sieve membrane and an inner membrane with an opening. The outer sieve membrane has about four transverse rows of sieve pores[4]. Sieve pores are rounded or angular, about 70–100mμ in diameter, about 6–7 in 1 μ. Closing membrane of the sieve pore is not yet found. The inner closing membrane is thin, and near its outer margin has a linear elliptic opening about 0.5–1 μ long and about 0.3–0.5 μ broad. The openings of the inner membranes are arranged in a submarginal, arcuate line forming the so-called 'longitudinal band'.

Habitat: Fresh water.

Occurrence: In diatomite. (Specimen, nos. 1543, E 251-Holotype) Nishise-mura, Kuma-gun, Kumamoto Prefecture. Pleistocene.

Stauroneis phoenicenteron (NITZSCH) EHRENBERG

Pl. 9, Figs. 1a–c.

Stauroneis phoenicenteron (NITZSCH) EHRENBERG, HUSTEDT, 1930, Bacill., p. 255, fig. 404.—HANNA, 1933, *23-24th Rep. Florida St. Geol. Surv.*, p. 89, pl. 2, figs. 4, 9.—MILLS, 1934, Index, p. 1465.—OKUNO, 1949, *Bot. Mag. Tokyo, vol. 62*, p. 98, pl. 3, fig. 8; 1952, Atlas Foss. Diat., pl. 19, fig. 4.

Valves lanceolate, usually with slightly

	End	Striae in 10 μ	Axial area	Central area
C. amphisbaena var. *subsalina*	rostrate	16–18	broad lanceolate	united with the axial area as a lanceolate hyaline area
C. hitoyosiensis	subrostrate	14–16	linear lanceolate	subrhomboid elliptic
C. formosa	rounded	14	linear lanceolate	subrhomboid elliptic

2) Loculus with the non-porous outer membrane.

3) Loculus with the porous outer membrane.

4) Cf. KOLBE, 1943, *Ber. Deut. Bot. Ges., vol. 61*, p. 94, pl. 4, figs. 14, 14a; OKUNO, 1950, *Bot. Mag. Tokyo, vol. 63*, p. 102, pl. 4, figs. 5, 5'.

protracted obtuse ends. 120 (70–325) μ long, 26 (16–53) μ broad. Axial area linear. Central area dilated to a stauros. Striae radiate, about 12–16 in 10 μ, punctate. Outline of the valve considerably variable. Electron optically, the porous part of the valve is composed of two alternating areas, the thin membraneous area and the thick costal area. The thin membraneous area has a transverse row of sieve pores. The thick area seems to be more or less projected in- or outwards. Sieve pores very variable in shape; round (about 50–100 mμ in diameter) to linear, about 20 in 10 μ. Near the axial area, sieve pores are round; near the margin of the valve, often linear. Sometimes sieve pores are divided into two lens-shaped secondary sieve pores. Closing membrane of the sieve pore is not yet found.

Habitat: Fresh water, littoral, very common.

Occurrence: In diatomite. (Specimen, no. 1342) Rutaka, Saghalien. Pleistocene.

Pinnularia higoensis OKUNO, sp. nov.

Pl. 9, Figs. 2a-c.

Valvis linearibus elongatis, medio leniter inflatis, cum polis subcapitatis. Ca. 240–260 μ longis, ca. 22–24 μ latis. Rhaphe leniter arcuata. Area axillaris late-linearibus, ca. 5 μ latis. Area centralis asymmetrice dilatata, subelliptica. Striis radiantibus, 9–11 in 10 μ, a linea longitudinali interruptis.

This new species is akin to *P. Tabellaria* EHRENBERG, from which it differs in its larger valve, coarser striae, and the presence of the longitudinal band.

Loculi transverse, about 9–11 in 10 μ. Both the outer and the inner membranes of the loculi are well preserved. The outer membrane has many sieve pores. Sieve pores round, 5–6 in 1 μ, about 50–110 mμ in diameter, arranged in transverse and two oblique rows. Closing membrane of the sieve pore is not yet found. Inner membranes very thin, each with an opening about 2–4 μ long and about 0.3–0.5 μ broad. Through the opening of the inner membrane, 3–5 (usually 4) transverse rows of sieve pores of the outer membrane are seen. According to my research, many fossils of the *Pinnularia* species were found with well preserved outer and inner membranes. (cf. OKUNO, 1954, *Bot. Mag. Tokyo, vol. 67*, pp. 173–177.)

Habitat: Fresh water.

Occurrence: In diatomite. (Specimen, nos. 1543, E 260–Holotype) Nishise-mura, Kuma-gun, Kumamoto Prefecture. Pleistocene.

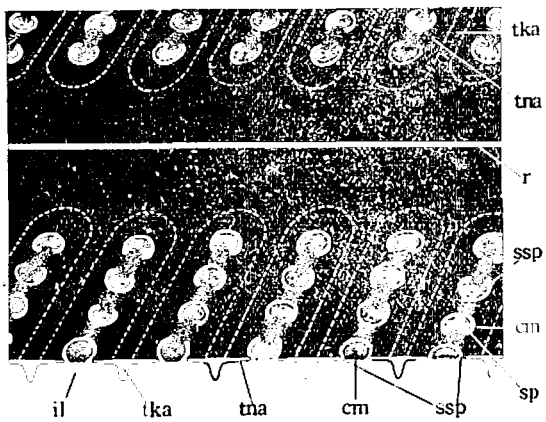
Gomphonema acuminatum EHRENBERG var. *coronata* (EHRENBERG) W. SMITH

Text-fig. 2; Pl. 9, Figs. 3a-d.

Gomphonema acuminatum EHRENBERG var. *coronata* (EHRENBERG) W. SMITH, HUSTEDT, 1930, Bacill., p. 370, fig. 681.—MILLS, 1934, Index, p. 773.—OKUNO, 1953, *Bot. Mag. Tokyo, vol. 66*, p. 122, pl. 1, fig. 5.

Valves wedge-shaped, strongly biconstricted, with broad apiculate apex and narrow basis; 84 (50–100) μ long, 12 (10–12) μ broad. Axial area narrow, central area with a stigma unilaterally. Frustule pores arranged in slightly radiating rows, 10–11 in 10 μ.

By the present electron microscopy it was revealed that the porous part of the valve is composed of two transverse areas alternately thin and thick (Text-fig. 2). The thin area is membraneous, with a transverse row of sieve pores. The thick area (costa) probably projects



Text-fig. 2. Diagram of the electron-microscopic fine structure of a part of the valve of *Gomphonema acuminatum* var. *coronata*. cm, Closing membrane of the sieve pore. il, Incomplete loculus. r, Raphe. sp. Sieve pore. ssp. Secondary sieve pore. tka, Thick area of the valve. tna, Thin area of the valve. (Dotting is used for shadowing only.) (Cf. pl. 9, Figs. 3a-d)

somewhat deeply inwards. Thus by the presence of thin and thick areas, the valve is probably made incompletely locular. Sieve pores are round or roundish, almost completely closed by a delicate closing membrane, leaving marginal horse-shoe-shaped secondary sieve pores. Usually the closing membrane is fixed to the lateral margin of the sieve pore by a short stalk. Sometimes the stalks of two adjacent sieve pores are arranged oppositely, and in such cases the two paired sieve pores give the appearance of the frustule pores with two opposite sieve pores found in *Triceratium Shadboltianum* var. *elongata*, *Ditylum Brightwellii*, and *Biddulphia Titiana* (cf. OKUNO, 1950, *Bot. Mag. Tokyo, vol. 63*, p. 99, pl. 2, figs. 4, 4′; 1952, *l. c., vol. 67*, p. 172, Text-fig. 1, 2-A, pl. 1, figs. 1a-d). In the mantle, the sieve pores sometimes have Σ-shaped secondary sieve pores, and in the girdle, the frustule pores are round holes without closing membranes (Pl. 9, fig. 3d). Holes about 100–150mμ in diameter, 12–15 in 10μ, arranged in transverse rows as in the mantle.

Habitat: Fresh water, littoral, often epiphytic.

Occurrence: In diatomites. Specimen, no. 357, E 252. Arii-mura, Minamimuro-gun, Mie Prefecture. Holocene. Specimen, no. 1270. Nogami-mura, Kusu-gun, Ôita Prefecture. Upper Pliocene.

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—— (1953-54), Diatomeenschalen im elektronenmikroskopischen Bild. I, II.[5]

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5) The present writer has not yet seen these publications.

Explanation of Plate 8

L.M.: Light Micrograph. E.M.: Electron Micrograph. Electron micrographs without special remarks were all obtained from the direct preparations.

Figs. 1a, b. *Actinoptychus undulatus* (BAILEY) RALFS. Lompoc, California, U.S.A. 1a (L.M. ×750). 1b (E.M. ×6000). 1a, b, Obtained from the same valve. (Cf. Text-fig. 1)

Figs. 2a, b. *Coscinodiscus elegans* GREVILLE. Sawane-chô, Niigata Pref. 2a (L.M. ×600). 2b (E.M. ×12000).

Figs. 3a-d. *Caloneis hitoyosiensis* OKUNO, sp. nov. Nishise-mura, Kumamoto Pref. 3a, b (L.M. 3a ×500, 3b ×1000). 3c, d (E.M. Formval substratum. 3c ×10000, 3d ×20000). 3a-d, Obtained from the same valve.

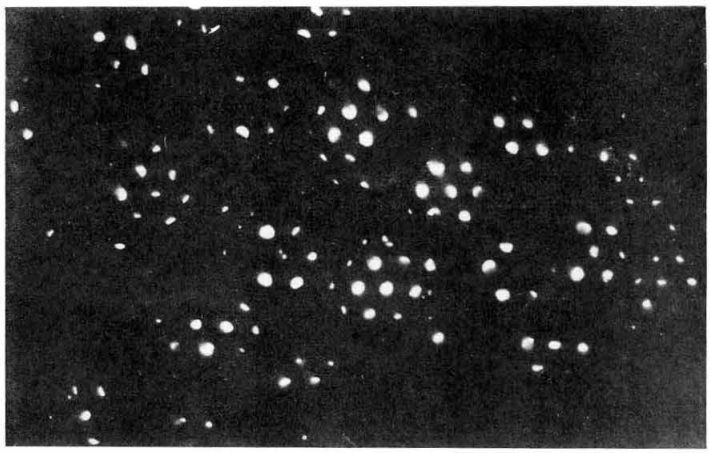
Explanation of Plate 9

Figs. 1a-c. *Stauroneis phoenicenteron* (NITZSCH) EHRENBERG. Rutaka, Saghalien. 1a, b (L.M. 1a ×400, 1b ×1000). 1c (E.M. Formval substratum. ×6000). 1a-c, Obtained from the same valve.

Figs. 2a-c. *Pinnularia higoensis* OKUNO, sp. nov. Nishise-mura, Kumamoto Pref. 2a (L.M. ×200). 2b, c (E.M. Formval substratum. 2b ×3000, 2c ×14000).

