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279. A NEW FOSSIL *CHLAMYS* FROM THE ENVIRONS OF UTSUNOMIYA CITY, JAPAN

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and

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宇都宮市周辺より *Chlamys* 属の一新種：宇都宮市の北縁，栃木県河内郡田原村新谷の中新統から *Chlamys* の新種を記載し，*hataii* と命名した。また宮城県遠田郡涌谷町追戸の追戸層から，*hataii* と同様な模様をした標本を採集したが，宇都宮産のものとくらべて，殻が非常に小型であるので，*hataii* に同定すべきかどうかは将来に残されている問題である。 増田孝一郎・阿久津純

Introduction and Acknowledgements

During his geological studies in the northern border of Utsunomiya City, Tochigi Prefecture, the junior writer collected several interesting fossil scallops in association with other molluscan shells from a tuffaceous sandstone at Niiya, Tawara-mura, Kawachi-gun, Tochigi Prefecture. Of those scallops, the one herein described as new to science also occurs among the collection of fossil scallops obtained by the senior writer from a medium- to coarse- grained sandstone of the Oido formation at Oido, Wakuya-machi, Tôda-gun, Miyagi Prefecture.

As the result of comparative study of these geographically remote specimens it was found that they represent a new species to which the present article is devoted.

Acknowledgements are due to Dr. Kotora HATAI of the Department of Geology, College of Education, Tohoku University, for kindly supervising the present work.

* Read Oct. 9, 1954; received July 20, 1955.

Geological Notes

The stratigraphy of the Tertiary strata developed in the northern border of Utsunomiya City, was classified into the following formations by the junior writer, from upper to lower;

Ôzo formation:—Consisting of light gray, tuffaceous, fine grained sandstone and siltstone with nodules, in which lenticular conglomerate is intercalated. Mollusca, Foraminifera and Echinoidea are abundant.

Yamamoto formation:—Consisting of yellowish brown, tuffaceous coarse-grained sandstone, in which is intercalated hard sandstone, tuff breccia, tuffaceous conglomeratic sandstone and massive tuffaceous siltstone.

Molluscan shells and shark's teeth occur.

Nagaoka formation:—Consisting of light gray, massive pumiceous tuff. In the northern part of the area the pumiceous tuff laterally changes into brecciated tuff in which is intercalated pebbly conglomerate and tuffaceous coarse-grained sandstone. Molluscan shells occur in the sandstone.

Yokoyama formation:—Consisting of massive pumiceous tuff, brecciated tuff and an alternation of tuffaceous sandstone and siltstone.

Ôya formation:—Consisting of basal conglomerate, massive pumiceous tuff, brecciated tuff and pumiceous fine-grained tuff, and intercalating and alternation of tuffaceous sandstone and siltstone with some molluscan shells. Kazamiyama andesite (two pyroxene-andesite) interfingers with the lower part of this formation.

(unconformity)

Kogashi older rocks:—Consisting of slate, sandstone, chert and quartz-porphyry.

The fossil scallop described in this article was collected from the Nagaoka formation in association with such molluscan shells as *Acila* sp., *Mytilus gigantius* HOLMBERG, *Cryptopecten yanagawaensis* (NOMURA and ZINBO), *Chlamys* cf. *nisataiensis* OTUKA, *Cardium* n. sp., *Cardium* sp., *Trachycardium shiobaraense* (YOKOYAMA), *Dosinia anguloides* NOMURA, and *Nautilus* sp.

Studies on the stratigraphy of this area are being continued by the junior writer, and the details will be published by him at another opportunity.

Description

Family Pectinidae

Subfamily Pectininae

Genus *Chlamys* (BOLTEN) RÖDING, 1798

Chlamys hataii MASUDA and AKUTSU, n.sp.

Pl. 20, figs. 1-6.

Shell moderate in size, rather thick, moderately inflated, orbicular, equilateral except for auricles; valves radiately ribbed; pointed at top, forming an angle of about 90°.

Right valve with about 20 elevated, squarish, round-topped, smooth radial ribs and fine intercalary threads; radial ribs wider than interspaces on the upper half of disc and tend to become subequal in breadth near the ventral margin, usually they bifurcate at about middle part of disc, and become a little imbricated at lower half; intercalary threads usually appear at upper half of disc, and are a little imbricated near margin; anterior auricle larger than posterior, furnished with deep byssal notch and more or less wide byssal area, and imbricately ornamented with several radial threads and concentric lines; posterior with a greater number of radial threads than anterior. Left valve nearly equally convex or very slightly more convex than the right and with sculpture similar to that of the right, though the radial threads are less imbricated than the right. Hinge of right valve with ctenolium, distinct cardinal crura and rather deep resilial pit provided with lateral ridges which have straight borders, acutely pointed apically, and rapid-

ly widening vertically. Internal surface nearly smooth, except for characteristic marginal serration.

Dimensions (in mm.):—

Valve	Right*	Right	Right	Left	Left	Left
Height	54.2	55.0	34.2	65.0	60.0	38.4
Length	50.0	52.0	33.4	57.5	—	36.3
Hinge-length	26.0	28.8	20.0	30.0	33.0	21.5
Depth	10.7	—	7.4	18.3	13.0	9.6
Apical angle	90°	90°	95°	90°	90°	90°

* Holotype specimen.

Type locality and geological horizon:—Niiya, Tawara-mura, Kawachi-gun, Tochigi Prefecture (lat. 36°37′ 39″ N., long. 139° 54′ 06″ E.). Nagaoka formation. Miocene (Early).

Depository:—Department of Geology, College of Education, Tohoku University, Sendai, Japan. Reg. No. 1370 (Holotype).

Remarks:—This species is named in honor of Dr. Kotora HATAI of the Tohoku University.

This species is characterized by having about 20 elevated, squarish, round-topped, smooth radial ribs, which are wider than the interspaces in breadth at the upper half of disc, a little imbricated with bi- or tri- or very rarely quadrifurcated radial ribs at lower half of disc, slightly imbricated, fine intercalary threads, deep byssal notch, distinct cardinal crura, conspicuous lateral ridges of resilial pit, and characteristic marginal serration in the right valve. The left valve is characterized by having the sculpture similar to that of the right valve.

Although the specimens collected from the Miocene Oido formation at Oido, Wakuya-machi, Tôda-gun, Miyagi Prefecture, are much smaller than the type specimens, with obtuse network and usually smaller proportion of shell height to hinge-length, their external sculpture are similar to *hataii* (Figs. 7–9). So, it is open to question whether those specimens can be identified with the type specimens of *hataii*. Further material are necessary to settle this problem.

This species is closely related to *Pecten insolitus* YOKOYAMA (YOKOYAMA, 1925, p. 18, pl. 5, fig. 3) by having a small shell, about 20 subequal, broad and squarish radial ribs, and an intercalary thread in their interspaces. YOKOYAMA's species was based upon a single right valve, which is said to have been collected from the Shigarami formation at Shimosoyama, Shigarami-mura, Kami-Minochi-gun, Nagano Prefecture. But YOKOYAMA's species differs from the present one by the smaller shell, undivided radial ribs, and hardly developed byssal notch. *Chlamys meisensis* (MAKIYAMA) (MAKIYAMA, 1926, p. 156, pl. 13, fig. 4) from the Miocene Bankôdô formation of Korea, is another related species, but it differs from the present specimens by the more inflated left valve and a greater number of radial ribs (23 to 27). *Chlamys akitana* (YOKOYAMA) and *Chlamys nisataiensis* OTUKA (MASUDA, 1954, pp. 111–116, pl. 12, figs. 1–17) also resemble the present species, but they can be distinguished from *hataii* by the greater number of radial ribs (23 to 25), rare occurrence of intercalary thread in the right valve in *akitana*, and the rather compressed shell, greater number of (25 to 32) and less elevated radial ribs in *nisataiensis*. *Chlamys jordani* (ARNOLD) (ARNOLD, 1906, p. 114, pl. 44, figs. 1, 1a–b) described from the Pliocene and Pleistocene formations of California also resembles this species, but it is distinguishable from the present new species, by the greater number of radial ribs (23 to 25), absence of intercalary threads in the right valve, lack of bifurcation of the radial ribs of the left valve.

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Explanation of Plate 20

Figs. 1a-b. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Holotype, Reg. No. 1370.
a, Right valve, ×1.
b, Hinge area of 1a, × 1. Loc. Niiya, Tawara-mura, Kawachi-gun, Tochigi Prefecture.

Fig. 2. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Paratype, Reg. No. 1367. Right valve, × 1. Loc. Same as above.

Fig. 3. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Paratype, Reg. No. 1368. Right valve, × 1.

Figs. 4a-b. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Paratype, Reg. No. 1376.
a, Right valve, × 1.
b, Internal view of 4a, × 1. Loc. Same as above.

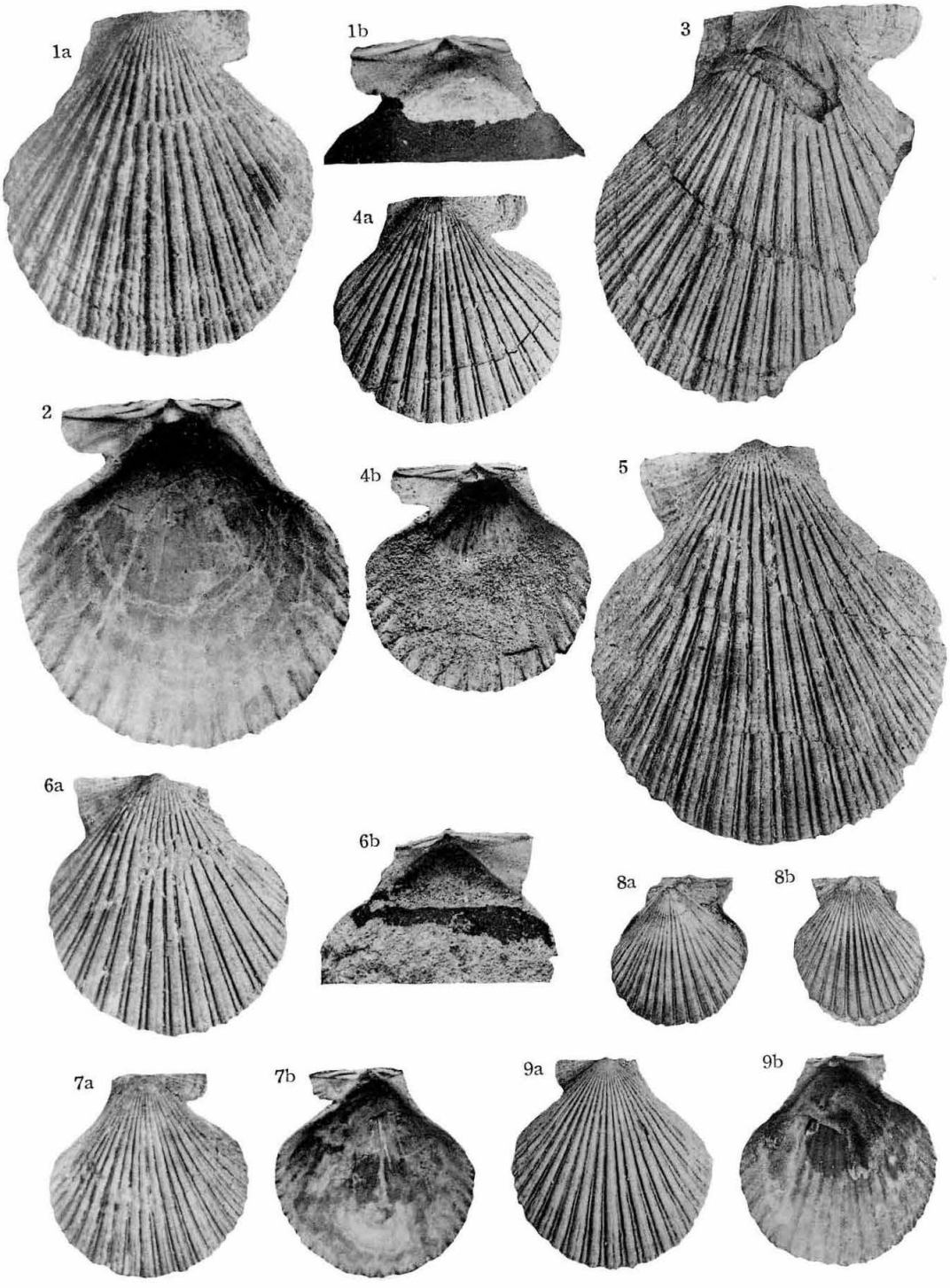
Fig. 5. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Paratype, Reg. No. 1368. Left valve, × 1. Loc. Same as above.