Figs. 3a-d. *Gomphonema acuminatum* EHRENBERG var. *coronata* (EHRENBERG) W. SMITH. 3a-c, Arii-mura, Mie Pref. 3a (L.M. ×1000). 3b, c (E.M. Formval substratum. 3b ×4000, 3c ×20000). 3d, Nogami-mura, Ôita Pref. (E.M. Collodion substratum. ×2000. *m*, Mantle. *g*, Girdle). 3a-c, Obtained from the same valve. (Cf. Text-fig. 2)

1a



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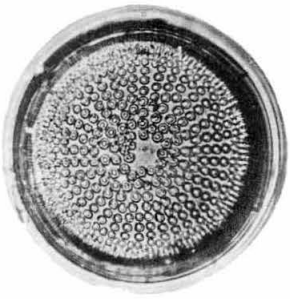

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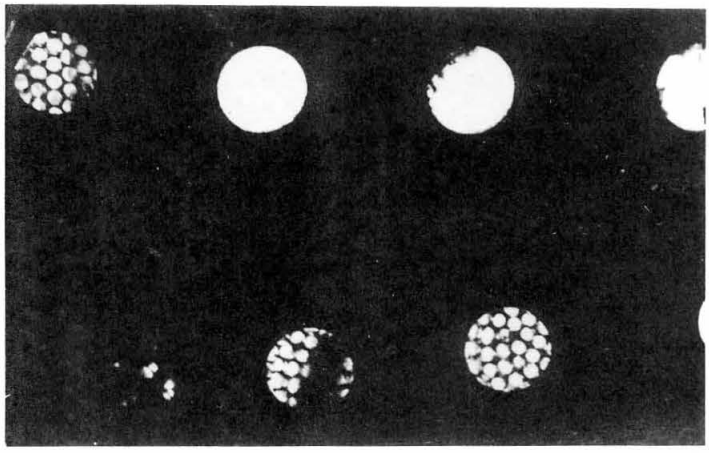
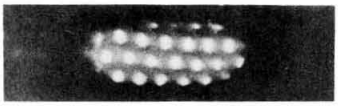


2b

3a 3b



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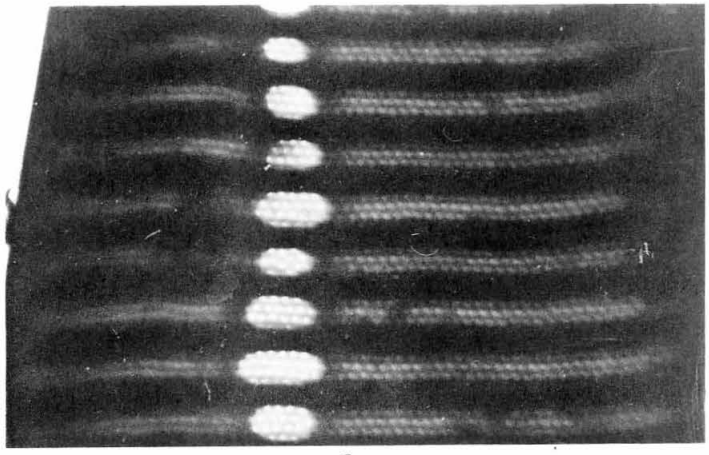
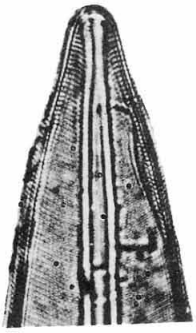
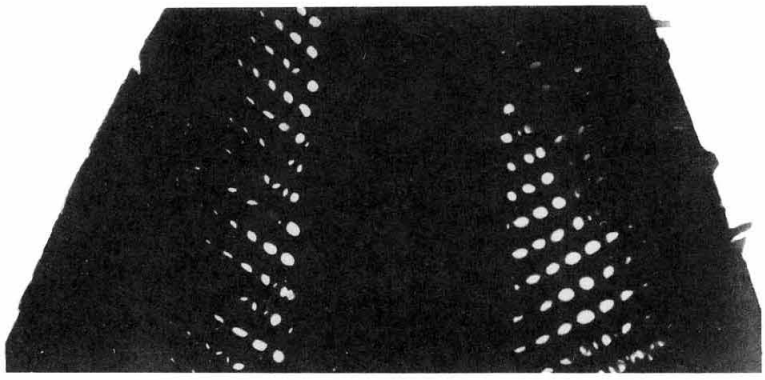


3c

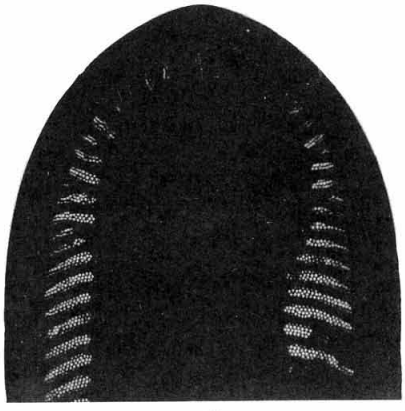
1a



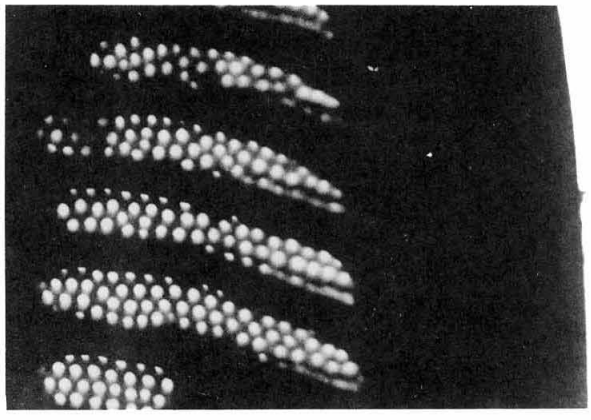
1b



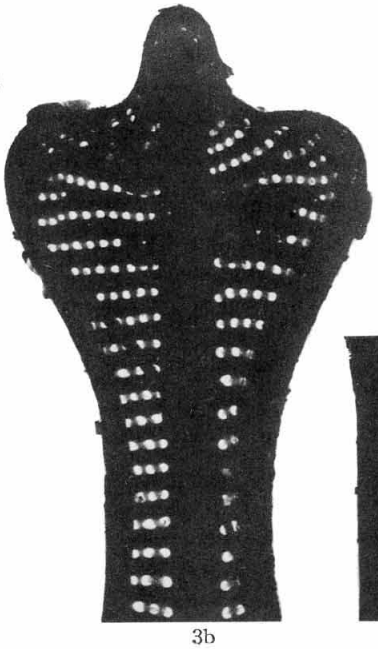
1c



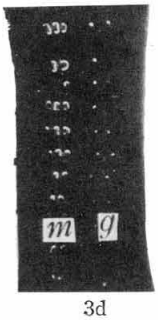
2a 2b



2c



3a 3b



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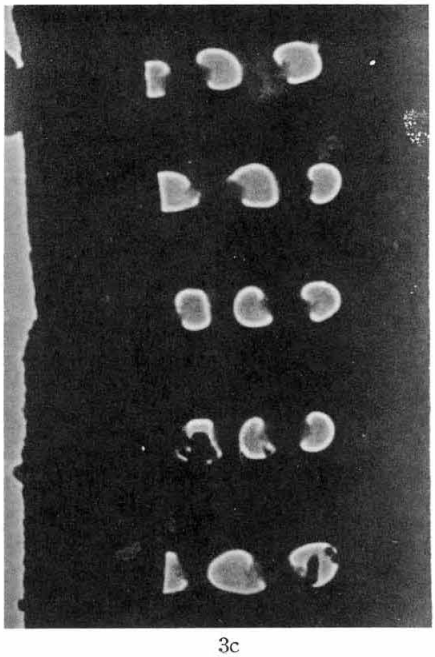

3c

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 19, pp. 59-64, pl. 10, Sept. 20, 1955

269. NOTES ON SOME TERTIARY PLANTS FROM KOREA (TYÔSEN). V*

KAZUO HUZIOKA

Mining College, Akita University

朝鮮産第三紀植物化石 V. 7 属 8 種記載した。このうち *Platycarya* を除いて他は朝鮮半島に現生しない属である。　藤岡一男

Contents

Family Juglandaceae

Two genera of Juglandaceae, *Juglans* and *Platycarya*, are now living in the Korean peninsula. Their specific names and geographic distributions are follows:

Juglans mandshurica MAXIM.: Korea (northern half), Manchuria, China, Ussuri, Dahurica, and Siberia.

J. sinensis DODE: Korea (southern provinces), and China.

Platycarya strobilacea SIEB. et ZUCC.: Korea (southern half), Japan and China.

The following fossils of Juglandaceae have been reported by previous authors from Korea:

Carya serracfolia (GÖPPERT): Kantindo formation, N. Kankyo-Do (ENDO, 1938)

Engelhardtia koreanica ÔISHI: *Engelhardtia* Bed and Kyusin coal-bearing bed, N. Kankyo-Do (ÔISHI, 1936, p. 58, Text-figs. 1-3; ENDO, 1939, p. 337, Pl. 23, figs. 1-2; ENDO, 1943, p. 296)

Juglans nigella HEER: Ryudo formation, N. Kankyo-Do (TATEIWA, 1925); Kantindo formation, N. Kankyo-Do (ENDO, 1938)

J. acuminata HEER: Kantindo formation, N. Kankyo-Do (ENDO, 1938)

J. sp.: Tusen coal-bearing bed, Kogen-Do (ENDO, 1938)

Pterocarya cfr. *denticulata* (WEB.): Kantindo formation, N. Kankyo-Do (ENDO, 1938)

P. sp.: Tusen coal-bearing bed, Kogen-Do (ENDO, 1938)

In the writer's disposal the following genera and species of Juglandaceae were determined in the Miocene floras of Korea: *Engelhardtia koreanica* OISHI, Cfr. *Platycarya miocenica* HU et CHANEY, and *Pterocarya asymmetrosa* KON'NO.

Genus *Engelhardtia* LESCHEN

Engelhardtia koreanica ÔISHI

Engelhardtia koreanica ÔISHI: ÔISHI (1936), p. 58, Text-figs. 1-3. ENDO (1939), p. 337, Pl. 23, Figs. 1-2. ENDO (1943), p. 296.

Of the genus *Engelhardtia*, about fifteen species now exist in tropical and

* Read June 26, 1954; received March 24, 1955.

subtropical Asiatic monsoon regions excepting the single species of Central America.

In 1936 ÔISHI first described *Engelhardtia koreanica* from Kokangen coal-mine in N. Kankyo-Do, based upon the singular involucre with two marginal nerves on each lobe at the wing. The bed in which *Engelhardtia koreanica* was found has been called the *Engelhardtia* Bed. ENDO (1943) also recorded this from the Miocene rocks of coal-mine, N. Kankyo-Do. Fossils of *Engelhardtia* have never been found in any other Eastern Asiatic Tertiary deposits.

The genus is not at present represented in Korea.

Occurrence :—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do ; *Engelhardtia* Bed (Miocene) ; Colls. KODAIRA and UOTANI.

Genus *Platycarya* SIEB. et ZUCC.

Cfr. *Platycarya miocenica*
HU et CHANEY

Plate 10, Figure 8

Compare: *Platycarya miocenica* HU et CHANEY: 1940, p. 27, Pl. 4, Figs. 6, 7; Pl. 5, Figs. 1, 3, 4.

The single fragmental leaflet which lacks the basal part, as shown in the figure, is closely comparable with *Platycarya miocenica* described by HU and CHANEY from the Miocene Shanwang flora of China. *P. miocenica* shows a close resemblance to *P. strobilacer* SIEB. et ZUCC., a common species found in present day forests of southern Korea as well as in China and Japan.

Occurrence :—Kinkodo, Usen-men, Geizitu-gun, N. Keisho-Do ; White diatomaceous mudstones of Changi Group (Miocene) ; Colls. KODAIRA and UOTANI.

Genus *Pterocarya* KUNTH.

Pterocarya asymmetrosa KON'NO

Plate 10, Figure 9

Pterocarya asymmetrosa KON'NO: KON'NO (1931), Pl. 16, Figs. 5-7 ; Pl. 17, Figs. 1-5 ; Pl. 19, Fig. 3. TANAI (1952), p. 124.

Many detached leaflets which are referable to *Pteracarya asymmetrosa* KON'NO of the Omi flora in Japan were examined. *P. asymmetrosa* is quite similar to the living *P. rhoifolia* SIEB. et ZUCC. of Japan and frequently occurs in the Miocene plant beds of Japan.

At present there is representative of the genus *Pterocarya* in the Korean peninsula, but there are ten species of the genus widely distributed in other regions of Eastern Asia.

HU and CHANEY (1940, p. 75, Pl. 43, Fig. 1) described *Pterocarya* (?) *serrulata* from the Shanwang flora of Shantung province in China, but differs from ours in the more linear lanceolate leaflet. Other species similar to *P. asymmetrosa* are *P. castanaefolia* (GÖPPERT) MENZEL (GÖPPERT : 1855, p. 27, Pl. 18, Fig. 18) of the European Miocene floras and *P. mixta* (KNOWLTON) BROWN (1937, p. 170, Pl. 47, Figs. 2, 3) from the Latah formation of Washington.

Occurrence :—Kinkodo, Usen-men, Geizitu-gun, N. Keisho-Do ; Laminated shale of Changi Group (Miocene) ; Colls. KODAIRA and UOTANI.

Kisshu-town, Kisshu-gun, N. Kankyo-Do ; White shale of Kisshu formation (Miocene) ; Coll. ÔISHI.

Genus *Nelumbium* JUSSIEU

Nelumbium sp.

Plate 10, Figure 10

Description :—General outline of leaf

unknown. Primary nerves stout, 17 in number. radiating from the center of leaf. Finer veins near the center forming delicate polygonal meshes.

Remarks and comparison:—Only a fragmental specimen, which preserved its central part only, was determined. As far as can be observed this leaf is referable to the genus *Nelumbium* and may be distinguished from the known species by the number of the primary veins.