Figs. 6a-b. *Chlamys hataii* MASUDA and AKUTSU, n. sp. Paratype, Reg. No. 1376.
a, Left valve, × 1.
b, Hinge area of 6a, × 1. Loc. Same as above.

Figs. 7a-b. *Chlamys* cf. *hataii* MASUDA and AKUTSU, Reg. No. 2616.
a, Right valve, × 1.
b, Internal view of 7a, × 1. Loc. Oido, Wakuya-machi, Tôda-gun, Miyagi Prefecture.

Figs. 8a-b. *Chlamys* cf. *hataii* MASUDA and AKUTSU, Reg. No. 1378.
a, Right valve, × 1.
b, Internal view of 8a, × 1. Loc. Same as above.

Figs. 9a-b. *Chlamys* cf. *hataii* MASUDA and AKUTSU, Reg. No. 2616.
a, Right valve, × 1.
b, Left valve, × 1. Loc. Same as above.



K. KUMAGAI photo

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 21, pp. 133-139, Pls. 21-22, 2 text-figs., Apr. 15, 1956

280. ELECTRON-MICROSCOPIC FINE STRUCTURE OF FOSSIL DIATOMS. IV*

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Kyoto University of Textile Fibers

化石珪藻の電子顕微鏡的微細構造. IV: *Stephanodiscus niagarae* (岡山県八東村産), *Navicula hasta* (熊本県西瀬村産), *N. maculata* 及びその 3 新変種 varr. *acuta, inflata, gigantea* (米国エスマーラルダ産) につき, また *Cymbella mexicana* (米国テレボンネ産) 及び, これと関連した現生種 2 種 *C. australica* (京都産), *C. tumida* (日光産), につき, さらに *Surirella elegans* (米国テレボンネ産) につき, それぞれの珪殻微細構造を記した。なお, 米国テレボンネ産のものについては, 原珪藻土及び精製珪藻土中の珪殻微細構造をある程度比較研究することが出来たので, その結果をも記した。

奥野春雄

Stephanodiscus niagarae EHRENBERG

Pl. 21, Figs. 1a, b.

Stephanodiscus niagarae EHRENBERG, HUBER-PESTALOZZI and HUSTEDT, 1942, Diat., p. 411, fig. 507.—HANNA, 1933, *23-24th Rep. Florida St. Geol. Surv.*, p. 90, pl. 2, fig. 3.—MILLS, 1934, Index, p. 1482.—OKUNO, 1943, *Bot. Mag. Tokyo, vol. 57*, p. 365, figs. 1a, b; 1944, *Kagaku* (*Science*), *Tokyo, vol. 14*, p. 167, figs. 1, 2; 1952. Atlas Foss. Diat., pl. 7, figs. 1, 2.

Valves circular, 28–136μ in diameter, with elevated or depressed center (cf. OKUNO, 1944, figs. 1b, c). Frustule pores about 10–11 in 10μ, arranged in radiating rows, each 2-4 rows forms a fasciculus. In the center of the valve, the arrangement of frustule pores somewhat irregular. Marginal zone finely porous, pores about 20-25 in 10μ, arranged in three lines decussating at about 60 degrees. On the inner border of the marginal zone, the valve is armed with spines about 10μ long. Spines on large valves straight, on small valves somewhat T-shaped.

Frustule pores probably locular. Of the frustule pores, the sieve membranes and the closing membranes were electron-optically clearly revealed, but it could not be determined which of these two membranes is placed on the outside or on the inside of the valve. Sieve membranes porous, with concentrically arranged sieve pores. Sieve pores rounded or angular, about 50–80 mμ in diameter, about 9–10 in 1μ. Opening of the closing membrane round, about 700–800 mμ in diameter. In many crude and refined valves, the sieve membranes were completely lost.

Habitat: Fresh water, planktonic.

Occurrence: In diatomite. (Specimen, no. 1110) Yatsuka-mura, Maba-gun, Okayama Prefecture. Pleistocene.

This species is very common in fresh water diatomites of Japan (cf. OKUNO, 1952, Atlas).

* Read June 18, 1955; received July 29, 1955.

Navicula hasta PANTOCSEK

Pl. 22, Figs. 1a, b.

Navicula hasta PANTOCSEK, 1893, Foss. Bacill. Ung., vol. 3, p. 69, pl. 5, fig. 74, pl. 14, fig. 213.–HUSTEDT, 1930, Bacilli., p. 306, fig. 541.—MILLS, 1934, Index, p. 1058.—TUMURA, 1937, *Bot. & Zool. Tokyo, vol. 5*, p. 798, pl. 3, fig. 68.—OKUNO, 1952, Atlas Foss. Diat., pl. 25, fig. 6.—HATTORI, 1954, *Journ. Japan. Bot., vol. 29*, p. 31.

Valves typically lanceolate, with somewhat acute ends. Length 68-90μ; breadth 13–18μ. Axial area narrow, central area suborbicular. The valve is alternately thicker and thinner in its costal and intercostal areas. Costal and intercostal areas severally 5 in 10μ, at the ends of the valve becoming closer, up to 12 in 10μ. Intercostal areas are porous with frustule pores. Frustule pores are rectangular holes, about 300–600 mμ long and about 70–100 mμ broad, 24–28 in 10μ. In the present electron-microscopy, no closing or sieve membrane was found in the frustule pores. In Pl. 22, Fig. 1b, at the edge of the broken raphe, a thin membrane about 400 mμ broad which I presume to be the inner membrane (*im*) of the raphe is clearly shown (cf. HUSTEDT, 1930, Bacill., p. 11, fig. 12-g).

Habitat: Fresh water, littoral.

Occurrence: In diatomite. (Specimen, nos. 1239, 1247, 1255, 1366, 1543, E71, E72, E328) Yamaura-mura and Tajibu-mura, Ôita Prefecture. Pliocene or Pleistocene. Nishise-mura, Kumamoto Prefecture. Pleistocene. Ureshino-chô, Saga Prefecture. Neogene. Kôriyama-mura, Kagoshima Prefecture. Pleistocene. Lake Suwa (From bottom mud, HATTORI, 1954).

The living form of this species was reported by TUMURA (1937) from Lake Ashi.

Navicula maculata (BAILEY) CLEVE

Text-fig. 1-A, B-1, 2; Pl. 22, Figs. 2a, b.

Navicula maculata (BAILEY) CLEVE, 1895, Synop. Nav. Diat., pt. 2, p. 46.—BOYER, 1927, Synop. North Amer. Diat., pt. 2, p. 403.—HANNA, 1933, *23-24th Rep. Florida St. Geol. Surv*, p. 94, pl. 11, fig. 3.

Valves lanceolate-elliptical, with produced or subrostrate ends. Length 90-108 (90–120)μ; breadth 38–40 (35–45)μ. Axial area narrow. Central area large, dilated transversely. Frustule pores (puncta) 5–6 (5–7) in 10μ, forming radiating and undulating longitudinal rows. Radiating rows about 6–7 in 10μ.

var. *acuta* OKUNO, var. nov.

Text-fig. 1-B (3, 4); Pl. 22, Figs. 3a, b.

Valvis lanceolatis, apicibus acute rotundatis. 130–220μ longis; 45–50μ latis. Striae subradiantibus 5–6 in 10μ, pori 5–6 in 10μ.

var. *inflata* OKUNO, var. nov.

Pl. 22, Figs. 4a-c.

Valvis late-ellipticis, cum polis productis. 105–210μ longis; 70–120μ latis. Striae radiantibus, 4–6 in 10μ, frequenter ad submarginem a linea longitudinali interruptis. Pori 4–5 in 10μ.

var. *gigantea* OKUNO, var. nov.

Pl. 22, Figs. 5a-c.

Valvis rhomboideo-lanceolatis, cum polis acutis vel subproductis. 200–300μ longis, 80–115μ latis. Striae subradiantibus, 4–5 in 10μ, pori 4–5 in 10μ.

These three new varieties are somewhat similar respectively to *N. maculata*, varr. *major*[1] and *lanceolata*[2]. The

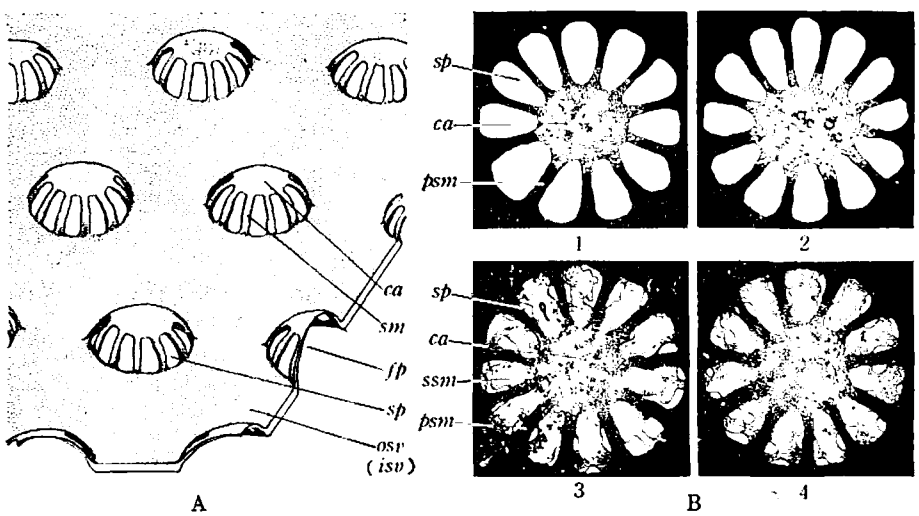
1) HEIDEN-ROSTOCK (1903), in A. SCHMIDT, Atlas Diat., pl. 244, figs. 1-4.

2) —— (1906), l. c., pl. 262, fig. 12.

differences are shown in the following table:

Comparison of *N. maculata* and its five varieties

	N. maculata	var. *acuta*	var. *inflata*	var. *gigantea*	var. *major*	var. *lanceolata*
Shape	lanceolate-elliptical	lanceolate	broad elliptical	rhombic-lanceolate	lanceolate to elliptical	lanceolate
End	produced or subrostrate	rounded acute	produced	acute or subproduced	produced or subrostrate	produced
Length (μ)	90-120	130-220	105-210	200-300	170-190	245
Breadth (μ)	35-45	45-50	70-120	80-115	62-68	70
Striae in 10μ	6-7	5-6	4-5	4-5	5	5
Pores in 10μ	5-7	5-6	4-5	4-5	5-6	5-6



Text-fig. 1. Fine structure of the frustule pores of *Navicula maculata* and varr. *acuta*, *inflata*, and *gigantea*. A, A portion of the valve, viewed from the outside (or the inside?), showing the hemispherical sieve membranes. B, Frustule pores viewed vertically (1, 2). Pores found in the species and the three new varieties. 3, 4, Pores found sometimes in var. *acuta*; note the presence of the secondary sieve membranes). *ca*, Central area. *fp*, Frustule pore. *osv*, Outer surface of valve (or *isv*, Inner surface of valve?). *psm*, Primary sieve membrane. *sm*, Sieve membrane. *sp*, Sieve pore. *ssm*, Secondary sieve membrane.

In the present electron-microscopy, it was elucidated that *N. maculata* and varr. *acuta*, *inflata*, *gigantea* are the same in their sieve membrane structure. Namely, the sieve membranes of the frustule pores of these four forms are hemispherical, and probably convex outwards (or concave inwards? The details could not be elucidated in the present research). The sieve membrane has a round to rectangular central area and 7-12 radial, slit-like sieve pores

(Text-fig. 1). The central area (*ca*) is membraneous, often porous with one or several pores of various shapes and sizes. The sieve pore (*sp*) is linear to clavate, about 2.5–4μ long and about 1–1.5μ broad. In *N. maculata* and var. *inflata*, sieve membranes (*sm*) were in many cases almost completely lost (Pl. 22, Figs. 2b, 4c); in var. *acuta* and *gigantea* they were in many cases well preserved. In the valves of var. *acuta*, the sieve pores half closed by the delicate, secondary sieve membranes (*ssm*) were rarely found (Text-fig. 1, B–3, 4; Pl. 22, Fig. 3b). Such a frustule pore with the primary and secondary sieve membranes probably represents the unbroken state of the frustule pore common to *N. maculata*, varr. *acuta*, *inflata* and *gigantea*. Frustule pores of these four forms seem somewhat locular, but owing to the overthickness of the valves for penetration of the electron beam, the details of the locular structure could not be revealed in the electron microscope. (Of the locular structure of var. *major*, see HEIDEN-ROSTOCK's diagram in A. SCHMIDT, Atlas Diat., pl. 244, fig. 3, which shows the incomplete loculi opening outwards.)

Habitat: Marine, littoral.

Occurrence: In diatomite. (Specimen, nos. m853–6. E350 (var. *acuta*)-Holotype. E237 (var. *inflata*)-Holotype. E364 (var. *gigantea*)-Holotype. Near Basalt, Esmeralda County, Nevada, U. S. A.[3] Probably late Pliocene.

3) The geological age of the deposit is not exactly known, but it is probably late Pliocene. It is badly faulted and in elevation is above its original level. The deposit has been mined by the Great Lakes Carbon Corporation for several years. The strata in this deposit are at a 30° dip and the deposit has been mined to a maximum depth of 100 feet. (Communicated by Dr. ERNEST L. NEU.)

Cymbella mexicana (EHRENBERG) CLEVE

Text-fig. 2 (5); Pl. 21, Figs. 2a-c.

Cymbella mexicana (EHRENBERG) CLEVE, 1894, Synop. Nav. Diat., pt. 1, p. 177—BOYER, 1927, Synop. North Amer. Diat., pt. 2, p. 283.—HUSTEDT, 1931, in A. SCHMIDT, Atlas Diat., pl. 367, figs. 1, 2.—HANNA, 1932, *Univ. Kansas Sci. Bull., vol. 20, no. 21*, pl. 32, fig. 4.—MILLS, 1933, Index, p. 561.—LOHMAN, 1938, *Geol. Surv. Prof. Paper, 189-C*, p. 84, pl. 23, fig. 14.

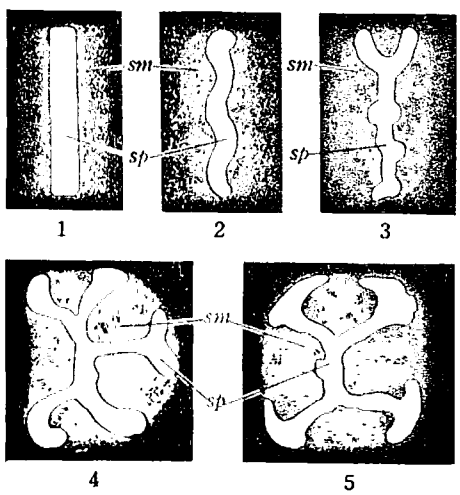
C. kamtschatica GRUNOW, 1885, in A. SCHMIDT, l. c., pl. 10, fig. 31.

Cocconema mexicana EHRENBERG, A. SCHMIDT, 1885, l. c., pl. 10, figs. 32, 33.—WOLLE, 1894, Diat. North Amer., pl. 6, fig. 4.

Valves lunate, with slightly gibbous ventral margin and subrostrate, truncate ends. Length 100–240μ; breadth 28–55μ. Raphe arcuate, with reflexed terminal fissures. Axial area linear, central area suborbicular. A stigma without a distinct fissure occurs in the center of the central nodule. Frustule pores about 8–10 in 10μ, arranged in slightly radiating transverse rows about 7–10 in 10μ, becoming closer at the ends, up to 13 in 10μ.

Electron-optically, the frustule pores are quadrate to rectangular, and they are probably holes. The frustule pore about 500–650 mμ long and 400–500 mμ broad, half closed on the out- or inside by 3–5 (usually 4) ingrowths of more or less spade-shaped sieve membranes, leaving between them a crossed slit-like sieve pore (Text-fig. 2 (5); Pl. 21, fig. 2c). The sieve membranes seem to be somewhat convex or concave at the center of the frustule pore. The sieve membrane of this species is rather comparable in its shape to that of *Didymosphenia* (cf. OKUNO, 1953, *Bot. Mag.*

Tokyo, vol. 66, p. 122, pl. 1, fig. 7; 1954. *Trans. Proc. Palaeont. Soc. Japan. N.S., No. 14*, p. 147, pl. 18, figs. 5b-d). In refined, commercial diatomite "Dicalite 4200"[4], I found valves of the present species in which the sieve membranes were completely lost (Pl. 21, fig. 2b). Such a destruction of sieve membranes was probably caused by the thermal and chemical treatments during the course of refinement. In living forms of *C. australica* (A. SCHMIDT) CLEVE from Kyoto (Specimen no. 1624. Apr. 1954), I found rectangular frustule pores with sieve membranes somewhat akin to those of the present species. In the frustule pores of *C. australica*, several leaves of tongue-shaped sieve membranes grow more or less deeply to the center, leaving an undulating or branched sieve pore which bears considerable resemblance to that of *C. mexicana* (Text-fig. 2 (2, 3, 4); Pl. 21, Figs. 3a, b). And in living forms of *C. tumida* (BRÉBISSON) Van HEURCK from Nikko (Specimen no. 1460. Apr. 1949), I found oblong frustule pores, each with a linear, rarely undulating or branched sieve pore (Text-fig. 2 (1, 2, 3); Pl. 21, Fgs. 4a, b). Thus, of the frustule pores of *Cymbella*, in relation with the dimension of the frustule pores and the degree of ingrowth of sieve membranes, hitherto, five types of sieve pores—the linear, the undulating, the dichotomous, and the more or less stellate types—were found (Text-fig. 2).



Text-fig. 2. Various types of sieve pores in the frustule pores of *Cymbella*. 1, Linear. 2, Undulating. 3, Dichotomous. 4, 5, Stellate. *sm*, Sieve membrane. *sp*, Sieve pore. 1, 2, 3, in *C. tumida*. 2, 3, 4, in *C. australica*. 5, in *C. mexicana*. (Type-4 was found only in the frustule pores along the border of the axial area.)

4) Earth, calcined at about 2000°F. in a rotary kiln, adding fluxing agent which has the effect of agglomerating small particles and whitening the earth. (Communicated by Dr. ERNEST L. NEU.)

Habitat: Fresh water, littoral.

Occurrence: In diatomite. (Specimen, no. 1645) Terrebonne, Deschutes County, Oregon, U. S. A. Miocene. Guatemala (CLEVE), Monterey (HUSTEDT), Kettleman Hills (LOHMAN), Wallace (HANNA). Living form; Kamtschatka (WEISSFL.), North America (BOYER, WOLLE), S. Andree (GRUNOW), Vancouver Island (CLEVE).

Surirella elegans EHRENBERG

Pl. 21, Figs. 5a-c.

Surirella elegans EHRENBERG. A. SCHMIDT, 1885, Atlas Diat., pl. 21, fig. 18.—BOYER, 1927, Synop. North Amer. Diat., pt. 2, p. 537.—MILLS, 1934, Index, p. 1516.—HUBER-PESTALOZZI, and HUSTEDT, 1942. Diat., p. 515, fig. 628.

Frustule in girdle view cuneate. Valves ovate. Length 130–190 (130–425)μ; breadth 70–90 (40–90)μ. Costae 18–20 in 100μ, indistinct to the broad central space. Intercostal area is finely porous. Frustule pores in the intercostal areas are round to elliptic holes about

350–650 mμ in diameter. Holes occur about 4–6 in 1μ, and arranged in transverse rows about 3–4 in 1μ. I found similar round holes in fossil frustules of *S. robusta* from Arii-mura, Mie Prefecture. Of the holes of these fossil forms, no closing membrane was found. In living form of *S. gemma*, HELMCKE and KRIEGER[5] found a compound frustule pore. According to them, the frustule pore of *S. gemma* opens freely inwards and seems to have outer sieve membrane with round poroids.

Habitat: Fresh water, littoral.

Occurrence: In diatomite. (Specimen, nos. 1640. E244. "Dicalite 4200") Terrebonne. Deschutes County, Oregon, U. S. A. Miocene.

Acknowledgement

The writer wishes to express his thanks to the Ministry of Education for a Grant in Aid for Scientific Research which made this research possible. Further the writer takes this opportunity of thanking Dr. ERNEST L. NEU, the Chief Chemist of the Dicalite Division, Great Lakes Carbon Corporation, who kindly sent the writer many specimens of the American diatomites with full description of localities, geological ages and etc.

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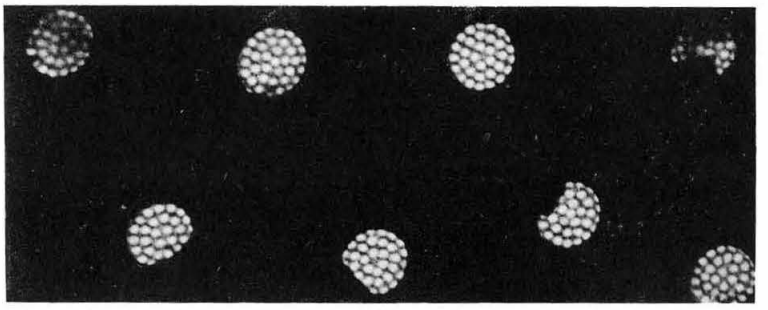

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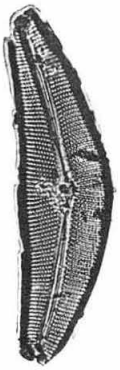

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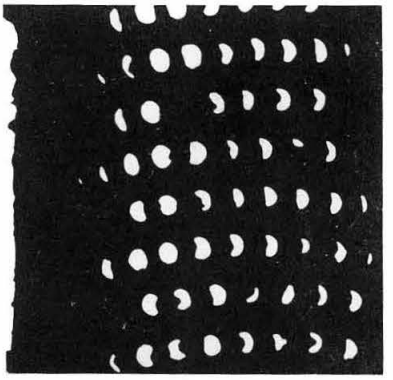

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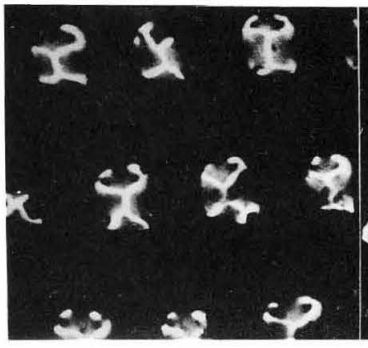
3a

4a



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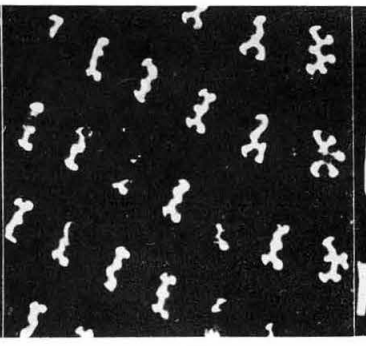

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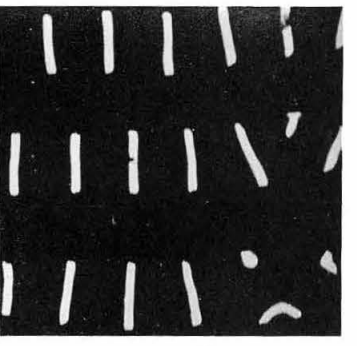

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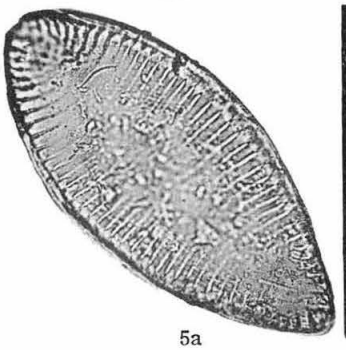

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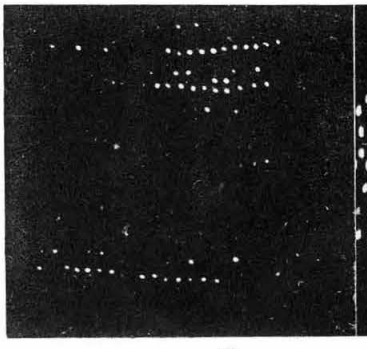