ENDO described the Palaeogene and the Miocene *Nelumbium* from Japan and Saghalien under the name of *Nelumbo nipponica* ENDO (1934, p. 255, Pls. 36–38). Of these the Miocene leaves bear 23 primary nerves and the Palaeogene leaves 21.

In Japan *Nelumbium* appeared in the latest stage of the Cretaceous period and ranged to the Pleistocene epoch. The range of *N. nucifera* GAERT., which is commonly cultivated in ponds and swamps of Korea, is now restricted in its natural growth to Southern Asia.

This *Nelumbium* sp. from the *Engelhardtia* Bed is the first report on the occurrence of the genus from Korea.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Genus *Cercidiphyllum* SIEB. et ZUCC.

Cercidiphyllum crenatum (UNGER) BROWN

Plate 10, Figures 6 and 7

Dombeyopsis crenata UNGER: 1850, p. 488.
Cercidiphyllum crenatum (UNGER) BROWN: BROWN (1935), p. 68, Figs. 1, 6, 8–10. BROWN (1939), p. 496, Pl. 56, Figs. 7, 15, 16. TANAI (1952), p. 129, Pl. 5, Fig. 4.
Cercidiphyllum japonicum, ENDO (1939), p. 345, Pl. 23, Fig. 7.

For further references, see BROWN (1935 and 1939).

Cercidiphyllum crenatum is quite similar to the living *C. japonicum* SIEB. et ZUCC., but was distinguished by BROWN in that the latter leaf is shorter in proportion to width and more symmetric than the former. The Korean leaves here described are generally small, symmetric and longer in proportion to width, though they vary considerably in both shape and size.

Cercidiphyllum crenatum is one of the most common species in the Aniaian (Lower Miocene) floras in Japan. The localities previously known to us are as follows: Abura of Hokkaido (HUZIOKA, 1950, p. 4), Aniai of Akita pref., Aburado of Yamagata pref. (TANAI, 1952), Seki of Niigata pref., and Kawai of Shimané pref., etc.

Occurrence: Yutendo, Meisen-gun, N. Kankyo-Do; Ryudo formation (Miocene); Coll. ÔISHI.

Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Kantindo, Meisen-gun, N. Kankyo-Do; Kantindo formation (Miocene); Coll. ÔISHI.

Kisshu-town, Kisshu-gun, N. Kankyo-Do; White shale of Kisshu formation (Miocene); Coll. ÔISHI.

Genus *Liriodendron* L.

Liriodendron meisenense ENDO

Plate 10, Figures 4 and 5

Liriodendron meisenense ENDO: 1939, p. 345, Pl. 23, Fig. 12.

In 1939 ENDO discovered fossil samara of *Liriodendron* named *L. meisenense* from the Kantindo formation of N. Kankyo-Do. In the present disposal, samara

and leaf, both of which are in an unsatifactory state of preservation, were newly found among the specimens from the *Engelhardtia* Bed of N. Kankyo-Do.

The samara can almost safely be referred to the type specimen of *L. meisenense*. The leaf, which is shown in Pl. 10, Fig. 5, shows characteristic lobation and nervation to *Liriodendron*, though it is quite fragmental but sufficient to permit a critical comparison with the known species. In this treatment the leaf is provisionally assigned to *L. meisenense* as it occurred in same bed with the fruit of *L. meisenense*.

Occurrence :—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Genus *Aesculus* L.

The genus *Aesculus* does not exist in the modern forest of Korea. As shown in the following list only four species are found in the temperate deciduous forests of Eastern Asia:

A. dissimilis BLUME: Japan (Hokkaidô).
A. turbinata BLUME: Japan (southern part of Hokkaidô, Honshû, Shikoku, and northern part of Kyûshû).
A. chinensis BUNGE: China (Chihli, Shensi, Honan, and Shansi).
A. wilsoni REHDER: China (Hunan, Hupeh, Szechuwan, and Chekiang).

Only *Aesculus* sp. of the Tusen flora of Kogen-Do has been recorded by ENDO (1939). Two additional species of *Aesculus* have been found from the Miocene floras of Korea, and are here recorded.

Aesculus majus (NATHORST) TANAI

Plate 10, Figures 1 and 2

Aesculiphyllum majus NATHORST: 1888, p. 6, Pl. 1, Fig. 3.
Aesculiphyllum minus NATHORST: 1888, p. 11, Pl. 2, Fig. 9.
Aesculus majus (NATHORST) TANAI: 1952, p. 131.

In 1888, NATHORST described two species of *Aesculus* under the form-generic name of *Aesculiphyllum* from Japan: *A. majus* from the Aniai coal-bearing formation of Kayakusa in Akita pref. and *A. minus* from the Aburado coal-bearing formation of Aburado in Yamagata pref. NATHORST's specimens are represented by detached leaflets which proved to be nothing but *Aesculus* and have been renamed by TANAI (1952). *A. majus* is seemingly unseparable from *A. minus* in the NATHORST's figure. These leaflets are common in the Aniaian (Lower Miocene) floras of Northeastern Japan.

The leaflets from the Changi group of N. Keisho-Do are identical with the Japanese Miocene *Aesculus majus* (NATHORST), though they are not completely preserved. *A. majus* is closely related to *A. turbinata* BLUME which is found in the modern forests of Japan, but differs from the modern Chinese *A. chinensis* BUNGE in the closer spacing of the lateral veins.

Occurrence :—Kinkodo, Usen-men, Geizitu-gun, N. Keisho-Do; White diatomaceous mudstone of Changi Group (Miocene); Colls. KODAIRA and UOTANI.

Cfr. *Aesculus miochinensis* HU et CHANEY

Plate 10, Figure 3

Compare:
Aesculus miochinensis HU et CHANEY: 1940, p. 63, Pl. 38, Figs. 4, 5; Pl. 39, Fig. 1.

An imperfect leaflet from the Kisshu

formation of N. Kankyo-Do is closely comparable with *Aesculus miochinensis* HU et CHANEY of the Shanwang flora in China. In our leaflet which lacks the apical half and the base, the marginal serration is not so conspicuous and the spacing of the lateral veins is rather distant from each other. This shows the Korean leaflet to be similar to *A. miochinensis* rather than to *A. majus*.

A. chinensis BUNGE of China has been considered by HU and CHANEY to be a modern equivalent of *A. miochinensis*.

Occurrence:—Kisshu-town, Kisshu-gun, N. Kankyo-Do; White shale of Kisshu formation (Miocene); Coll. ÔISHI.

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Explanation of Plate 10

(All figures in natural size)

The specimens are stored in Institute of Geology and Mineralogy, Faculty of Science, Hokkaido University, Sapporo.

Figs. 1-2. *Aesculus majus* (NATHORST) TANAI Loc. Kinkodo, Usen-men, Geizitu-gun, N. Keisho-Do, Changi group.

Fig. 3. Cfr. *Aesculus miochinensis* HU et CHANEY Loc. Kisshu-town, Kisshu-gun, N. Kankyo-Do, Kisshu formation.

Figs. 4-5. *Liriodendron meisenense* ENDO Loc. Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed.

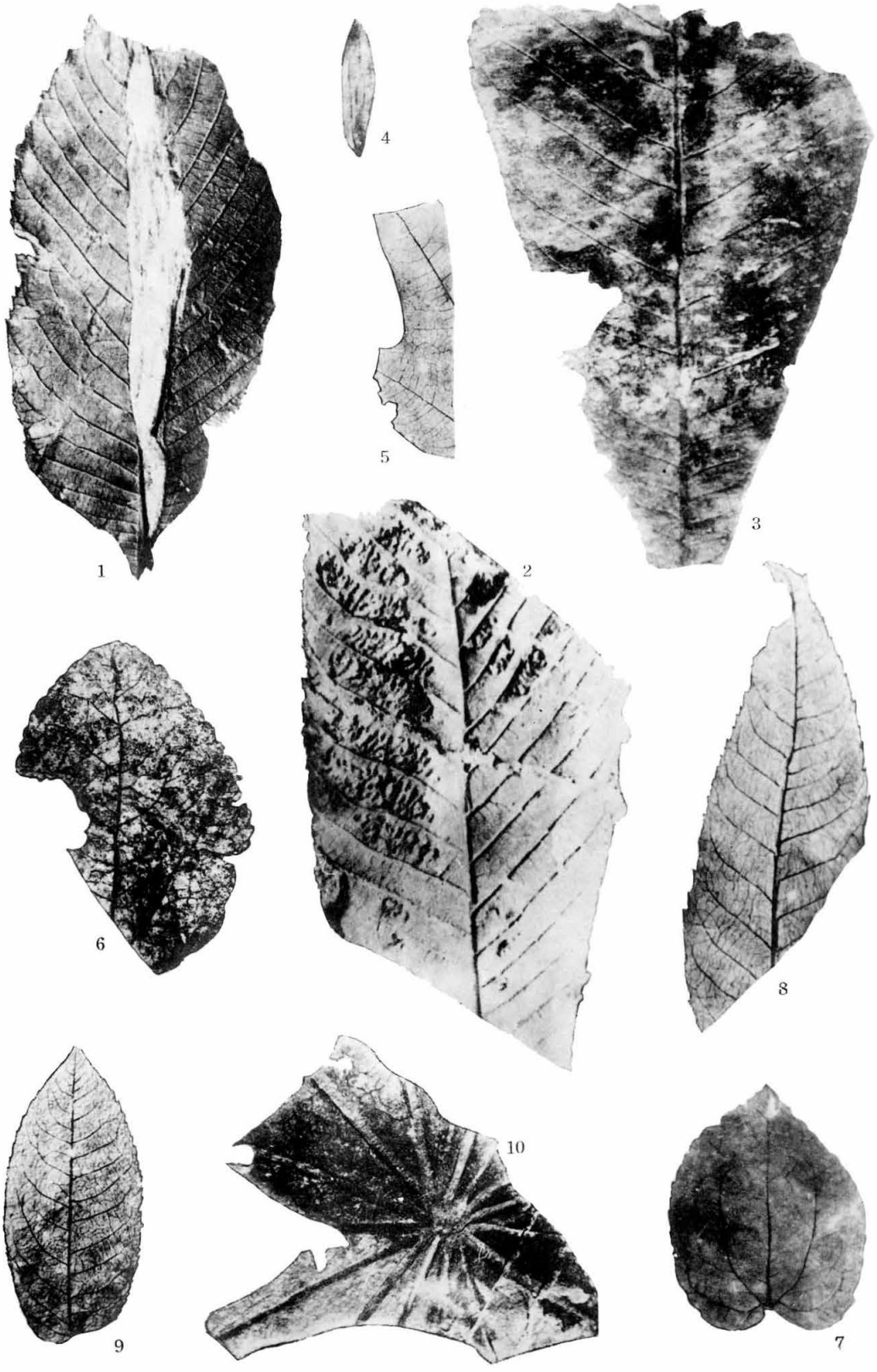
Fig. 6. *Cercidiphyllum crenatum* (UNGER) BROWN Loc. Yutendo, Meisen-gun, N. Kankyo-Do, Ryudo formation.

Fig. 7. *Cercidiphyllum crenatum* (UNGER) BROWN Loc. Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed.

Fig. 8. Cfr. *Platycarya miocenica* HU et CHANEY Loc. Kinkodo, Usen-men, Geizitu-gun, N. Keisho-Do, Changi group.

Fig. 9. *Pterocarya asymmetrosa* KON'NO Loc. Ditto.

Fig. 10. *Nelumbium* sp. Loc. Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed.



T. TAKAYASU photo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 19, pp. 65-72, Pl. 11, 1 Text-Fig.

270. DISCOVERY OF *PROCERATOPYGE* IN THE *CHUANGIA* ZONE IN MANCHURIA, WITH A NOTE ON THE CERATOPYGIDAE*

MISCELLANEOUS NOTES ON THE CAMBRO-ORDOVICIAN GEOLOGY AND PALAEONTOLOGY, NO. XXV.

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滿洲 *Chuangia* 帶中に *Proceratopyge* の発見と Ceratopygidae について:—*Proceratopyge* (*Proceratopyge*) *liaotungensis* KOBAYASHI and ICHIKAWA (新種) の発見は *Chuangia* 帶を下部 Olenidian と対比する 1 証拠となる。この機会に小林は Ceratopygidae の新分類 (第 67 頁の表) を提唱する。

小林貞一・市川健雄

Except certain agnostidians no trilobite genus has so far been known in the *Chuangia* fauna, which is common with any of the other province. Therefore the find of *Ceratopyge* in a *Chuangia* limestone is of special interest for interprovincial correlation. In cleaning trilobites in limestone slabs which the senior author collected from a point (C_7) on the southeastern foot of Paichiashan (白家山) hill on the roadside to Kuochiatun (郭家屯) in the Chinchiachengtzu (金家城子) district at the neck of the Liaotung peninsula, the junior author found a pygidium with a pair of lateral spines. Paying special attention to this kind of trilobites, he obtained a lot of pygidia and associated cranidia from the collection what are now known to belong to *Proceratopyge*. The *Chuangia* limestone at the locality contains *Lingulella*, *Obolus*, *Acrotreta*, *Pseudagnostus orientalis* KOBAYASHI, and *Chuangis batia* (WALCOTT) beside *Proceratopyge liaotungensis* KOBAYASHI and ICHIKAWA, new species. For the stratigraphy of the district the reader is referred to the papers by AOJI (1925), KOBAYASHI (1933), ENDO and RESSER (1937) and NAKAMURA and SOO (1942).

Proceratopyge is distributed in Sweden from the late Middle Cambrian (*Lejopyge laevigata* zone) to the early Upper Cambrian (*Agnostus pisiformis* zone to *Orusia lenticularis* zone, lower part), (WESTERGÅRD, 1947). In Australia the genus occurs in the *Eugonocare*, *Glyptagnostus* and *Rhodnaspis* stages where the first is correlated to the *Agnostus pisiformis* zone and the two others to the *Olenus* zone (WHITEHOUSE, 1939). *Proceratopyge liaotungensis* in Manchuria must be a link between the Baltic and Australian forms. In Eastern Asia *Chuangia* is a guide fossil to the Changshanian stage superjacent to the Kushan stage. *Drepanura* is a leading member of the Kushan fauna. *D. cremita*

* Read at the 46th meeting of the Society at Tokyo, June 30, 1951; recieved May 4., 1955.

found in the *pisiformis* zone (WESTERGÅRD, 1947) may be homotaxial to Eastern Asiatic species of *Drepanura* and the *Chuangia* limestone containing *Proceratopyge laiolungensis* is considered to be nearly coeval with the lower Olenidian in Sweden and the *Proceratopyge* bearing stages in Australia.

Family Ceratopygidae RAYMOND, 1931

The family was first instituted by RAYMOND to include *Ceratopyge* and *Albertella* to which *Crepicephalus* was later added by WALCOTT (1916) and *Lonchocephalus* and *Saratogia* were appended in ZITTEL-BROILI's Grundzüge, 1924. It was referred to the Zacanthoidea by RICHTER (1932). KOBAYASHI (1953) on the contrary eliminated these genera from the family but *Ceratopyge* and combined the last with *Proceratopyge*, *Hysterolenus* and *Kogenium* in it. In describing *Lopnorites* and *Diceratopyge*, TROEDSSON (1937) splitted the family into two branches, Ceratopyginae and Hysteroleninae. There are two more genera added to the family. One is *Onychopyge* HARRINGTON (1938, non WOODWARD, 1880), i. e. *Prionopyge* HARRINGTON and LEANZA (1942) and the other *Dichelepyge* HARRINGTON and LEANZA (1952). Finally it is probable that *Ceratopeltis latilimbata* POULSEN, 1937, which occurs in the upper Canadian Cape Weber of East Greenland together with two species of *Niobe* is a member of this family, because it is similar to *Proceratopyge* no less than either to *Mansuyia* or to *Kaolishania*.

When RAYMOND (1925) urgued the taxonomy of *Ceratopyge canadensis* WALCOTT (1912) (Pl. 11, fig. 12) from Upper Cambrian of British Columbia, he pointed out *Dolichometopus* (*Housia*) *varro* WALCOTT (1916) (Pl. 11, figs. 13 a-b) from Upper Cambrian (*Elvinia* zone) of Utah as its nearest ally. They are, however, not dolichometopids and their pygidia certainly similar to that of *Proceratopyge*, instead of *Ceratopyge*. *Ptychoparia vacuna* WALCOTT, 1890, from Upper Cambrian of South Dakota is, as correctly suggested by RESSER (1936), a *Housia* having lateral furrows on the glabella. In the obsoletion of the glabella and the possession of genal spines *Ceratopyge canadensis* for which KOBAYASHI proposes here *Hausiella* can readily be distinguished from *Hausia*. It has one more segment in thorax than does *Proceratopyge* or *Lopnorites*.

The narrowness of fixed cheeks at eyes is the distinguishing characteristic of *Housia* and *Housiella* from *Proceratopyge* and *Marjumia* with the last of which KOBAYASHI (1925) has combined *Housia* in the Marjumiidae. *Marjumia typa* WALCOTT, 1916, the type of the genus, is a very distinct form having 14 segments in thorax and 3 pairs of spines on pygidium. The great similarity of "*M*" *callas* WALCOTT to *Kogenium*, however, can hardly be overlooked. It is probable that *Housia* and *Housiella* were derived from *callas*-like form of late Middle Cambrian "*Marjumia*" or *Kogenium*. By this reason Housiinae KOBAYASHI (nov.) is considered to be an Upper Cambrian branch isolated from the main stem of the Ceratopygidae.

The stem of the family or the Proceratopyginae KOBAYASHI, (nov.) is represented by *Proceratopyge*, *Kogenium*, *Lopnorites* and *Prionopyge*. Their glabellae are conical or cylindrical and usually a pair of spines issue from the first segment of pygidium. Nine segments are countable on the thoraces of *Proceratopyge* and *Lopnorites*.

The Ceratopyginae TROEDSSON em. indicate the trends of evolution along

which the cylindrical glabella (*Diceratopyge*) was expanded in the middle (*Hysterolenus*, Pl. 11, fig. 11) or dilated toward the front (*Ceratopyge*) and the number of the thoracic segments reduced. There are only 6 segments in the thoraces of *Diceratopyge* (Pl. 11, fig. 15), *Ceratopyge* (REGNELL, 1939) and *Dichelepyge*. In the last mentioned, however, the glabella is truncato-conical. Two pairs of spines issue from the first and second segments in it, but only the posterior ones are present in the three other genera.

The former subfamily distributed in Eurasia and Australia from late Middle and Upper Cambrian. Furthermore, *Proceratopyge inexpectans* and two species of *Prionopyge*, all represented merely by pygidia, are reported from the *Parabolinella* and *Kainella* zones of South America. The distribution of the latter subfamily extends from Northern Europe to Argentina in the Lower Ordovician period, but in the Upper Cambrian it is represented only by *Diceratopyge* from Tienshan. A scheme of classification of the Ceratopygidae is shown in a table inserted here.

Classification of the Ceratopygidae RAYMOND
(Type Species in brackets)

Subfamily Proceratopyginae KOBAYASHI, new subfamily

Genus *Proceratopyge* WALLERIUS, 1895, (*Proceratopyge conifrons* WALLERIUS) Late Middle Cambrian to Lower Ordovician; Sweden, Tienshan, Honan, South Manchuria, South Korea and Argentina.

Subgenus *Proceratopyge*, s. str. Late Middle and Upper Cambrian; Sweden, Tienshan, South Manchuria and Australia.

Subgenus *Kogenium* KOBAYASHI, 1935 (*Kogenium rotundum* KOBAYASHI) Late Middle Cambrian; Korea

Subgenus *Lopnorites* TROEDSSON, 1937 (*Lopnorites rectispicatus* TROEDSSON) Upper Cambrian; Sweden. Tienshan and Australia

Subgenus *Prionopyge* HARRINGTON and LEANZA, 1952 (*Onychopyge riojana* HARRINGTON, 1938) Lower Ordovician; Argentina

? Genus *Ceratopeltis* POULSEN, 1937 (*Ceratopeltis latilimbata* POULSEN). Late Canadian; East Greenland.

? Subfamily Housiinae KOBAYASHI, new subfamily

Genus *Hausia* WALCOTT, 1916. (*Dolichometopus* (*Hausia*) *varro* WALCOTT) Upper Cambrian; Utah and South Dakota.

Genus *Hausiella* KOBAYASHI, new genus. (*Ceratopyge canadensis* WALCOTT). Upper Cambrian; British Columbia.

Subfamily Ceratopyginae TROEDSSON, 1937, em. Kobayashi, 1955.

Genus *Ceratopyge* HAWLE and CORDA, 1847 (*Olenus forficula* SARS) Tremadocian; Scandinavia and (?) Central Asia.

Genus *Hysterolenus* MOBERG, 1898. (*Hysterolenus tornquisti* MOBERG). Tremadocian of Northern Europe; Skiddavian of Argentina and (?) Upper Cambrian of Tienshan.

Genus *Diceratopyge* TROEDSSON, 1937, (*Diceratopyge mobergi* TROEDSSON). Upper Cambrian; Tienshan.

Genus *Dichelepyge* HARRINGTON and LEANZA, 1952. (*Dichelepyge pascuali* HARRINGTON and LEANZA). Tremadocian of Argentina.

As noted by MOBERG (1898), the hypostoma of *Hysterolenus tornquisti* bears some resemblances with that of *Megalaspis*. WESTERGÅRD's specimens of *Proceratopyge* (*nathorsti* and *tullbergi*) show the facial suture to be sagittal in

front and medial ventrally. *Lopnorites* is allied to *Charchaquia* in cephalic aspect and so *Proceratopyge conifrons* to *C. norini* in immature cranidia. Thus the Ceratopygidae appear not distant from the Asaphidae or the Taihungshaniinae.

Genus *Proceratopyge* WALLERIUS, 1895

The morpholygy of the genus was immensely clarified by WESTERGÅRD through his study on excellent specimens. Now it is certain that *Kogenium*, *Lopnorites* and *Prionopyge* are intimately related to *Proceratopyge*. At the same time there is a wide variation among a number of species in the four genera. Therefore these names may be better to reserve as subgenera of *Proceratopyge*, although WESTERGÅRD synonymized *Lopnorites* with *Proceratopyge*.

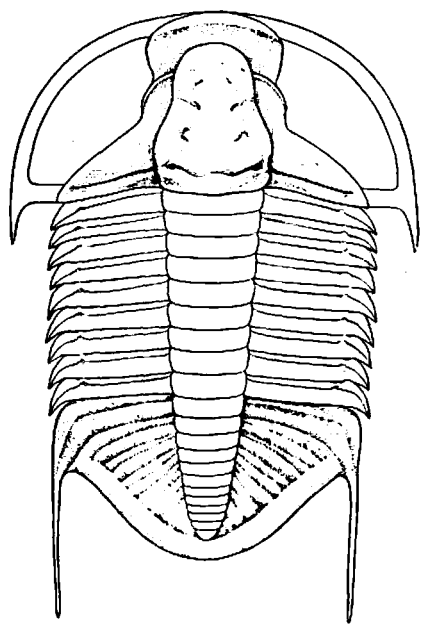

Figure. *Proceratopyge* (*Proceratopyge*) *fragilis* (TROEDSSON)

The pygidium is very broad in *Proceratopyge conifrons* (Pl. 11, fig. 14), quite long in *Kogenium rotundum* and intermediate in *Lopnorites rectispicatus* (Pl. 11, fig. 16). The cranidium found associated with the pygidium of *K. rotundum* has a conical glabella and wide fixed cheeks. In *P. conifrons* the glabella is subconical and the fixed cheeks are narrow. *Proceratopyge*, s. str. typified by *conifrons* comprises the followings:

Proceratopyge nathorsti WESTERGÅRD, 1922

Lopnorites fragilis TROEDSSON, 1937 (Text-figure)

Proceratopyge lata WHITEHOUSE, 1939

Proceratopyge nectans WHITEHOUSE, 1939

Proceratopyge similis WESTERGÅRD, 1947

Proceratopyge magnicauda WESTERGÅRD, 1948

The subgeneric distinction of *Lopnorites* is made from *Proceratopyge* by its cylindrical glabella. Beside *L. rectispicatus* the subgenus includes *Proceratopyge tullbergi* WESTERGÅRD, 1922, *Lopnorites grabaui* TROEDSSON, 1937, *Proceratopyge rutellun* WHITEHOUSE, 1939 and *Proceratopyge polita* WHITEHOUSE, 1939. Without the cephalon, however, it is difficult to say definitely the subgeneric position of *Kogenium triangularis* KOBAYASHI, 1935, *P. inexpectans* HARRINGTON, 1938, TROEDSSON'S *Lopnorites* 2 spp. from Tienshan, 1937, and KOBAYASHI'S *Lopnorites* sp. from Hunan, 1938.