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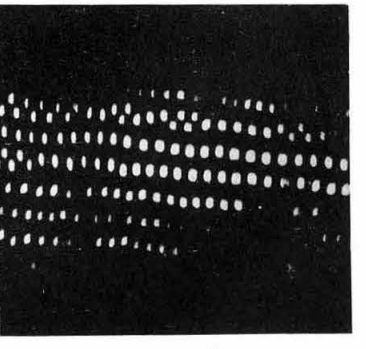

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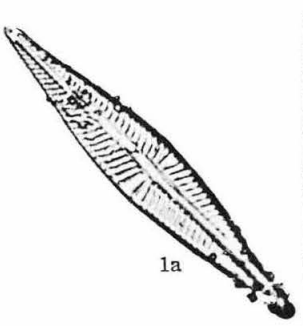
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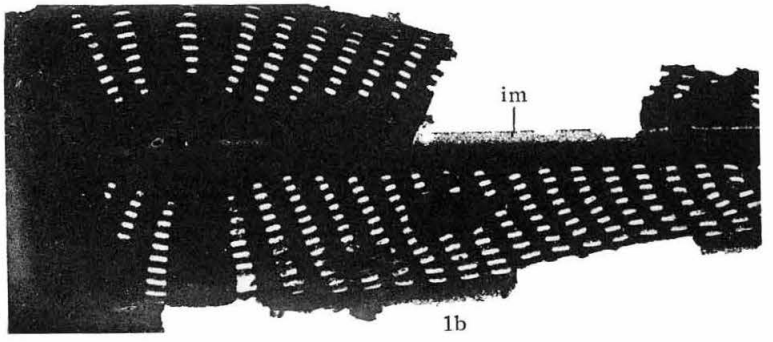

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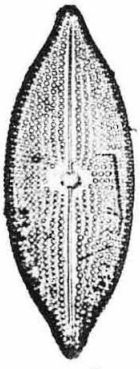
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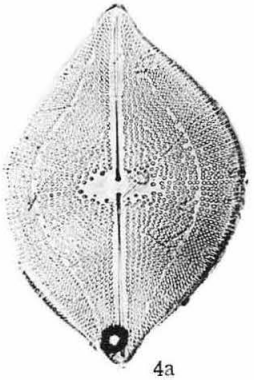
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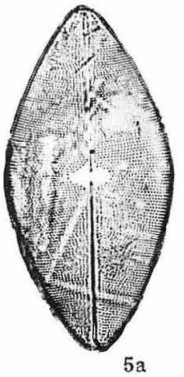
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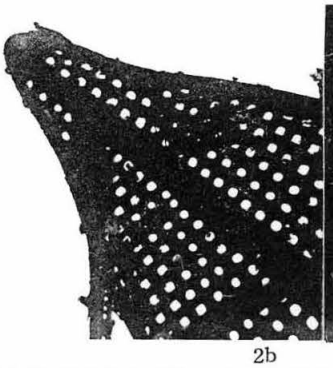
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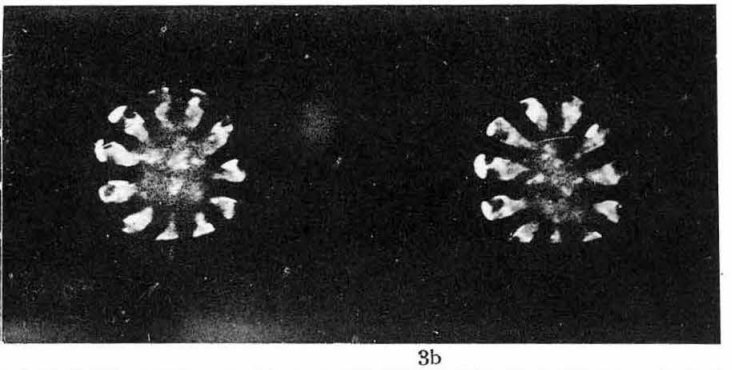
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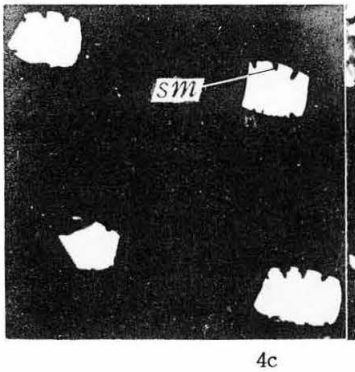

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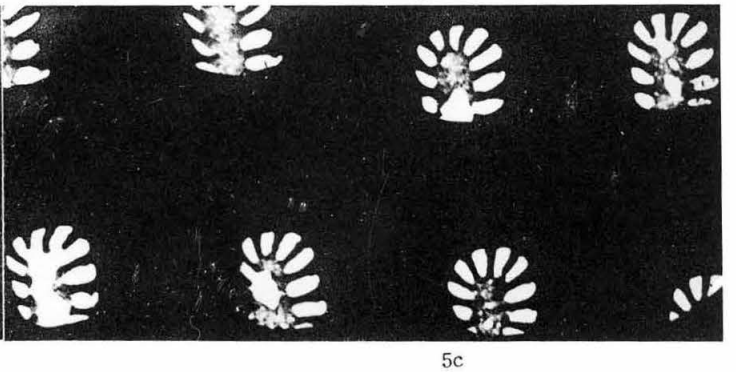
5c

Explanation of Plate 21

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

Figs. 1a, b. *Stephanodiscus niagarae* EHRENBERG. Yatsuka-mura, Okayama Pref. 1a (L. M. ×500). 1b (E. M. ×12000).

Figs. 2a-c. *Cymbella mexicana* (EHRENBERG) CLEVE. 2a, b, in "Dicalite 4200". 2c, in natural earth[6]. Terrebonne, Oregon, U. S. A. 2a (L. M. ×400). 2b, c (E. M. 2b, Sieve membranes are lost. ×5000. 2c, Sieve membranes are preserved. ×13000). 2a, b, Obtained from the same valve.

Figs. 3a, b. *C. australica* (A. SCHMIDT) CLEVE. Living form. Kyoto, Kyoto Pref. 3a (L. M. ×500). 3b (E. M. ×12000).

Figs. 4a, b. *C. tumida* (BRÉBISSON) Van HEURCK. Living form. Nikko, Tochigi Pref. 4a (L. M. ×650). 4b (E. M. ×13500).

Figs. 5a-c. *Surirella elegans* EHRENBERG. 5a, b, in "Dicalite 4200". 5c, in crude earth. Terrebonne, Oregon, U. S. A. 5a (L. M. ×300). 5b, c (E. M. 5b ×9000. 5c ×8100).

6) Earth subjected to drying, a very slight degree of milling, and some classification, to remove coarse grit and extremely fine particles. (Communicated by Dr. ERNEST L. NEU.)

Explanation of Plate 22

Figs. 1a, b. *Navicula hasta* PANTOCSEK. Nishise-mura, Kumamoto Pref. 1a (L. M. ×800). 1b (E. M. ×4000). *im*, Inner membrane of raphe.

Figs. 2a, b. *N. maculata* (BAILEY) CLEVE. Esmeralda, Nevada U. S. A. 2a (L. M. ×500). 2b (E. M. ×1350). Sieve membranes are completely lost. 2a, b, Obtained from the same valve.

Figs. 3a, b.——var. *acuta* OKUNO, var. nov. Esmeralda, Nevada, U. S. A. 3a (L. M. ×200). 3b (E. M. ×25000). 3a, b, Obtained from the same valve.

Figs. 4a-c.——var. *inflata* OKUNO. var. nov. Esmeralda, Nevada, U. S. A. 4a, b (L. M. 4a ×300. 4b ×260). 4c (E. M. ×10000). *sm*, Remain of the broken sieve membrane.

Figs. 5a-c.——var. *gigantea* OKUNO, var. nov. Esmeralda, Nevada, U. S. A. 5a, b (L. M. 5a ×200. 5b ×150). 5c (E. M. ×12500).

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281. SOME BRACHIOPODS FROM THE LOWER KANOKURA SERIES OF THE KITAKAMI MOUNTAINS, JAPAN*

ICHIRO HAYASAKA and MASAO MINATO

Geological and Mineralogical Institute, Hokkaido University

北上山地・叶倉統産の腕足類化石：北上山地から採集された，叶倉統産の腕足類 8 種を記載。このうち 6 種は従来，本邦から未記載で，1 種 (*Cancrinella cancriniformis spinosa*) は新亜種に属する。
早坂一郎・湊 正雄

The eight species described in the following pages are all found in the Lower Kanokura-series (MINATO, M. et al. 1954) developed in the southern part of the Kitakami mountains. Their age may be Middle Permian in rough estimation, that is, it may correspond to the *Neoschwagerina-Verbeekina* zone of THOMPSON.

Derbya magnifica LICHAREW
Chonetes (Plicochonetes) deplanata (WAAGEN)
Cancrinella villiersi kozlowskiana (FREDERICKS)
C. cancriniformis spinosa, subsp. nov.
Striatifera? sp.
Linoproductus cora (D'ORBIGNY)
Martinia semiplana WAAGEN
M. semiplana WAAGEN var. *lata* GRABAU

Before going into the description, the writers wish to offer their thanks to Messrs. K. YAMADA and H. SUETOMI, who collected some of the fossils here dealt with.

Derbya magnifica LICHAREW

Pl. 23, Figs. 1a, b, c.

1932. *Derbya magna*, LICHAREW (non *Derbya magna* BRANSON, 1930):—Fauna of the Permian Deposits of Northern Caucasus, I: Brachiopoda; Subfamily Orthotetinae WAAGEN. *Transactions of the United Geological and Prospecting Service of USSR, fasc. 215*, pp. 18-20 (Russian); pp. 40-42 (English), pl. 1, figs. 1, 2, 6, 7, 13; pl. 2, fig. 1; (?) pl. 3, fig. 1.

1939. *Derbya magnifica*, LICHAREW:—The Atlas of the Leading Forms of the Fossil Fauna USSR, vol. VI: Permian (Russian), p. 80, pl. 17, fig 1.

LICHAREW himself, who proposed the name *Derbya magna* for this species, later substituted it by the name *D. magnifica* because it was found that the former had been preoccupied by "*Orthotetes (Derbya) magnus* BRANSON." (LICHAREW, 1939).

A rather severely deformed inner mold of a *Derbya* from the Kanokura series of Imo is the material at hand of this species. LICHAREW's original description with illustration is very thorough, and the important specific characters recognized are almost wholly represented in the Japanese specimen, except that the latter is somewhat smaller, and that the auricular expansions are not recognized; the latter feature, however, may possibly be due to its being an inner mold. At any rate, the Japanese

* Read Dec. 12, 1951; received Aug. 4, 1955.

fossil seems to be most closely allied to *Derbya magnifica* LICHAREW as far as our knowledge is concerned.

The valves are only weakly convex. The ventral one is slightly concave anteriorly: the dorsal is almost semi-circuler in outline. The ventral valve develops a long, conspicuous median septum inside; and the pseudodeltidium is wider than in *D. grandis* WAAGEN (WAAGEN, W., 1882) which looks quite like the former, only being somewhat shorter: the latter is from the Middle *Productus*-Limestone.

In the collection of brachiopods now at hand there is another specimen, also a poorly preserved small example (17036), which, judged from the characters observed, looks like a young individual of the species here described.

Among allied species hitherto known, *Derbya cymbula* HALL and CLARKE (DUNBAR, C. O. and CONDRA, G. E., 1932) may be one closely approximate to the present species. If a wide range of form variation is allowed of the species, the Eurasiatic and the American forms may well be regarded as conspecific. Otherwise, the Kitakami example of *D. magnifica* and the North American *D. cymbula* differ in the outline of valves. The former, though somewhat deformed, is longer than wide in outline compared with the latter, and the median folding, not very distinct, is recognized in the former, while such is lacking in the latter. The North American species ranges from the uppermost Pennsylvanian to the Lower Permian.

Hor.: Lower Kanokura-series.
Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Reg. no.: 17035, Coll.: YAMADA.
Loc.: Kanokura, Setamai-machi, Kesen-gun, Iwate Prefecture. Reg. no.: 17036, Coll.: M. MINATO.

Chonetes (Plicochonetes) deplanata (WAAGEN)

Pl. 21, Fig. 8.

1883. *Chonetes deplanata*, WAAGEN: Salt Range Fossils, p. 637, pl. LX, figs. 5, 6.

Shell represented by ventral valves only, that are notably depressed, very slightly convex in all directions, and with flattened wings. Hinge line straight, representing the greatest width of shell; cardinal extremities acute, sharply pointed. Apex also is slightly, pointed and bending over a little.

Sinus starts at the apex as a very narrow and shallow depression, but it rather abruptly broadens and deepens towards shell margin. Within sinus, there are three very low and fine plicae, one at the middle, and the two others on either side of it. On both sides of this sinus, there are strong and broad ribs, that bifurcate (or trifurcate) anteriorly. Near the boundary between the wing and the body of the valve, there also develop two indistinct short ribs.

Remarks: This species is characterized by having a transverse shell, which is far wider than long, by being trapezoid in outline. The specimens, now under consideration may look somewhat to resemble *Chonetes squamulifera* WAAGEN, (WAAGEN, W., 1882): however, they are easily distinguishable from the latter in having far flatter ventral valve, with dichotomous plicae.

Hor.: Lower Kanokura series.
Loc.: Kanokura-yama, Setamai-machi, Kesen-gun, Iwate Prefecture. Reg. no.: 17176 Coll.: M. MINATO.

Cancrinella FREDERICKS, 1928.

In the collection of the Department of Geology and Mineralogy of our

University there are a number of small productids which are characterized by thin, thread-like radial striae and more or less elongate warts at irregular intervals, crossed by concentric wrinkles. Pedicle valve is strongly convex. These characters show a very great possibility of the specimens being *Cancrinella*. Although the specimens at hand are not at all in very good condition of preservation, it seems there are forms in which the brachial valves are concave, on the one hand, and those that have geniculated brachial valves, on the other.

When FREDERICKS attempted a classification of *Productus* into many types in 1928, he based his differentiation on two groups of features, primary and secondary. Primarily the productoid brachiopods were divided into three groups according to the form of brachial valves: namely, a) "Plani" in which the brachial valve is practically plane, b) "Concavi" including the forms with a concave brachial valve and c) "Geniculati" those with a geniculate brachial valve. The secondary characterizing features were sculptures and ornamentations of the shell surface. By the combination of these primary and secondary elements many different types may be distinguished, but 15 are represented by actual forms or species in FREDERICKS' paper, of which 3 are not given names: the named 12 include *Buxtonia* THOMAS, *Echinoconchus* WELLER, *Pustula* THOMAS and *Productus* (s. s.) SOWERBY, all the others being new. *Cancrinella* is one of the new subgenera or genera of FREDERICKS.

Cancrinella is characteristically a striato-spinose group. According to his system FREDERICKS recognized two distinct forms or species, namely:

1) forms with a concave dorsal valve: examples—*Prod. villiersi* D'ORB. *koninckianus* KEYS. and
2) forms with a geniculate dorsal valve: examples—*Prod. cancriniformis* TSCHERN., *Prod. cancrini* VERN.

No forms with a plane brachial valve seems to have been recognized by FREDERICKS.

Now, the forms with a concave dorsal valve among the specimens at hand naturally fall in the first group—that of *Prod. villiersi* as is evident from the description and illustration of the Bolivian material by KOZLOWSKI, 1914. In other words, they are *Cancrinella villiersi kozlowskiana* FREDERICKS.

On the other hand, the specimens described as *Prod. villiersi kozlowskiana* by the senior author of this note in 1925, three years before the publication of the classification of FREDERICKS, have not had to be called by this name since then, because it was characterized by the geniculation of the dorsal valve. They are to be regarded as belonging to the second group represented by *Prod. cancriniformis*, according to the system of FREDERICKS. However, as far as the writers' knowledge on *Prod. cancriniformis* obtained through various descriptions and illustrations available is concerned, the fossils under consideration as well as the equivalent forms in the present collection widely differ from it in point of sculpture and ornamentation, not to speak of the general growth habit. In these respects those fossils are very much more closely similar to *Cancrinus villiersi kozlowskiana*. It would seem more reasonable to call them by some other subspecific name corresponding to *kozlowskiana*.

If, however, FREDERICKS' principle of classification is to be strictly adhered to, these latter forms must be dealt with as a subspecies of *Canc. cancrini-*

formis instead of *Canc. villiersi*. The authors consider it advisable to propose for it a new name *spinosa*.

Cancrinella villiersi kozlowskiana (FREDERICKS)

Pl. 23, Fig. 5.

1914. *Productus villiersi*, KOZLOWSKI:—Les brachiopodes du Carbonifère supériur de Bolivie, *Annals de Paléontologie, IX*, pp. 42-45, pl. II, figs. 39-60.

1915. *Productus cancrini*, DIENER:—The Anthrac. Fauna of Kashmir, Kunaur and Spiti. *Pal. Ind. N.S., vol. V, 2*, p. 73, pl. VI, fig. 1; pl. VIII, fig. 1.

1924. *Productus villiersi koninckiana*, FREDERICKS:—Up. Pal. Ussuriland, 11. Perm Brach. Cape Kalouzin. *Rec. Geol. Com. Russ. Far East, no. 40*, p. 18, pl. I, figs. 36-40; pl. II, figs. 86, 87.

This is a small, striato-spinose productid, ornamented with thin radial striae and rather faint concentric wrinkles dotted with more or less elongate spine bases. With respect to these features this subspecies is not distinguishable from what was described by the senior writer in 1925 as *Prod. villiersi kozlowskiana*. Forms identical with the latter are found in the present collection, and they are called *Canc. cancriniformis spinosa*, as described below. In reality neither of these forms is easily distinguished from the Bolivian species, *Prod. villiersi* of KOZLOWSKI, as far as the characters observed on the pedicle valves are concerned. The present subspecies coincides with the latter in possessing a concave (not geniculate) brachial valve, which is geniculate in the other.

The senior author of this paper when described the Kitakami forms had only a scanty material. At that time the form of the dorsal valve, whether concave or geniculate, was not duly estimated as a distinctive feature of any importance. In reality, it is in 1928 that FREDERICKS published his new classification of Producti, based on his extended studies on numerous specimens.

Hor.: Lower Kanokura series.

Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Coll.: YAMADA. Reg. no.: 17221.

Cancrinella cancriniformis spinosa subsp. nov.

Pl. 23, Figs. 4a, b.

1925. *Productus villiersi kozlowskiana*, HAYASAKA (non FREDERICKS):—On some Brach. from the *Lyttonia*-Horiz., Kitakami Mts. *Japan. Jour. Geol. Geogr., vol. 4*, pp. 96-97, pl. V, figs. 10, 11.

Several specimens are in the collection, but few are in a better condition than those described by the senior author in 1925 as *Prod. villiersi kozlowskiana*; they are mostly external molds of distorted pedicle valves of a small size. Surface ornamentation consists in thin radial striae and more or less elongate spine bases as well as faint concentric wrinkles. In one of the specimens the brachial valve is seen to be strongly geniculate, with the surface sculpture similar to that of the opposite valve.

As stated above, this subspecies is in general appearance very much like *Canc. villiersi kozlowskiana* except that the brachial valve is geniculate, which feature disproves the specimens being this very species, according to the definition of FREDERICKS.

Hor.: Lower Kanokura series.

Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Coll.: K. YAMADA. Reg. no.: 17848.

Stratifera? sp.

Pl. 23, Figs. 6, 7.

There are, in our collection, fragments

of what can not be anything else than a particular form of a Productid. Although the specimens are by no means in a favorable state of preservation, being more or less deformed as well, certain important sculptural features are clearly recognized. In one of the specimens which is an external mold of a brachial valve the following characters are observed.

The valve is rather uniformly and shallowly concave except around apex. Hinge line is straight and is conjectured to be slightly shorter than the greatest breadth of the valve. No trace of a median fold is recognized.

The surface sculpture is very characteristic. It consists of very fine radiating thread-like striae in alternation with equally thin interspaces, and very conspicuous concentric wrinkles by which the radial striae are often interrupted. The radial striae seem to increase in number anteriorly by insertion of new ones: they count in the anterior part about 10 in a space of 10 mm. The concentric wrinkles are very narrow and numerous, quite regular in the umbonal region: they become very irregular marginally; some are flexuous and discontinuous, some others bifurcate.

Remarks:—The most conspicuous of the characters of this imperfect fossil is, as stated above, the surface sculpture of the shell. Among the different patterns of the surface ornamentation of Productids the one characteristic of such groups as *Striatifera* CHAO (CHAO, Y.T., 1927) and *Linoproductus* CHAO (CHAO, Y.T., 1927) are the type to which that of the Japanese fossil under consideration belongs. The two genera referred to are distinguished from each other in the form of the brachial valves. However, as the complete form of valves of the Japanese specimens is not known, it is not possible to say to which it is more approximate in this respect. Consequently, a detailed observation on the surface sculpture becomes necessary to decide the matter.

Through critical studies of the forms described by CHAO as species of *Striatifera* and *Linoproductus*, the present writers are convinced that the Japanese species represents the type of the former rather than that of the latter.

Assuming that the Kitakami fossil under consideration is a *Striatifera*, it looks very much like a Permian species from Kashimir described by DIENER as *Productus undatus* (DIENER, C., 1908). It is generally accepted that this and the other Permian (and upper Carboniferous) Producti called *Prod. undatus* are not identical with the original Carboniferous form of Europe.

There are many Permian Productids that are characterized by the surface ornamentation of *Striatifera-Linoproductus* type as is described in the monographs of CHAO, for instance. An exaggerated aspect of this feature is shown in some specimens of *Striatifera compressa* and its variety, *mongolica*, from the Permian of Caucasus (LICHAREW, B. K., 1937): the closeness and irregular forms of the concentric wrinkles shown in some of the pictures given by CHAO are almost indistinguishable from the actual surface of the Kitakami fossil.

Hor.: Lower Kanokura series.

Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Coll.: K. YAMADA. Reg. no.: 17039.

Linoproductus cora (D'ORBIGNY)

Pl. 23, Figs. 9, 10.

1884. *Productus cora*, WAAGEN: Salt Range fossils. p. 677, pl. LXVI, figs. 1-2; pl. LXVII, fig. 3.

1925. *Productus cora*, HAYASAKA: On some Brachiopods from the *Lyttonia*-horizon of the Kitakami Mountains. *Japan. Jour. Geol. Geogr. vol. 4*, p 94, pl. V, figs. 7-9.

This species shows quite different aspects, according to the condition of preservation of the individual specimens. One of them here illustrated as fig. 10 is quite indistinguishable from the specimen figured formerly by HAYASAKA in his fig. 7, pl. V, which was also a Kitakami specimen. The other specimen here dealt with and figured as fig. 9 is doubtlessly a mold of the dorsal valve of the same species. It is completely identical with WAAGEN's specimen illustrated by him as fig. 1b in his plate LXVII.

Hor.: Lower Kanokura series.
Loc.: Kanokura-sawa, Setamai-machi, Kesen-gun, Iwate Prefecture. Coll.: M. MINATO and H. SUETOMI. Reg. nos.: 17038, 17243.

Martinia semiplana WAAGEN

Pl. 23, Fig. 2.

1852. *Martinia semiplana*, WAAGEN, *Productus*-Limestone Brachiopoda, p. 536, pl. LXIII, fig. 4.
1902. *Martinia semiplana*, TSCHERNYSCHEW: Die Obercarbonischen Brachiopoden des Ural und des Timan, p. 565, pl. LX, figs. 15-16.
1936. *Martinia semiplana*, GRABAU: Early Permian fossils of China, *Palaeont. Sinica, ser. B, vol. VIII, fasc. 4*, p. 237, pl. XXIV, figs. 1-4.

Several specimens, mostly external molds of pedicle valves, from the *Lyttonia* bed at Imo are referable to this species. The outline of the ventral valve is roundly subpentagonal, with very prominent beak; the hinge-line is about 1/2 the maxium breadth. All the ventral valves have a very narrow and very shallow sinal depression.