The parabolic outline of the pygidium, narrow axial lobe prolonged into a postaxial keel, well marked axial rings, obsolete segmentation of pleural lobes except the first pleura which is delimited by an interpleural furrow and protruded into a strong spine are said to be the distinguishing characteristics of *Prionо-*

pyge HARRINGTON and LEANZA.

Proceratopyge (*Proceratopyge*) *liaotungensis* KOBAYASHI and ICHIKAWA, new species

Plate 11, Figures 1-9.

Description :—Cranidium well inflated; glabella short conical, tapering forward, more or less rounded in front and distinctly elevated above cheeks; lateral furrows, if present, very weak; occipital furrow fairly strong; occipital ring thickened mesially; eye-band of moderate size, opposed each other at the mid-length of the glabella and connected with the glabella by a pair of oblique eye-rdige; preglabellar area concave; frontal rim narrower than the limb and somewhat bent up; a preglabellar cusp outlined by paired furrows extending in- and back-ward from lateral ends of the frontol rim; facial sutures intramarginal on the anterior border.

Pygidium exclusive of spines semicircular, a little broader than twice the length; axial lobe conical, prominently elevated above a little inflated pleural lobes, composed of three or four rings and a small terminal lobe; first pleura with a deep pleural groove almost rectangularly bent at the lateral end and protruded into a spine which extends beyond the posterior of the pygidium proper; pleural lobe behind the first interpleural furrow composed of a subtriangular inner part and a relatively thick marginal border which is depressed and becomes confluent with its counter behind the axial lobe.

Surface smooth.

Observation and comparison :—There are 5 cranidia and 11 pygidia. The largest pygidium is 4.4 mm. long. All of the pygidia look alike, but in large ones the axial lobe looks more conical than samller ones in which in turn the lobe narrows abruptly near the rear end.

The relatively short glabella, distinct eye ridge, peculiar preglabellar cusp, diagonal anterior sutures, absence of a median tubercle, broad pygidium and its obsolete segmentation behind the spiniferous pleura are characteristics of this species.

Proceratopyge similis WESTERGÅRD has a similar triangular cusp in front of the glabella, but is different in many other aspects. The glabella is longer in most other species than in this.

Occurrence :—*Chuangia* limestone in Chinchiachengtzu district (loc. C_7) in Liaotung, South Manchuria.

Subfamily Ceratopyginae TROEDSSON em. KOBAYASHI

See KOBAYASHI, 1952, for *Ceratopyge orientalis* GRABAU, MS, *Hysterolenus* (?) *manchuricus* KOBAYASHI, 1933, and *Hysterolenus* spp. by WALCOTT, 1913 and ENDO, 1937.

Genus *Ceratopyge* HAWLE and CORDA, 1847

BOEK and SARS' *Trilobita acicularis* and *T. lyra* (1835) are no more than varieties of *Ceratopyge forficula* (BRÖGGER, 1882, STØRMER, 1940), (Pl. 11, fig. 10). *C. latelimbata* MOBERG and SEGERBERG, 1906, has a smaller glabella, and distinct eye ridges crossing broader fixed cheeks. *Ceratopyge* (?) sp. is reported by WEBER (1926) from Central Asia.

Genus *Hysterolenus* MOBERG, 1898

Hysterolenus (?) *levicauda* MOBERG, 1906, from the *Dictyograptus* zone of Sweden is represented by an immature pygidium, 1. 6 mm. long which is divided into 7 or 8 segments with a short spine

on the fourth pleura.

Hysterolenus tornquisti var. by STUBBLEFIELD, 1927, from the *Clonograptus* zone of England and *H. modestus* HARRINGTON, 1938, from the *Kayseraspis* zone of Argentina are each represented by a cranidium. A trilobite resembling *H. tornquisti* is reported to occur in the *Dictyonema* band of North Wales (FEARNSIDE, 1910). TROEDSSON's pygidium of *Hysterolenus* (?) sp. from the Upper Cambrian of Tienshan looks fairly typical of the genus.

Postscript:—*Proceratopyge* and some other trilobites and brachiopods were found in 1949 by C. H. CHAO, N. T. TANG and C. J. SHEN at Ch'uhsien (滁県) in Eastern Anhui; lately agnostid, *Proceratopyge* and others discovered by H. F. SHENG in Shangch'en (上陳) district, Chiangshanhsien (江山県) in Southeastern Chekiang. LU-YENHO (1951), Brief Notes on the Upper Cambrian in Central and South China. (華中, 華南上奥武紀鱗爪. 地質論評 15 巻, 4-6 期. 134 頁).

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Explanation of Plate 11

Proceratopyge (*Proceratopyge*) *liaotungensis* KOBAYASHI and ICHIKAWA, new species.....p. 69

Figure 1. Cranidium (No. 2), holotype, ×4
Figure 2. Cranidium (No. 1), ×4
Figure 3. Pygidium (No. 6), ×4
Figure 4. Pygidium (No. 7), ×4
Figure 5. Pygidium (No. 8), ×4
Figure 6. Pygidium (No. 10), ×3
Figure 7. Pygidium (No. 9), ×3
Figure 8. Pygidium (No. 11), ×2.5
Figure 9. Pygidium (No. 12), ×3

Early Upper Cambrian *Chuangia* limestone; Paichiashan, Chinchiachengtzu district, South Manchuria. Collection of Geological Institute, University of Tokyo.

Figure 10. *Ceratopyge forficula* (SARS) .....p. 69
Figure 11. *Hysterolenus tornquisti* MOBERG .....p. 67
Figure 12. *Housiella canadensis* (WALCOTT).....p. 66
Figures 13 a-b. *Housia varro* WALCOTT .....p. 66
Figure 14. *Proceratopyge conifrons* WALLERIUS .....p. 68
Figure 15. *Diceratopyge mobergi* TROEDSSON .....p. 67
Figure 16. *Lopnorites rectispicatus* TROEDSSON .....p. 68


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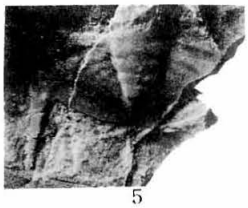
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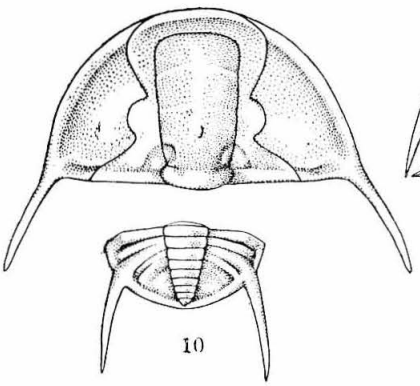
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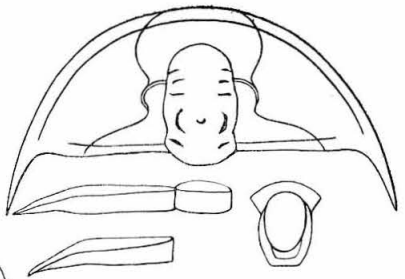
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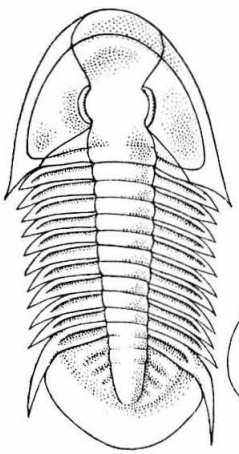
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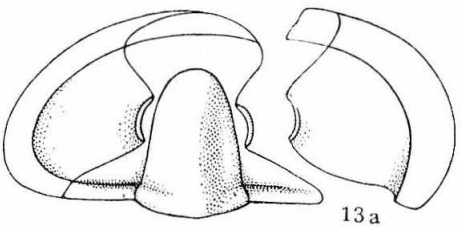
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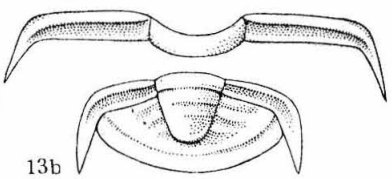
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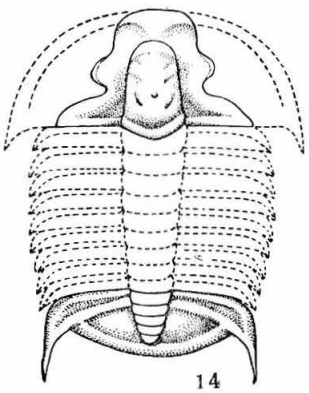
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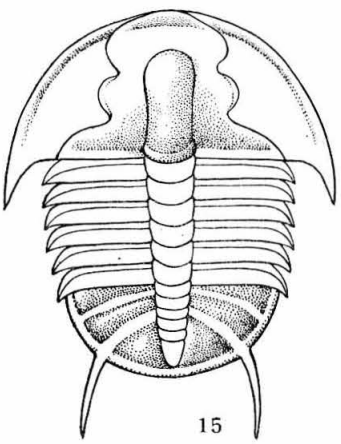
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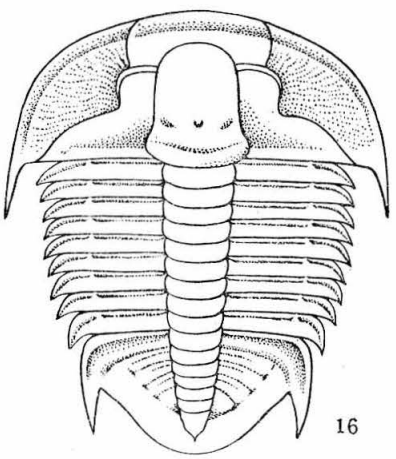
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Trans, Proc. Palaeont. Soc. Japan, N. S., No. 19, pp. 73-80, Pl. 12, 2 Text-figs. Sept. 20, 1955

271. ON SOME MOLLUSCAN FOSSILS FROM THE PALAEOGENE WAKKANABE FORMATION IN HOKKAIDO.*

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北海道古第三紀・若鍋層の化石：若鍋層は北海道の第三紀層中，もつとも古い海成層とみなされるものである。この地層からの化石はかつて長尾巧，大立目謙一郎によつてその一部が研究されたが発表されていない。今回は次の2種を取扱つた。*Crassatellites* (*E.*) *yabei* subsp. *yessoensis* NAGAO et OTATSUME, *Venericardia* (*C.*) *otatsumei* n. sp., *Venericardia* (*V.*) *subnipponica* NAGAO, *Claibornites* (*S.*) *quinquangulus* n. sp., *Spisula sorachiensis* OTATSUME (MS.), *Pitar* cfr. *matsumotoi* (NAGAO).

これらの化石はすべて若鍋層を特徴づける独自の化石群をなすと考えられる。　魚住悟

This paper presents some species of the molluscan fauna from the Wakkanabe formation which is a member of the Ishikari group and is thought to be the oldest marine sedimentary rock in the Tertiary of the Ishikari coal-field, Hokkaido.

The divisions of the very greatly disturbed Ishikari group have been established within these fifty years by many palaeontologists and stratigraphers, including H. YABE (1901), H. IMAI (1923, 1925), K. OTATSUME (1933), S. TASHIRO (1951), S. TAKAO (1952) and others.

They are schemed as follows, in descending order:

Ashibetsu coal formation
Upper *Corbicula* formation
Ikusyunbetsu coal formation (*Woodwardia* zone)
Lower *Corbicula* formation
Bibai coal formation
Wakkanabe formation
Yubari coal formation
Horokabetsu formation
Noborikawa coal formation

The lower half of the Ishikari group has been correlated by the late Prof. T. NAGAO (1935) to be Eocene, while the upper half (from the Wakkanabe to the Ashibetsu coal-bearing member) to be Oligocene in age.

Moreover, the Ishikari group has been commonly believed to be unconformably overlain by the Poronai group which was also supposed by T. NAGAO to be Oligo-Miocene in age.

Recently, H. YABE (1951) is, however, of the opinion, that the Ishikari group may be almost contemporaneous with the Poronai group, although the former is heterofacies in origin from the latter, viz., the Ishikari group which consists mostly of the sediments terrestrial in origin, may be alluvial deposits of that time when the Poronai group was being deposited in the "Poronai Sea".

That is to say, the so-called uncomformable relation between the Ishikari

* Read Mar. 22 1955, at the meeting of Hokkaido Branch, Geological Society of Japan, received June 13, 1955.

and Poronai groups being observable in many localities of the Ishikari coal-field, does not indicate an actual stratigraphical break in the sense of unconformity.