Hor.: Lower Kanokura series.
Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Coll.: K. YAMADA. Reg. no.: 17218.

Martinia semiplana WAAGEN var. *lata* GRABAU

Pl. 23, Fig. 3.

1936. *Martinia semiplana*, var. *lata*, GRABAU: Early Permian fossils of China, *Palaeontologia Sinica, ser. B. vol. VIII, fasc. 4*, p. 239, pl. XXI, figs. 1-3.

GRABAU separated this variety by reason that shells are wider than long, in comparison with the type of WAAGEN's species.

In the collection at hand, the shells of this transverse type are found in association with the preceding species: they also have very narrow and shallow sinal depression.

Hor.: Lower Kanokura series.
Loc.: Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Coll.: K. YAMADA, Reg. no.: 17222.

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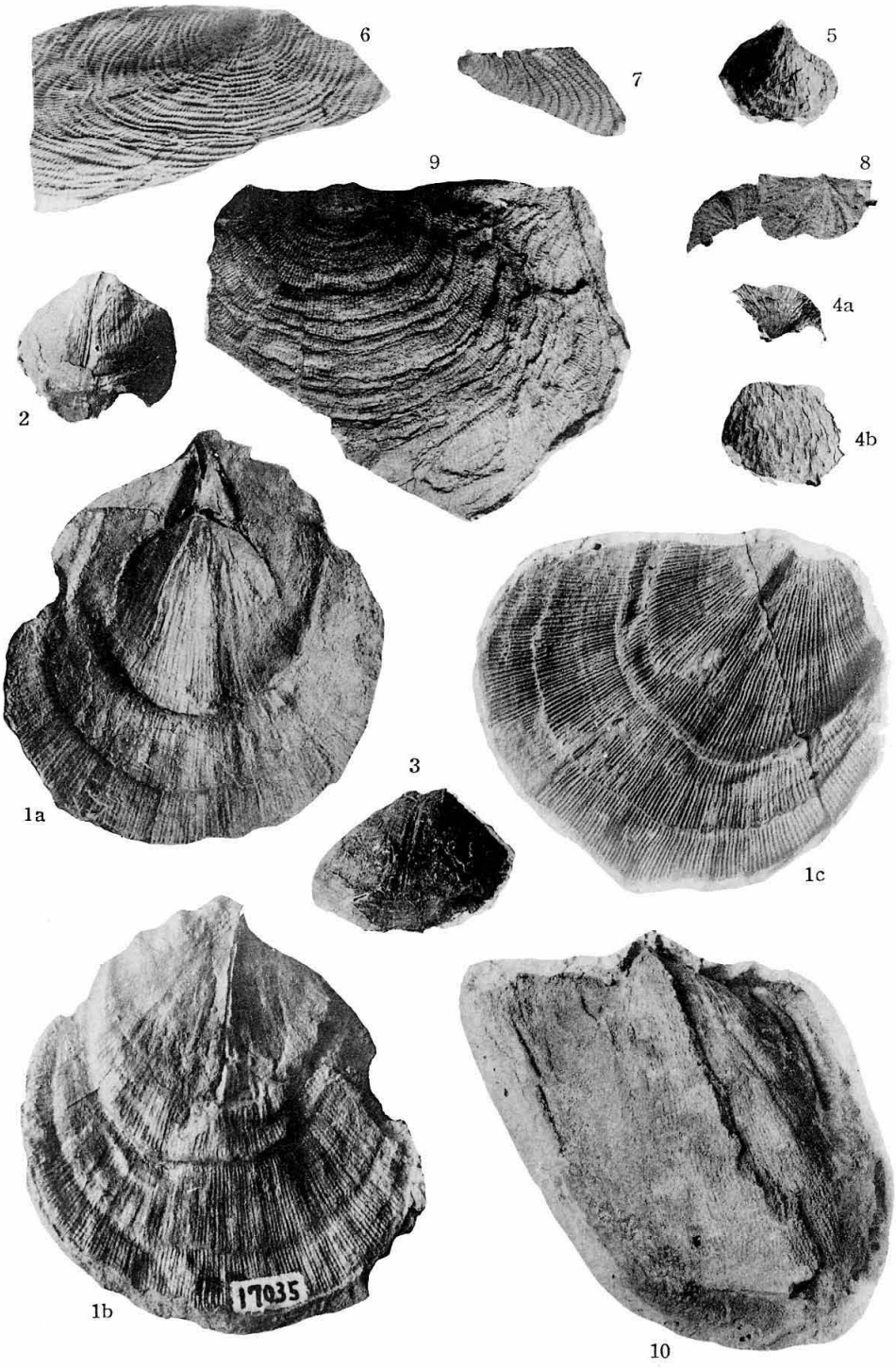

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Explanation of Plate 23

(All figures in natural size.)

Figs. 1a, 1b, 1c. *Derbya magnifica* LICHAREW
Reg. no.: 17035. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Fig. 2. *Martinia semiplana* WAAGEN
Reg. no.: 17218. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Fig. 3. *Martinia semiplana* var. *lata* GRABAU
Reg. no.: 17222. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Figs. 4a, 4b. *Cancrinella cancriniformis spinosa* HAYASAKA et MINATO
Reg. no.: 17848. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Fig. 5. *Cancrinella villiersi kozlowskiana* (FREDERICKS)
Reg. no.: 17221. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Figs. 6, 7. *Striatifera* ? sp. indet.
Reg. no.: 17039. Imo, Yahagi-mura, Kesen-gun, Iwate Pref.

Fig. 8. *Chonetes (Plicochonetes) deplanata* (WAAGEN)
Reg. no.: 17176. Kanokura-yama, Setamai-machi, Kesen-gun, Iwate Pref.

Figs. 9, 10. *Linoproductus cora* (D'ORBIGNY)
Fig. 9: reg. no.: 17038; fig. 10: 17243. Kanokura-sawa, Setamai-machi, Kesen-gun, Iwate Pref.

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282. ON FOUR BRACHIOPOD SPECIES OF THE SUBFAMILY ORTHOTETINAE FROM THE KANOKURA SERIES OF THE KITAKAMI MOUNTAINS, JAPAN*

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北上山地叶倉統産の腕足類 Orthotetinae 亜科の 4 種：北上山地の叶倉統から産した腕足類のうち，Orthotetinae 亜科に属する 4 種を記載した。*Streptorhynchus pelargonatus* SCHLOTHEIM, *Orthotetina kayseri* (JÄKEL.) FLIEGEL, *Geyerella*? sp. indet., *Orthotetes rugosa* FREDERICKS。このうちはじめの 3 種は従来，北上山地からは未報告のものである。　　湊　正雄・中村耕二

Thanks to the efforts of Messrs. H. YABE, S. MABUTI, K. SHIIDA and others, especially of I. HAYASAKA, a fairly large number of brachiopod fossils have been described from the Kanokura series developing through the southern part of the Kitakami mountains, northeastern Honsyu, Japan. Of them, the following three species belonging to the subfamily Orthotetinae have been described by HAYASAKA up to the present day.

Derbya hemisphaerica FREDERICKS
Hamletella kitakamiensis HAYASAKA
Orthotetes rugosa FREDERICKS

Now the writers wish to take the opportunity to describe the following four species of Orthotetinae:

Streptorhynchus pelargonatus SCHLOTHEIM
Orthotetina kayseri (JÄKEL.) FLIEGEL
Geyerella ? sp. indet.
Orthotetes rugosa FREDERICKS.

All these fossils were collected also from the Lower Kanokura series, of which three species except *Orthotetes rugosa* were first discovered in the Kitakami district. The last mentioned species was once described by HAYASAKA from the Kitakami mountains, but the new specimens dealt with by the writers are more perfect and derived from other localities than that of Prof. HAYASAKA's finding.

Before proceeding to the description, the writers wish to offer their thanks to Messrs. H. SUETOMI, M. AKATSUKA, and T. MAEKAWA, who collected some of the specimens here dealt with. Thanks are also due to Mr. S. KUMANO, who took the photographs accompanying this paper.

Description of species

Streptorhynchus pelargonatus SCHLOTHEIM

Pl. 24, Figs. 1a, 1b, 1a', 1b'.

1856. *Streptorhynchus pelargonatus*, DAVIDSON: British Permian Brachiopoda. p. 32, pl. II, figs. 32-36.
1880. *Streptorhynchus pelargonatus*, DAVIDSON: Fossil Brachiopoda, supplement, p. 32, pl. XXX, fig. 3.
1884. *Streptorhynchus pelargonatus*, WAAGEN: Salt range fossils. p. 579, pl. 50. figs. 3-5, 7.

* Read Oct. 29; received Aug. 10, 1955.

1911. *Streptorhynchus pelargonatus*, FRECH: Dyadische Kohlenschichten von Lo-ping, RICHTHOFEN's China V, p. 243, pl. XXIV. fig. 2.

1932. *Streptorhynchus pelargonatus*, LICHAREW: Fauna of the Permian deposits of Northern Caucasus, *Trans. Unit. Geol. Prospect. Serv. USSR.*, p. 36, pl. I, fig. 5; pl. IV, fig. 4.

1933. *Streptorhynchus pelargonatus*, HUANG: Late permian Brachiopoda of Southern China. *Palaeont. Sinica, ser. B, vol. 9, fasc. 2*, p. 17, pl. II, fig. 13.

Shell of small size, longer than wide, slightly distorted, hinge line shorter than the greatest width of the shell, which is measured near the mid-length of the shell. The dimensions are as follows: length of ventral valve, 17. 4 mm, greatest width, 14.3 mm, length of hinge line, 11.0 mm, height of area, 8.6 mm, width of delthyrium at the base, 3.5 mm, length of dorsal valve, 8.8 mm and the delthyrial angle 20°.

The specimen is much depressed by rock pressure, so it does not show any original convexity, but it must surely be true that the shells of both valves were originally not so much convex.

The ventral valve larger than the dorsal one, the beak of which is small, not incurved. The cardinal area somewhat distorted, almost flat or slightly concave, the whole surface of which is transversely striated by numerous striae, some of which are strongly impressed; delthyrium very narrow covered by vaulted pseudodeltidium; on both sides of delthyrium there are narrow grooved areas, which are sharply defined from either transversely striated area or delthyrium; this narrow area is longitudinally striated.

Dorsal valve far wider than long, nearly flat or somewhat concave except in the umbonal region, where the small beak is rather abruptly elevated, sinus very shallow and narrow.

Internally the dental plates and median septum lacking in the ventral valve, also socket plates as well as median septum lacking in the dorsal valve.

Whole surface marked by fine radial striations and less numerous concentric striae, the former of which are sub-equal in strength and no definite differences can be recognized between them in respect to either thickness or strength, although they are augmented towards the margin of the valve by intercalations and the new intercalated ribs show relatively less long and less broad than the others.

Remarks: This well known species, which is widely distributed in the Permian of Eurasia and is characteristic in possession of relatively smaller sized shell with very high cardinal area, is found also in the Japanese Permian, although it is, at present, repesented by only one specimen.

BROILI, now about forty years ago, treated some brachiopoda specimens of Timor under the name of *Streptorhynchus pseudopelargonatus*; the specimens are actually quite allied with *S. pelargonatus* in size and form, but he regarded them to be specifically different from the latter in having equally strengthend striae over the whole surface of the shell.

Since most specimens described and figured by the former palaeontologists under the name of *S. pelargonatus* show the alternation of strong and weak ribs on the surface of the shell, BROILI's view may be correct in this point. HAMLET, however, who followed BROILI in the study of some molluscan and molluscoidal remains of Timor, doubted the validity of the specific status of *S. pseudopelargonatus*; he believed that the ap-

pearance of the ornamentation on the surface of the shells seems sometimes to be quite different, owing to the different conditions of preservation. LICHAREW was of the opinion, that HAMLET's view may be correct.

Although it is an open question, whether the specimens of BROILI should be regared specifically different from the genotype of *Streptorhynchus* or not, the writers wish, respecting the specimen now in consideration, to treat it under the name of *S. pelargonatus*. They do so because there are a number of such specimens without any kinds of alternations in the strength of ribs as those described by DAVIDSON and WAAGEN under the name of *S. pelargonatus*.

The specimens figured by LICHAREW under the name of *S. pelargonatus* show traces of the alternation in the ribs, but he doubted the possibility of the separation of *S. pseudopelargonatus* from SCHLOTHEIM's species.

Besides this, the specimen now in hand, shows less numerous concentric striae; the feature is also quite common with some specimens figured by DAVIDSON and WAAGEN.

In this regard, besides the alternations of the ribs of different strength, BROILI also once placed his specimens under a species separated from *S. pelargonatus*, since the concentric striae seemed to him to be quite less numerous in the Timorean specimens than the universally known species of SCHLOTHEIM (*S. pelargonatus*).

Accordingly, if one admits the specific validity of *S. pseudopelargonatus*, the Kitakami specimen, now in hand, must be regarded to be specifically different from BROILI's species in respect to the concentric striae, and if one does not admit the validity of BROILI's species, the writers' material should be regarded to be quite the same as DAVIDSON and WAAGEN's specimens, which were described under the name of *pelargonatus*.

Now it seems considerable importance attaches to the delthyrial angle and the breadth of the delthyrium in the specimens figured by DAVIDSON; the writers are in doubt whether all these specimens really beolng to a single species or not.

Among the specimens treated in the classical monographs by DAVIDSON and others, the following specimens are, to the writers' best knowledge, most like the Kitakami specimen, viz., figs. 3 in supl. pl. XXX, DAVIDSON and 3 a–e, 4 a –c, 5 a–c, 7 a–d in plate 50, WAAGEN.

ENDERLE once described and figured a brachiopoda by the name of *Streptorhynchus* cf. *pelargonatus* from the Anthracolithic of Balia Maaden in Asia Minor. It shows similarity to the genotype of genus *Streptorhynchus* in general outer configuration, size and height of area, but specimens at hand possess area ornamented by longitudinal striae. The feature is quite different from that of SCHLOTHEIM's species and also from BROILI's species, thus ENDERLE's specimens may be specifically different from both of the latter.

Chinese specimens described by FRECH, GRABAU and HUANG under the name of *S. pelargonatus* from Lo-ping, Mongolia and Kweichou are all quite identical with SCHLOTHEIM's species, which show also quite similar aspects with the Japanese specimen now in hand, in every respect.

Hor.: Lower Kanokura-series.
Loc.: Hosoo-sawa, Tsukitate-mura, Motoyoshi-gun, Miyagi Pref.
Coll.: T. MAEKAWA. Reg. no.: 11559.

Orthotetina kayseri (JÄKEL) FLIEGEL

Pl. 24, figs. 4a, 4b, 4a', 4b'.

1883. *Streptorhynchus crenistria* var. *senilis*, KAYSER (non PHILLIPS): Obercarbonische Fauna von Lo-ping, p. 178, not figured.
1900. *Orthotetes* (*Orthotetina*) sp., SCHELLWIEN: Beiträge zur Systematik der Strophomeniden des oberen Palaeozoikum. *N. Jb. f. Min. etc.* Taf. 1, Fig. 6.
1901-1902. *Orthotetina kayseri* JÄKEL, FLIEGEL: Ueber obercarbonische Faunen Ost-und Südasien. *Palaeontographica, 48*, p. 127, Taf. VI, Fig. 9.

The specimen now in hand is strongly deformed by rock pressure and accordingly it has been much flattened and distorted, although it might have originally belonged to a somewhat distorted species.

From the present deformed specimen, it is almost impossible to imagine the original convexity of the valves, however the ventral valve might be nearly flat or somewhat concave except in the umbonal region, and further it has a very narrow and shallow sinal depression in the middle, while the dorsal valve is convex throughout, except towards the cardinal extremities, the greatest convexity being posterior to the middle.

Area of the ventral valve high, not regularly incurved. The delthyrium is covered by a pseudodeltidium, which is slightly elevated above the outer area; on both sides of the deltidium, there is a very narrow grooved portion.

Internally the delthyrial supporting plates relatively short, about one third the length of the shell; they are parallel and situated very closely in relation to each other.

The ornamentation on the surface of the valves is also not observable, because the material is preserved as a "steinkern", however there seem originally not to have existed any plicae, additional to the very fine striae.

Dimensions are as follows: length of the ventral valve, 27 mm, width 28 mm, height of area 10.6 mm, length of delthyrial supporting plate 11.3 mm, and the width of delthyrium at the base 7 mm.

Remarks: The specimens collected by RICHTHOFEN at Lo-ping in Southern China and described and figured by KAYSER in RICHTHOFEN's China, unfortunately do not belong to a single species. Of them, SCHELLWIEN regarded the specimen which KAYSER figured in his plate XXIII as fig. 1, 1a to be an independent species both from PHILLIPS' species and from the other specimens figured by KAYSER in his plate XXIII as figs. 2 to 7. SCHELLWIEN named it as *Streptorhynchus kayseri* SCHELLWIEN.

Furthermore, FLIEGEL also established a new species on the basis of specimens figured by KAYSER in his plate XXIII as figs. 2, 5, and 7, which was called by him under the name *Orthotetes circularis* FLIEGEL.

Now, *Orthotetes circularis* FLIEGEL must be regarded to belong to the genus *Orthoteteina* SCHELLWIEN, from the internal structure of the apical part of the shell, which is clearly observable from the figures given by SCHELLWIEN.

Also FLIEGEL wrote once as follows: "Wesentliches Gattungsmerkmal ist das Auftreten zweier kräftiger Septen in der grossen Klappe, die jedoch nicht bei den alteren Orthoteten divargieren, sondern ziemlich parallel, dicht nebeneinander vom Wirbel aus verlaufen (*Orthotetina* SCHELLWIEN)".

Meanwhile JÄKEL distinguished one other species as an independent form in the collection of RICHTHOFEN, which was treated also by KAYSER under the name

Streptorhynchus crenistria var. *senilis*, but was not illustrated by him. JÄKEL called this specimen by the name *Orthotetes kayseri* JÄKEL (FLEIGEL, 1901–1902), although he did not publish any discussion concerning this.

Later SCHELLWIEN examined this specimen himself which was named by JÄKEL as *Orthotetes kayseri*, and he transferred this species into *Orthotetes* (*Orthotetina*).

Now the Kitakami specimen, though it is quite poor condition for specific identification, being much deformed and the external sculpture being unobservable, may quite nearly resemble or rather be identical with the figured specimen by FLIEGEL, as well as that of SCHELLWIEN by the name of *Orthotetina kayseri* JÄKEL, at least in respect to the apical struture and the outer configuration of shell.

This species is easily distinguishable from *Orthotetina circularis* FLIEGEL in having definite sinal depression in the ventral valve.

Hor.: Lower Kanokura-series.
Loc.: Matsukawa, Niitsuki-mura, Motoyoshi-gun, Miyagi Pref.
Coll.: M. AKATSUKA. Reg. no.: 17071.

Orthotetes rugosa FREDERICKS

Pl. 24, Figs. 2a, 2b, 2c, 2d.

1925. *Orthotetes rugosa*, FREDRICKS: Upper Palaeozoic of the Ussuriland, Permian brachiopoda of Cape Kalouzin. *Rec. Geol. Comm. USSR. Far East. No. 40*, pl. 1, figs. 25-34.

1925. *Orthotetes rugosa*, HAYASAKA: On some brachiopods from the *Lyttonia* horizon of the Kitakami mountains. *Japan. Jour. Geol. Geogr. vol. IV*, p. 91, pl. V, fig. 1.

Several specimens are now available for study. Of them, one is preserved as a "steinkern" representing the internal surface of the valves. The dimensions of this specimen follow: width 48 mm, length 34.5 mm (ventral valve) and thickness 15.0 mm, and the corresponding external mold has the following dimensions: width 57 mm, and length 35.0 mm.

This specimen, however, is strongly deformed by pressure after the fossilization, and is observed to be much elongated transversely, while it seems to be fairly reduced in length, because the anterior part, including the anterior commissure is seen to be bent toward the ventral side. Accordingly the dimensions enumerated above do not show by any means the correct size of this shell. Originally the specimen now in concern, might be longitudinally a longer form.

The ventral valve with beak much pointed and erected, is highly convex in the umbonal region, becoming flat in the medial area, while it becomes decidedly resupinate anteriorly.

The dorsal valve with greater convexity in the medial region, becomes flat forward and only gently arched towards the sides, while the visceral part is rather flat.

Internally, the median septum is well preserved in the ventral valve as a mold, the posterior end of which unites the spondylium, although one half of the spondylium was broken off before the specimen was collected.

The impressions of the muscular scars are also well preserved on both sides of the septum, which is semi-circular in outline.

In the interior of the dorsal valve, the bilobed cardinal process and median septum and adductor scars are observable, the latter of which consist of four scars; the anterior pair is rather shallow and wide, while the posterior pair is deep and narrow.

The surface of both valves observed on the specimen attach to the "steinkern" noted above as well as other fragmental specimens is ornamented by very fine radial striae and by very coarse and irregular wrinkles like concentric markings, which give the shell, especially near the anterior commissure a much distorted and irregular appearance. Also the radial striae increase anteriorly by intercalations.

Remarks: Although all the specimens, now in concern are quite imperfect, it is indubitable that they are assignable to the genus *Orthotetes* from their internal structure, and the ornamentation of the shell. Among the species hitherto described, the present specimens may be most nearly related or rather identical with *Orthotetes rugosa* described by FREDERICKS from Ussuri and also by HAYASAKA from Kitakami district, especially in having quite irregular concentric wrinkle-like markings on the surface of shell, besides very fine radiating striae.

Hor.: Lower Kanokura series.
Loc.: Kanokura-sawa, Setamai-machi, Kesen-gun, Iwate Pref.
Coll.: M. MINATO. Reg. no.: 17191, 11531;
Coll.: H. SUETOMI. Reg. no.: 11395.

Geyerella ? sp. indet.

Pl. 24, fig. 3.

The fragmental specimen only is available, which may be an external mold of the ventral valve belonging to a species of Orthotetinae; the posterior part of it is not preserved, and the internal structure is wholly unknown.

Therefore it is almost impossible to assign this specimen to any genus or species. However, from the general outer form and the nature of plications, besides the longitudinal striae developing on the whole surface of the valve, this specimen seems to be referable to *Geyerella*, especially it may resemble *Geyerella tschernyschewi* var. *latiareata* described and figured by LICHAREW from Northern Caucasus, in association with *Derbya magnifica*, *Streptorhynchus pelargonatus* etc.

The plications of this specimen now in hand are somewhat weak and indistinct at the posterior portion, but become stronger and more angulated towards the anterior margin of the shell.

Hor.: Lower Kanokura-series.
Loc.: Hosoo-sawa, Tsukitate-mura, Motoyoshi-gun, Miyagi Pref.
Coll.: T. MAEKAWA. Reg. no.: 11551.