K. ASANO (1950) regarded YABE's view to be true and he assumed the lower half of the Poronai group to be quite equivalent with the Wakkanabe member on the basis of his studies of the foraminiferal remains derived from the Wakkanabe formation: such species as *Ammobaculites akabiraensis* is found coexisting into the Wakkanabe formation and the lower member of the Poronai group.

M. MINATO and others (1952), including the writer, also once stated their opinions as concerned with the stratigraphical position of the Poronai formation: the upper half of the Ishikari group may be contemporaneous with the lower half of the Poronai group in geological age, although it is quite uncertain whether the lower half of Ishikari group corresponds stratigraphically to the basal memder of the Poronai group or whether it does not.

Meanwhile, a molluscan fauna from the Wakkanabe formation, was studied for a period of many years age, by T. NAGAO, K. OTATSUME and T. INOUE, but unfortunately few of their results were published, except regarding some brackish species. Moreover, a few marine species were once treated by M. MINATO and S. KUMANO (1950), who have once treated *Crassatellites yabei* var. *yessoensis* and *Paphia munroei* YOKOYAMA. Among them, the latter is the species which M. YOKOYAMA has first described from the Shiraki formation, being a member of the so-called Paleogene Uryu group in the Uryu coal-field, which is situated immediately north-west of the Ishikari coal-field.

Now, the writer wishes in this paper to describe the following six species from Wakkanabe formation, of which two species are new to science.

Crassatellites (*Eucrassatella*) *yabei* subsp. *yessoensis* NAGAO et OTATSUME
Venericardia (*Cyclocardia*) *otatsumei* UOZUMI n. sp.
Venericardia (*Venericor*) *subnipponica* NAGAO
Claibornites (*Saxolucina*) *quinquangulus* UOZUMI n. sp.
Spisula sorachiensis OTATSUME (MS)
Pitar cfr. matsumotoi (NAGAO)

All these species above mentioned, as well as the marine species listed fomerly by T. NAGAO (1935) and described by T. INOUE (1941) and T. MIZUNO (1952) from the Wakkanabe formation, have never been found from the Poronai group until present day.

Furthermore, it is very remarkable that members of the species of Genus *Venericardia* from the Wakkanabe formation, are entirely different from the species which occur from the Poronai formation.

Such being the case, the differences between the Poronai and Wakkanabe faunas must be regarded to rather great, in spite of the close relationship claimed by ASANO to exist in the foraminiferal assemblage between those two formations.

It is an open question whether the different aspect of those two faunas as stated above, signifies to the fact that those two formations are heterofacies*)

* Judging from the present knowledge, the writer is now of the opinion that the seatemperature, suggested by the Wakkanabe fauna may be of warmer type than that suggested by the so-called Poronai fauna which contains such typical cold-water elements as Genus *Acila*, *Thyasira*, *Neptunea*, *Buccinum*, etc. Besids other environmental conditions of the two faunas might also be not wholly coincident with each other: the Wakkanabe formation consists of sandstone and shale, intercalating terrestrial sediments, while the Poronai formation consists of shale only being pure marine deposits.

in origin, although they are contemporaneous with each other, or whether it suggests really two different stratigraphical units. In this regard, further palaeontological and stratigraphical studies should be necessary.

Here the writer wishes to record his warmest thanks to Prof. M. MINATO of the Geological and Mineralogical Institute, University of Hokkaido for kindly looking over the manuscript. Thanks are also due to M. MATSUI, T. FUJIE, the Geological and Mineralogical Institute, University of Hokkaido, and K. OGASAWARA, a geologist of Sumitomo Coal-Mining Campany for offering some specimens.

Description of Fossils

Family Crassatellitidae

Genus *Crassatellites* KRUEGER 1823

Crassatellites (*Eucrassatella*) *yabei* subsp. *yessoensis*

NAGAO et OTATSUME

Pl. 12, Figs. 7 a—b.

1933. *Crassatellites yabei* var. *ezoensis* OTATSUME: *Graduation Thesis of Inst. Geol. Min. Hokkaido Imp. Univ.* (Manuscript).

1950. *Crassatellites yabei* var. *yessoensis* MINATO et KUMANO: *Shinseidai no Kenkyu* (*Study of the Cenozoic*), *No. 5*, p. 14, Pl. 7, figs. 47, 47a-b (in Japanese).

Shell large, thick, transverse elongate scalene, equivalve and very inequilateral; beaks about one-third~two-sevenths of the length of shell from the anterior end. Anterior dorsal margin slightly concave and sloping steeply downwards from the beaks at an angle of about 45°; anterior end broadly rounded and smoothly merges in the ventral margin which is even; posterior dorsal margin noticeably concave, sloping downwards from the beaks at an angle of 55° for about one-third of length of the anterior margin, and then nearly horizontally running to the posterior end where it is abruptly truncate; a very feeble ridge passes downwards on the surface from beaks to posterior end. Lunule narrow, cordate and very deeply impressed. Escutcheon long and narrow, not so deeply sunken as lunule with the exception of near the beaks. The surface of shell is ornamental with concentric incremental lines, which are more or less irregular; pallial line distinct; muscle scar well developed with anterior one larger than posterior one.

Dimensions (in mm):—

Reg. No.	Length	Height	Thickness
11370 (Holotype)	40.6	50.5	29.2
No. 10424	61.2	44.1	20.8
No. 4685	63.4	50.1	24.1

Occurrence:—Upper stream of the Katura-sawa, a western branch of the Sorachi-gawa, Akabira-machi, Sorachi-gun, Ishikari Prov. (Type locality); the Kazima-sawa, a branch of the Pankehorokaparo-gawa, Yubari-City, Ishikari Prov.; the Nishihara-zawa, Manji Coal-Mine, Sorachi-gun, Ishikari Prov.; the Tekkyo-sawa, Manji Coal-Mine, Sorachi-gun, Ishikari Prov.; the Shukuzurenosawa, Yubari-City, Ishikari Prov.; all in Hokkaido.

Repository:—U.H. Reg. No. 11370, 4684, 4685, 4687, 4689, 5675, 5684, 5911, 10424. (U.H.=Dept. Geol. Min. Fac. Sci. Hokkaido Univ., Sapporo)

Remarks:—This species, characterized by its very inequilateral form, is easily separable from all other species of this genus from the Japanese Tertiary deposits and Recent species previously reported, by the characteristics just mentioned. *Crassatellites yabei* (NAGAO, 1928, pp. 48–49, pl. 13, figs. 17–20, 23–28, pl. 3,

figs. 5, 6, 10–12, 23, 24) from the Ashiya group of Kyushu, is a species similar to the present one, but the whole surface, especially near the umbo of the former is decorated by distinct, narrow and regular concentric ribs, which are wholly lacking in the latter. Further the umbo of the Ashiya species is more prominent than that of present species.

This species resembles *Crassatellites dalli* (WEAVER 1916, p. 39, pl. 2, figs. 15–18) and *C. merriar* (WEAVER 1916, p. 36, pl. 1, figs. 7, 8) from Upper Eocene of Washington, North America, but it differs in the more unequilateral form and in having a proportionately low shell.

Family Carditidae

Genus *Venericardia* LAMARCK 1801

Venericardia (*Cyclocardia*) *otatsumei* UOZUMI n. sp.

Pl. 12, Fig. 2

Shell moderate in size, thick, higher than long; pear-like outline; posterior dorsal line, nearly straight; ventral margin very broadly rounded and slightly curved to the anterior end; posterior margin somewhat convex, steeply sloping downwards, joining the ventral margin, drawing a semi-circle; anterior margin moderately produced, tending to give the shell a pear-like outline; regularly rounded passing to ventral margin without any angles; the surface ornamentation consists of growth lines somewhat crowd near the ventral margin, and 15 radial ribs, with wider interspaces than the width of the ribs; radial ribs are sharply rounded on the umbone from nearly middle of shell and flatly rounded near the ventral margin; on the posterior dorsal region, the ribs become narrower and crowded; on the anterior region the ribs are wider and distinct, and mark a slight arc to the produced anterior end. Lunule small and distinct. Hinge unknown.

Dimensions (in mm):—

Reg. No.	Length	Height	Thickness
11366 (Holotype)	26.1	25.0	14.0
No. 10341	31.0	32.2	?

Occurrence:—The Kanegazawa, a branch of the Yubari-gawa, Shimizusawa, Yubari-City, Ishikari Prov. (Type locality); the Nakano-sawa, a branch of the Sorachi-gawa, Sorachi-gun, Ishikari Prov.

Repository:—U. H. Reg. No. 11366, 10341.

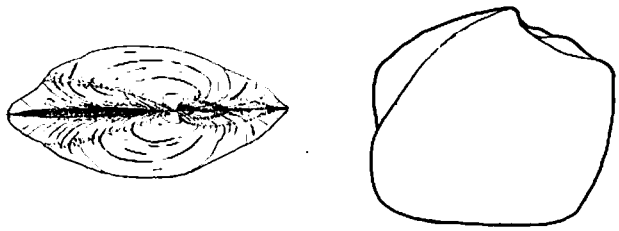
Remarks:—This species is easily distinguished from *Venericardia mandaica* (YOKOYAMA, 1911, p. 9, pl. 13, figs. 8–13) in having no nodes on the ribs, in having a less number of ribs and in the produced anterior end. *V. honnai* (TEGLAND, 1933, p. 113, pl. 7, figs. 3–9) somewhat resembles this species in outline, but the former has more numerous prominent ribs with interspaces narrower than width of ribs.

Venericardia (*Venericor*) *subnipponica* NAGAO

1928. *Venericardia subnipponica* NAGAO: *Sci. Rep. Tohoku Imp. Univ. 2nd Ser., Vol. 12, No. 1*, p. 55, pl. 13, figs. 9, 14, pl. 14, figs. 1–29.

This species was first described by T. NAGAO with a number of illustrations from the Ashiya group in Kyushu, Japan. Judging from his description and figures, the species may show a wide variation, especially in form and size.

However, the specimens from the Wakkanabe formation show rather definite form; they are always small in size and high in comparison to the length; they



Text-Fig. B. Sketch showing the outline and dorsal view of *Claibornites quinquangulus*.

are almost identical with the forms figured by T. NAGAO in his pl. 14, figs. 20–22, and 29.

Dimensions (in mm):—

Length	Height	Thickness
23.0	24.1	16.3

Occurrence:—Shimizusawa, Yubari-City, Ishikari Prov.; the Nakano-sawa, a branch of the Sorachi-gawa, Sorachi-gun, Ishikari Prov.

Family Lucinidae

Genus *Claibornites* STEWART 1930

Claibornites (*Saxolucina*) *quinquangulus* UOZUMI n. sp.

Pl. 12, Figs. 6 a-b

Shell large, thick, equilateral, pentagonal in outline; beaks situated near the middle of shell, strongly inturned; anterior dorsal margin slopes gently, with three slight waves as shown in Text-Figure B, otherwise being generally straight; anterior end truncate in this case both angles about 105° and edge between the two angles straight or nearly so; posterior dorsal gently slopes, straight to slightly convex; posterior end steeply truncate forming angles of about 90° with the ventral margin. Both sides of shell are depressed; anterior depression is wider and feebler than posterior one, posterior one obscurely angulated along the shallow sulcus running from beaks to ventral posterior corner, its angulation being more distinct on the lower half of the shell. Lunule elongate lanceolate, deeply depressed and situated along the entire length of the anterior dorsal edge; lunular area is constituted of three parts which differ in the rate of depression, becoming deep toward the umbo as shown in Text-Figure B.

Ligament very long, its length is nearly equal to the length of posterior dorsal margin and deeply sunken. Surface sculptured by numerous narrow lamellae and the interspace between lamellae covered by fine irregular lines of growth. Hinge with two cardinals; posterior one more strong the anterior one, divaricate by shallow groove; hinge plate rather wide and heavy as shown in Text-Figure A.

Text-Fig. A. Sketch showing the hinge of *Claibornites quinquangulus*.

Dimensions (in mm):—

Reg. No. 11363 (Holotype)	Length	Height	Thickness
	57.2	52.5	27.0
No. 11286	55.1	46.0	24.6
No. 11287	43.0	38.5	21.6

Occurrence:—The upper-stream of the Katsurasawa, a branch of the Sorachi-

gawa, Akabira-Machi, Sorachi-gun, Ishikari Prov. (Type locality); the fourth pit, Akabira-Mine of Coal-Mining Co. Ltd.; Utasinai-Machi, Sorachi-gun, Ishikari Prov. (unknown in detail).

Repository:—U. H. Reg. No. 11286, 11287, 11363.

Remarks:—This species which is characterized by its angulated form, deep lunule and escutcheon, belongs to the group of *Lucina hodenacensis* (DESHAYES, 1860, p. 650, pl. 40, figs. 11–14), and *Lucina proxina* (DESHAYES, 1860, p. 649, pl. 41, figs. 1–3), from the Eocene of France.

The Hokkaido form has, however, a more angulated form than the foreign specimens. It is, moreover, distinguished from the first of the latter, by its more distinct posterior depression area, and from the second by its more equilateral shell.

Lucina diegoensis (DICKERSON, 1916, p. 484, pl. 37, figs. 1 a–b) from the Tejon Eocene of California is somewhat like the present species in some features of lunule and escutcheon, but the form is more rounded as to the shell.

Family Mactridae

Genus *Spisula* GRAY 1837

Spisula sorachiensis OTATSUME (MS)

Pl. 12, Figs. 3, 5

1933. *Spisula sorachiensis* OTATSUME; *Graduation Thesis of Inst. Geol. Min. Hokkaido Imp. Univ.* (Manuscript).

Shell moderately large, trigonal, equivalve, nearly equilateral, flattened; sculptured by indistinct incremental lines of growth; beaks strongly incurved and acutely pointed. Posterior dorsal margin somewhat convex; anterior one slightly concave; anterior end, more or less produced and more sharply pointed than the posterior; ventral margin very broadly rounded; escutcheon impressed and broad. Posterior dorsal area limited by a feeble blunt ridge which extends from the umbo to the posterior extremity. Hinge plate rather wide, lateral tooth well developed at both sides; posterior one slightly longer than anterior. Pallial sinus deep, finger-like form at its end and its dorsal line horizontal.

Dimensions (in mm):

	Length	Height	Thickness
Reg. No. 11365	68.3	53.3	23.2
11364	60.0	49.0	13.1

Occurrence:—The Naie Coal-Mine, Mitsui Coal-Mining Co. Ltd., Sorachi-gun, Ishikari Prov. (Type locality); the Nakanosawa, a branch of the Sorachi-gawa, Sorachi-gun, Ishikari Prov.; the Obirasibe-gawa, Uryu-gun, Teshio Prov.; the Ponkemaya-gawa, Yubari-City, Ishikari Prov.

Repository:—U. H. Reg. No. 5898, 5910, 10024, 10375, 10376, 10379, 11365, 11364.

Remarks:—This species closely resembles *Spisula weaveri* (PACKERD, 1916, p. 313, pl. 27, fig. 9) California Eocene species, but is distinguished from it by being longer in proportion to height than the Wakkanabe form. Also the species bears a close resemblance to *S. polynyma nagakoensis* (HATAI et NISHIYAMA, 1949, p. 92, pl. 25, fig. 18), but may be distinguished from that species by its more transversal form and smoothly rounded posterior dorsal border.

Family Veneridae

Genus *Pitar* RÖMER 1857

Pitar cfr. matsumotoi (NAGAO)

Pl. 12, Figs. 1, 1 a–b, 4

1928. *Pitaria matsumotoi* NAGAO: *Rep. Sci. Tohoku Imp. Univ. 2nd. Ser. Vol. 12, No. 1*, p. 73, pl. 11, fig. 17, pl. 13, figs. 4-6.

The speciemens at hand are similar in outline to *P. matsumotoi* NAGAO, described from the Ashiya group, but appear to differ in the prominent pallial sinus, and in more rounded ventral margin.

Further, the hinge structure of *P. matsumotoi* has not been known and accordingly the two cannot be compared with each other in this respect. For those reasons, further investigation is needed before it can be stated whether the present specimens are firmly conspecific with Ashiya species.

Dimensions (in mm) :—

	Length	Height	Thickness
Reg. No. 11367	61.1	56.7	30.5
No. 11368	45.2	36.6	?
No. 5925	50.0	42.1	28.6

Occurrence :—Mayachi, Yubari-City, Ishikari Prov.; the Pankemaya-gawa, Yubari-City, Ishikari Prov.; the Pirautorunai-sawa, Shimokinebetsu, Obirashibe, Uryu-gun, Teshio Prov.

Repository :—U. H. Reg. No. 11367, 11368, 5925.

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Explanation of Plate 12

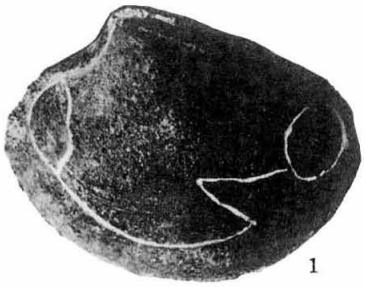
Figs. 1, 1 a-b, 4. *Pitar cfr. matsumotoi* (NAGAO): U. H. Reg. No. 11367, 11368. 1: Internal view of left valve; 1 a-b: hinge of left and right valve; 4: side view of left valve.

Fig. 2. *Venericardia (Cyclocardia) otatsumei* UOZUMI: U. H. Reg. No. 11366, Side view of left valve.

Figs. 3, 5. *Spisula sorachiensis* OTATSUME (MS.): U. H. Reg. No. 11364, 11365, Side view of left valve.

Figs. 6 a-b. *Claibornites (Saxolucina) quinquangulus* UOZUMI: U. H. Reg. No. 11363. a: Side view of left valve; b: dorsal view of same.

Figs. 7 a-b. *Crassatellites (Eucrassatella) yabei* subsp. *yessoensis* NAGAO et OTATSUME: U. H. Reg. No. 11370. a: Side view of right valve; b: dorsal view of same.



1

2

3

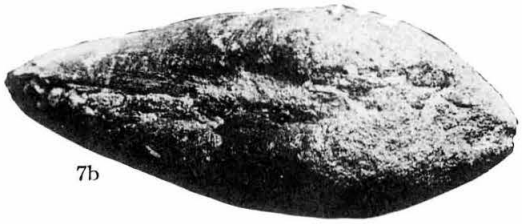
1a

6b

6a

1b

4



7b

5

7a

S. Kumano photo.

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 19, pp. 81-84, Pl. 13, Sept. 20, 1955

272. ON SOME MIOCENE SPECIES OF *DOSINIA* FROM JAPAN*

SABURO KANNO

Tokyo University of Education

本邦第三紀中新世産 *Dosinia* について：筆者は第三紀中新世の介化石を研究中，たまたま *Dosinia* の新型を発見し，また本邦の中新世に特徴的な *Dosinia* (*Kaneharaia*) *kaneharai* YOKOYAMA について若干の新知見を得たのでこれらを報告する。　　菅野三郎

Introduction

The purpose of this paper is to describe two new forms of *Dosinia* from the Miocene deposits of Saitama and Miyagi Prefectures and to give remarks on the well known *Dosinia* (*Kaneharaia*) *kaneharai* YOKOYAMA.

The writer wishes to thank Professors Haruyoshi FUJIMOTO and Kotora HATAI of the Geological and Mineralogical Institute, Tokyo University of Education for their encouragement.

Description of Species

Family Veneridae

Genus *Dosinia* SCOPOLI, 1777

Dosinia ovata KANNO, n. sp.

Plate 13, Figures 6a-c

Shell moderate in size, compressed, obliquely subovate in outline, very inequilateral; test rather thin; beaks pointed, weak, turned-in, not touching each other, directed anteriorly; lateral margins rounded, the anterior broader than the posterior; dorsal margin sloping, slightly convex behind beak. Lunule deep, cordate in outline, bounded behind by a distinct ridge, longitudinally and finely striate within and 8.3 mm in length, 3.35 mm in width measured on right valve (type); escutcheon apparently linear. Surface marked by rather fine, close-set, regularly disposed concentric grooves separated by slightly wider interspaces (about 20 per 10 mm). Pallial sinus large and rather deep, extending forward nearly to the middle of the valve, its end obtusely pointed. Hinge plate rather narrow and its inner margin gently concave; right valve with three cardinals, the posterior bifid, the anterior short, thin and close to the medial.

Dimensions (in mm):—56.3 in length, 48.2 in height and 13.7 in the thickness of right valve (type), 45.2 in length, 35.7 in height and 11.5 in thickness of the another right valve (paratype).

Remarks:—Related to *Dosinia angulosa* (PHILIPPI) (1847, p. 229, pl. 6, fig. 1), *D. anguloides* NOMURA (1935c, p. 216, pl. 17, fig. 2) and *D. odosensis* NOMURA (1935b, p. 59, pl. 7, fig. 2), this species can be distinguished therefrom by the more anteriorly placed pointed beak, more

* Read June 18, 1955; received June 18, 1955.

oblique shell outline and shallower pallial sinus so far as is known of those species.

Locality and geological formation:—River side cliff about 70 meters below the bridge of Harakawa, Takezawa-mura, Hiki-gun, Saitama Prefecture. Iida formation of the Ogawamachi group, Miocene. Tokyo University of Education, Reg. No. 5900.

Associated fauna:—*Ostrea gravitesta* YOKOYAMA, *Dosinia akaisiana* NOMURA, *Callista sinensis* (HOLTON), *C. brevisiphonata* (CARPENTER), *Siliqua pulchella* (DUNKER).

Dosinia (*Kaneharaia*) *kaneharai* YOKOYAMA, 1926

Plate 13, Figures 7a-b

1926 *Dosinia kaneharai* YOKOYAMA, *Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 1, pt. 4*, p. 133, pl. 17, figs. 1-5; pl. 18, fig. 2.

1935 *Dosinia kaneharai* NOMURA, *Saito Ho-on Kai Mus. Res. Bull., no. 5*. p. 83, pl. 3, figs. 6-8.

1936 *Dosinia* (*Kaneharaia*) *kaneharai* MAKIYAMA, *Mem. Coll. Sci., Kyoto Imp. Univ., ser. B, vol. 11, no. 4, art. 8*, pp. 213-214.

Remarks:—That this species shows considerable variation in its shell outline has already stated by S. NOMURA (1935a, p. 84). Its surface sculpture is characterized by having strong, concentric cords with narrower furrows, which upon growth or in gerontic individuals become more crowded at the margins. These mentioned features seem to be a constant one.

The pallial sinus of this specimens ascends obliquely to the middle part of the shell rather acutely and its apex is narrow. In *D. kancharai ouchiensis* and in *D. ovata* the shape of the sinus is rather different.

Although *Dosinia kaneharai* is a characteristic Miocene species, its absolute range has not yet been determined.

Locality and geological formation:—Road cliff at Nishigoto, Tsunetoyo-mura, Higashi-Shirakawa-gun, Fukushima Prefecture. Tanagura formation, Miocene. Tokyo University of Education, Reg. No. 16704.

Associated fauna:—*Ostrea gravitesta* YOKOYAMA, *Chlamys kaneharai* YOKOYAMA, *Fellaniella usta* (GOULD), *Dosinia odosensis* NOMURA, *Cyclina sinensis* (GMELIN), *Cultellus izumoensis* YOKOYAMA, *Panope japonica* (A. ADAMS), *Sinum yabei* OTUKA, etc.

Dosinia (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp.

Plate 13, Figures 1-5

Shell large in size, compressed, elongate ovate in outline, much higher than long, inequilateral; test heavy; beaks prominent, turned-in not touching, directed anteriorly; lateral margins rounded, dorsal margin forming uniform convex curve behind beak, but becoming rather straight to the end of the lunule in front; ventral margin long and sloping, evenly convex. Lunule rather deep, elongate cordate in outline, bounded behind by an indistinct ridge, longitudinally and finely striate within, and 18.5 mm in length, 5.7 mm in width. Surface with flat concentric cords (about 6 per 10 mm in adult) separated by narrower grooves, the marginal area provided with rather fine concentric lines of growth. Pallial sinus rather shallow, obliquely ascending, bluntly pointed at end. Hinge plate very broad, with a flat area in each valve behind the teeth. Cardinals and laterals well developed. Muscular impression strong.

Dimensions (in mm):—

No.	Length	Height	Thickness	$\frac{H}{L}$	$\frac{T}{L}$	
1.	62.2	71.4	20.8	114.8	33.4	Holotype Right valve
2.	64.2	79.8	22.6	124.2	34.6	Paratype 〃 〃
3.	24.3	26.3	——	108.6	——	〃 〃 〃

Remarks:—The heavy test and strong concentric sculpture of the present specimens resemble the well known Miocene *Dosinia kaneharai* YOKOYAMA (1925, p. 132, pl. 17, figs. 1–5; pl. 18, fig. 2), but the more pointed beak, smaller pallial sinus and higher shell serve to distinguish it therefrom. *Dosinia sibataensis* NOMURA and ONISI (1940, p. 183, pl. 18, fig. 1) from the Miocene of the Sennan district in Miyagi Prefecture is another related species, but it can be distinguished from the present one by the thinner test, more triangular shell outline and fine concentric growth lines.

Locality and geological formation:—Valley cliff about 150 meters in the upstream of the Tamagawa reservoir, Minami-ide, Ouchi-mura, Igu-gun, Miyagi Prefecture. Middle fossil zone of the Yoshigasawa formation of the Kaneyama group, Miocene. Tokyo University of Education, Reg. No. 5899.

Associated fauna:—*Laevicardium shiobaraense* (YOKOYAMA), *Chione y-iizukai* (KANEHARA), *C. osyuensis* NOMURA, and ZINBO, *Glycymeris* sp.

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Explanation of Plate 13

(All figures in natural size)

Figs. 1a-c. *Dosinia* (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp., (Holotype). a. Right valve, b. anterior side view of the same, c. hinge plate and teeth of the same.

Fig. 2. *Dosinia* (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp. Left valve, hinge plate and teeth.

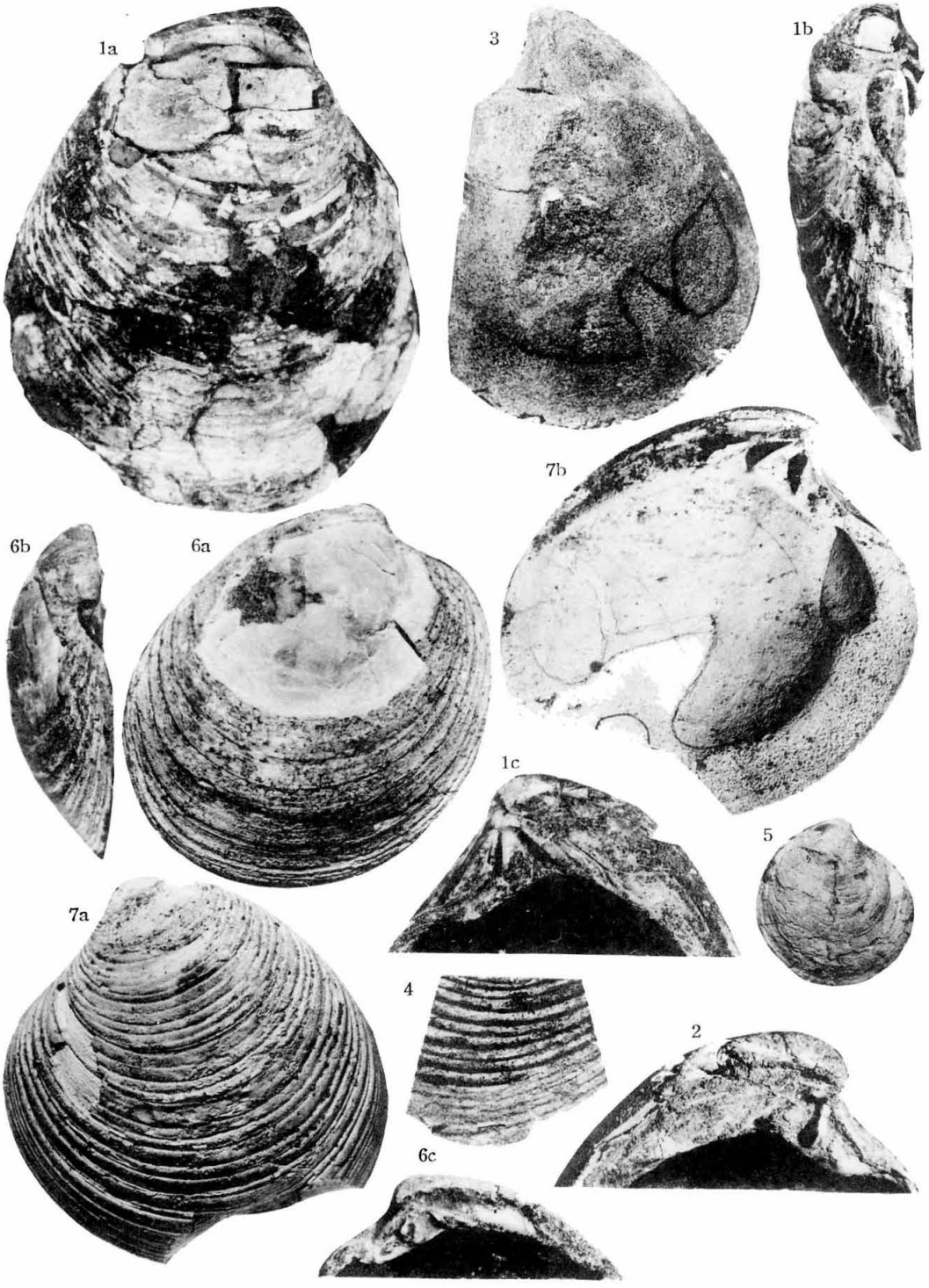
Fig. 3. *Dosinia* (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp. A mould of left valve showing the pallial sinus and muscular impression.

Fig. 4. Surface sculpture of *Dosinia* (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp.

Fig. 5. *Dosinia* (*Kaneharaia*) *kaneharai ouchiensis* KANNO, n. subsp.

Figs. 6a-c. *Dosinia ovata* KANNO, n. sp., (Holotype). a. Right valve, b. anterior side view of the same, c. hinge plate and teeth of the same.

Figs. 7a-b. *Dosinia* (*Kaneharaia*) *kaneharai* YOKOYAMA. a. left valve, b. inner surface of the same.



S. AOKI Photo.

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 19, pp. 85-87, 2 Text-figs., Sept. 20, 1955

273. A FOSSIL PALM TRUNK FROM KANAZAWA*

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さきに金沢兼六園にある竹根石を調査し，これをヤシ類の幹と根の化石であることを組織学上から鑑定して *Palmoxylon Maedae* と名付けた。この化石の由来に外来説があるが確かな根拠がなく，筆者はむしろ内地産と考えていた。果せるかな，金沢の浅野川の河床から新しい *Palmoxylon* の破片が発見せられたが，この新化石は組織学的に *P. Maedae* に非常に似ているが別種であるので，これを *P. kagaense* と命名する。恐らく浅野川上流の緑色凝灰岩（中新世）に含まれたものが流れて来たものであろう。昭和 28 年 8 月常盤園下の砂礫中から泉頭純君の採集したもの。　　小　倉　　謙

A few years ago, the writer studied the internal structure of a fossil in Kenroku Park at Kanazawa, which has been called usually as "Take-ne-ishi", and described it as a new palm, *Palmoxylon Maedae* (1952)[1]. It was mostly regret that the locality of this fossil was uncertain. It was said, that it has been transported from an uncertain southern country, though there was no certainty, but the writer suggested that the fossil might be found in Japan. The recent finding of another specimen of *Palmoxylon*, very similar to *P. Maedae*, from Kanazawa seems to support the suggestion of the writer.

Material

The new material is a small fragment of a palm trunk, about 3×5 cm in breadth and 10 cm in length. On the surface numerous longitudinal striations are to be seen. It is mostly brownish black, very hard, and the polished surface is lustrous.

This fragment was found in 1953 among the grains of River Asano at Kanazawa, and it might be supposed that this was transported here from the upper stream of the river, where green tuff of the Miocene age, in which numerous silicified woods have been found, is widely distributed. The writer expected to be found other materials from this district, but it was at present in vain, so that this manuscript will be published, though the material is still incomplete.

Internal Structure

The preservation of this fossil is pretty fine, and it is nearly enough to observe its anatomical structure.

In cross section dark brown masses distributing densely throughout are very distinct (Figs. 1, 2). They are fibrous sheaths accompanying the small vascular bundles, while the fundamental tissue is

* Contributions from the Botanical Institute, Faculty of Science, University of Tokyo, N. S. No. 67.

Read June 18; received May 19, 1955.

1) A fossil palm in Kenroku Park at Kanazawa. *Trans. Proc. Palaeont. Soc. Japan, N.S., No. 8.* 1952. Cfr. further literatures cited here.

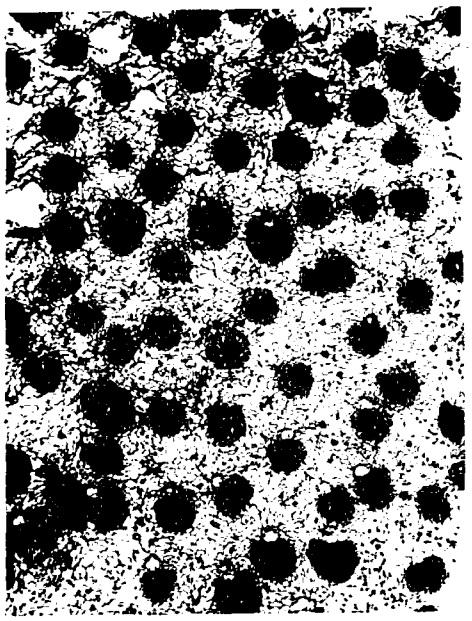

Fig. 1. Cross section of a part of the fossil, showing the arrangement of vascular bundles accompanying fibrous sheaths and small fibrous strands. ×8

Fig. 2. One part of Fig. 1 enlarged. ×35

pale brownish. The size or form of fibrous sheaths and bundles is not constant; they are distributed about 110 within 100 mm² in average. They are circular or elliptical, 0.6–0.9 mm in diameter, and on one side of each of them is a slight indentation, in which vascular bundle is situated.

The vascular bundle is much smaller than the fibrous sheath, and in the smaller one it is embedded in the indentation of the sheath, but in the larger one it is somewhat bulges out of the sheath. Though the smaller vessels constructing protoxylem and the surrounding cells are slightly thick-walled and well preserved, and they are distinguished from the fundamental tissue, the larger vessels and the phloem are almost badly preserved, representing by empty cavities.

The fibrous sheath consists of thick-walled fibers, whose preservation is pretty well.

The fundamental tissue is also well preserved and is characterized by a rich porosity. In cross section the cells are cylindrical and communicate with each other to form large cavities. The cavities are nearly polygonal, and those near the bundles are smaller. The walls of these cells are always thin.

Within the fundamental tissue are found small fibrous strands, which accompany no vascular bundles. Each of them consists of few (10–20) fibers, similar to the bundle sheath, and as they have thick-walled and dark-brown colour, their presence is distinct. On the periphery of each strand is present a row of short, thin-walled cells, the so-called stegmata, though their distribution is

rather few.

Affinity

As the writer described in the previous paper on the method of the classification of *Palmoxylon*, it will not be repeated here on it.

The characteristics described above show clearly that this fossil must be a fragment of the trunk of a *Palmoxylon*. In order to know the exact features of *Palmoxylon*, it will be necessary to compare the distribution and the construction of the vascular bundles on the peripheral part and the central part of the trunk. In the present fragment this comparison was impossible, but owing to the compact distribution and the small size of the vascular bundles, it may be supposed to be the peripheral part of the trunk.

The characteristics of this fossil are as follows:

1) Fibrous sheath is much larger than the vascular bundle, and there is a small indentation on one side, in which a small bundle is situated, so that the sheath shows the Cordate type.

2) The fundamental tissue includes large intercellular spaces and is very porous.

3) In the fundamental tissue fibrous strands are included, and on their periphery are found stegmata consisting of small cells.

These characteristics, especially the porosity of the fundamental tissue, resemble very closely to *Palmoxylon Maedae*, formerly described, but in the smaller size and the closer distribution of the vascular bundles this specimen is different from *P. Maedae*. The present species is, therefore, very similar, but is quite different from *P. Maedae*, and may be an undescribed species belonging to the Cordate group of STENZEL.

Description

Palmoxylon kagaense sp. nov.

A part of a fossil trunk showing *Palmoxylon* type. Vascular bundles accompanying fibrous sheaths scattered throughout densely. Fibrous sheath large, cordate; vascular bundle small, situated at the indentation of the sheath. Phloem usually uncertainly preserved. Xylem consists of mostly of small vessels; large vessels rarely preserved. Fundamental tissue very porous, including large intercellular spaces, surrounded by a single row of parenchyma. Fibrous strands scattered in fundamental tissue, small; stegmata situating at periphery.

Locality: River Asano, Kanazawa, Province Kaga. Collected in 1953. Horizon, probably Miocene.

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