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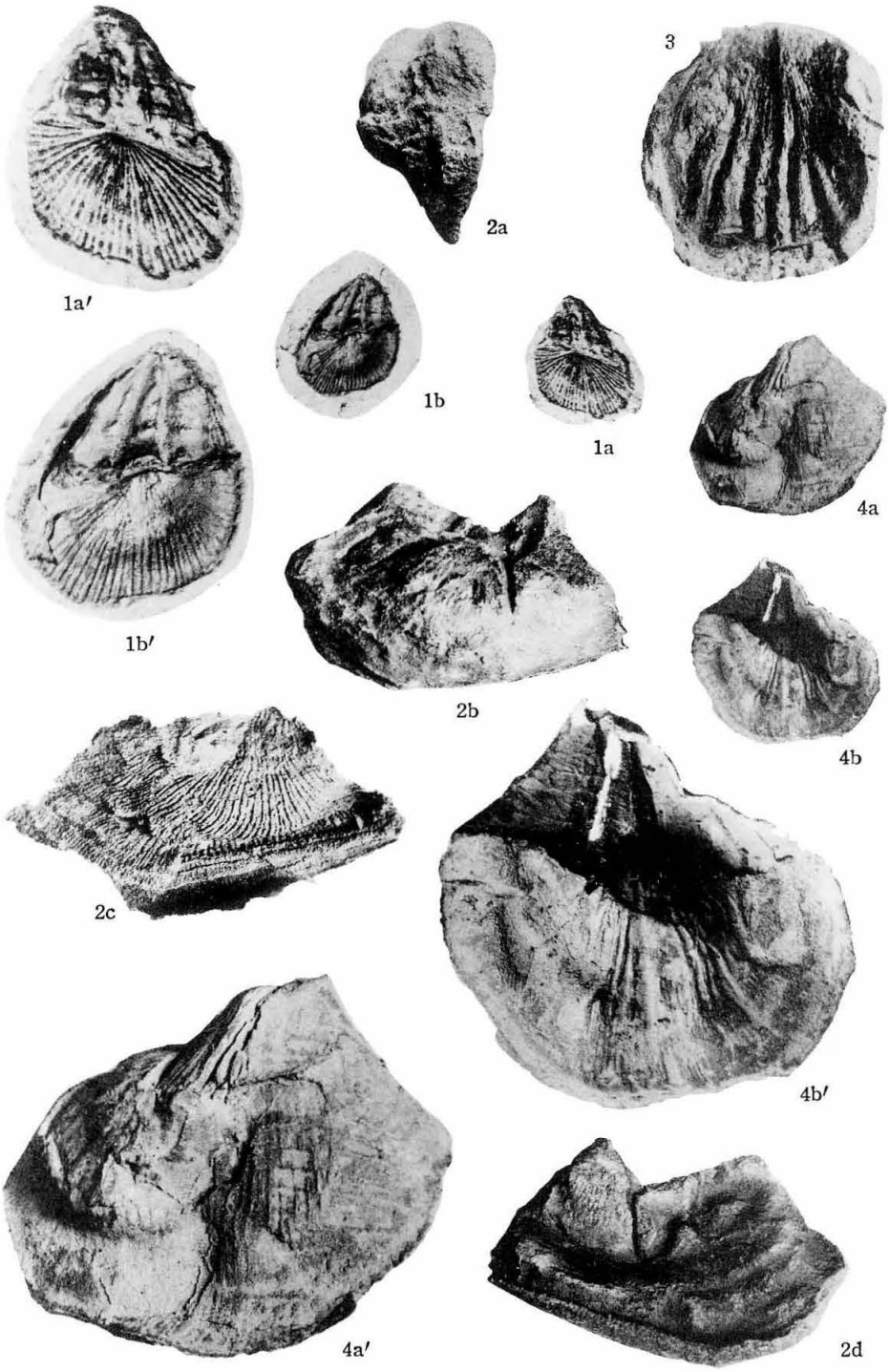

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Explanation of Plate 24

Figs. 1a, 1a′, 1b, 1b′. *Streptorhynchus pelargonatus* SCHLOTHEIM. 1a, 1b, (×1) 1a′, 1b′, (×2) Reg. no.: 11559. Hosoo-sawa, Tsukitate-mura, Motoyoshi-gun. Miyagi Pref.

Figs. 2a, 2b, 2c, 2d. *Orthotetes rugosa* FREDERICKS. (×1) Reg. no.: 11395. Kanokura-sawa, Setamai-machi, Kesen-gun, Iwate Pref.

Fig. 3. *Geyerella* sp. (×1) Reg. no.: 11551. Hosoo-sawa, Tsukitate-mura, Motoyoshi-gun, Miyagi Pref.

Figs. 4. *Orthotetina kayseri* (JÄKEL) FLIEGEL. 4a, 4b, (×1) 4a′, 4b′, (×2) Reg. no.: 17071. Matsukawa, Niitsuki-mura, Motoyoshi-gun, Miyagi Pref.

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283. A NEW SPECIES OF *PARAFUSULINA* FROM THE KITAKAMI MASSIF, JAPAN*

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北上山地気仙地方の紡錘虫でこれまで俗に松葉石とよび，*Schwagerina wanneri* (SCHUBERT) または *Parafusulina wanneri* (SCHUBERT) として報ぜられていた *Parafusulina* の一種に *Parafusulina matsubaishi* FUJIMOTO と命名報告する。 藤本治義

Introduction

A peculiar type of Fusulinid, commonly called "Matsubaishi" in Japanese occurs abundantly in the marine Permian deposits of many localities of the Kitakami Massif. Its mother rocks are generally calcareous sandstone or arenaceous shale. The fossils have highly elongate subcylindrical to cylindrical shells and resemble pine-needles in shape, whence their Japanese name.

The specimens were previously reported by Y. ONUKI (1938), I. SHIIDA (1940) and others as *Schwagerina wanneri* (SCHUBERT) or as *Parafusulina wanneri* (SCHUBERT); they are here referred to *Parafusulina matsubaishi* FUJIMOTO, n. sp. The description of this new species is presented in this article, and are from the four localities mentioned below.

1. Omotematsukawa, Niitsuki-mura, Motoyoshi-gun, Miyagi Prefecture. Collected by the writer.
2. Kamiyase, Niitsuki-mura, Motoyoshi-gun, Miyagi Prefecture. Collected by R. YAMADA
3. Iwaizaki, Higashigami-mura, Motoyoshi-gun, Miyagi Prefecture. Collected by R. MORIKAWA and the writer.
4. Imo, Yahagi-mura, Kesen-gun, Iwate Prefecture. Collected by R. YAMADA.

About fifteen years ago Isao SHIIDA carried out a detailed geological research of the Kesen-machi district in which these fossil localities are included. According to him, the order of succession of the Permian deposits is as follows (in descending order:—

Kesennuma Group	Futatsumori Formation	Mostly clayslate, conglomerate, sandstone and limestone. About 1000 meters in thickness.
	Kamiyase Formation	Mostly limestone, clayslate, conglomerate and schalstein. About 500 meters in thickness.

I. SHIIDA obtained many specimens of *Parafusulina wanneri* of I. SHIIDA (=*Parafusulina matsubaishi* n. sp.) from the upper part of his Kamiyase Formation as well as from the Futatsumori. Those of the former are said to be associated with *Schwagerina japonica* (GÜMBEL), *Pseudofusulina kraffti* (SCHELLWIEN, *Pseudofusulina solida* (COLANI) and *Parafusulina richthofeni* (SCHWA-

* Read July 19, 1954; received Sept. 19, 1955

GER), and with the latter were found *Yabeina* cf. *hayasakai* OZAWA, *Yabeina shiraiwensis* OZAWA, *Leptodus richthofeni* (KAYSER), and etc.

The specimens from the Kamiyase Formation dealt with in this paper were collected at Omotematsukawa in Niitsuki-mura.

With regard to the Iwaizaki district there are many important stratigraphical studies by S. MABUCHI, Y. INAI, I. SHIIDA, S. HANZAWA and others. According to S. HANZAWA and S. MABUCHI there are five main fossil zones, which in descending order, are :—

1. *Richthofenia* zone
2. *Yabeina* zone
3. { a-*Neoschwagerina-Verbeekina* zone
   { b-*Waagenophyllum* zone
   { c-*Parafusulina* zone

Parafusulina spp. including *Parafusulina wanneri* of I. SHIIDA were found in the *Parafusulina* to *Yabeina* zones in association with many other Permian fossils.

The Yahagi-mura and Setamai-mura districts immediately north of the Niitsuki-mura district are well known for their typical development of upper Paleozoic rocks. Yoshio ONUKI (1938) and Masao MINATO (1954) carried out precise stratigraphical and paleontological studies in those districts and were successful in obtaining the *Parafusulina* now in question.

According to Y. ONUKI the *Parafusulina* which the writer regards to represent a new species, ranges from the upper part of the Sakamotozawa series (*Pseudoschwagerina* and Algae zone) to the lower part of the Umenoki series through the Kanokura series. The specimens described as *Schwagerina wanneri* (SCHUBERT) or as *Parafusulina* cf. *wanneri* (SCHUBERT) by these authors are probably the same as *Parafusulina matsubaishi* of the writer.

From the foregoing studies, *Parafusulina matsubaishi* n. sp. occurs in the Kitakami Massif from the *Pseudoschwagerina* zone (upper part of the Sakamotozawa series) to the *Yabeina* zone, and its acmaic stage of development is presumed to be between the zones of *Pseudoschwagerina* and *Neoschwagerina*. Thus it is concluded that the zone of *Parafusulina matsubaishi* lies between these two.

Acknowledgements

The writer thanks Messrs. R. MORIKAWA and R. YAMADA for the opportunity to study the valuable materials.

Description of the New Species

Parafusulina matsubaishi FUJIMOTO, new species

Pl. 25, Figs. 1-10.

The shell is large, highly elongate subcylindrical and needle-like, with straight to slightly curving axis of coiling, tapered and pointed polar ends. Mature shells of five to seven volutions, measuring 18 to 21 mm long and 1.43 to 2.00 mm wide, giving form ratio of 12 to 10.5. The inner one volution is subspherical and the next two or three volutions are fusiform with sharply pointed poles. Beyond the fourth volution, the shell becomes more cylindrical and the poles become somewhat blunt.

The proloculi of most specimens are nearly spherical but in some they are irregular. Diameters measure 160 to 300 μ, averaging 220 μ for five specimens.

The spirotheca is thin, and almost the same as in *Parafusulina wanneri* (SCHUBERT). Alveoli are coarse and

distinct throughout the keriotheca.

The septa are closely spaced. The average septal counts of the first to sixth volutions are about 8, 18, 21, 23, and 30, respectively. They are strongly fluted in their lower part but become almost plain above. Cuniculi are distinct in at least the outer four volutions, but they are narrow and low.

The tunnel is rather high and not broad. Axial fillings are heavy and present in all volutions.

Table of measurements of *Parafusulina matsubaishi* n. sp. (in mm.)

	Prol.	1	2	3	4	5	6	7	8	Reg. No. Locality
Width of volutions	0.16	0.44	0.64	0.88	1.24	1.72				19421 Omotematsukawa
	0.28	0.40	0.56	0.80	1.08	1.44	1.98			19455 Tsukitate
	0.20	0.40	0.64	0.84	1.12	1.44	1.98			19496 Tsukitate
	0.16	0.28	0.48	0.72	1.04	1.48				19496 Tsukitate
	?	?	0.48	0.76	1.04	1.48	2.00			19456 Omotematsukawa
	0.30	0.43	0.57	0.81	1.16	1.48	1.95	2.29	2.85	*Parafusulina wanneri* after THOMPSON
Thickness of spirotheca	0.015	0.020	0.030	0.038	0.045	0.045	0.060			19421 Omotematsukawa
		0.022	0.030	0.036	0.038	0.050	0.063	0.079	0.082	*Parafusulina wanneri* after THOMPSON
Septal count		?	22	22	25	27	30			19421 Omotematsukawa
		11	17	22	23	26?				19495 Tsukitate
		6	14	18	22	72				19496 Tsukitate
		10	17	17	15	19	20			*Parafusulina wanneri* after SCHUBERT
		11	18	17	19	20	22	24	24	*Parafusulina wanneri* after THOMPSON

For comparison with the new species, *P. wanneri* after Schubert, and *P. wanneri* after THOMPSON are inserted.

Length	Width	L/W	No. volutions	Reg. No.	Locality of Specimen
18.00	1.48	12	5	19496	Tsukitate
21.00	2.0	10.5	6	19456	Omotematsukawa
18.00	1.60	11	5		Iwaizaki
15.00	2.9	5.1	7½	*P. wanneri* after THOMPSON for comparison	
18.00	2.9	6.2	8	*P. wanneri* after THOMPSON for comparison	
13.00	2.5	5.2	7	*P. wannerii* after SCHUBERT for comparison	
14	3	4.7	7	*P. lutugini* SCHELLWIEN for comparison	
16	4	4	10	*P. kaerimizensis* (OZAWA) for comparison	
14	2.7	6	6	*P. kattaensis* (SCHWAGER) for comparison	

Remarks:—*Parafusulina matsubaishi* n. sp. resembles *Parafusulina wanneri* (SCHUBERT) more closely than other species of the genus. However, the present new species can be distinguished from the mentioned one by the more elongate subcylindrical to cylindrical shell, more tapered and pointed polar ends, and by the inner one volution being more spherical.

Occurrence:— *Parafusulina matsubaishi* is abundant in the calcareous sandy shale or fine grained sandstone at Omotematsukawa. The specimens of this species are found concentrated in layers several centimeters thick with their axis parallel (Figs. 9, 10), just as in the same manner as *Parafusulina wanneri* in the Permian of Timor.

Repository:—The specimens treated in this paper are deposited in the collection of the Geological and Mineralogical Institute, Tokyo University of Education.

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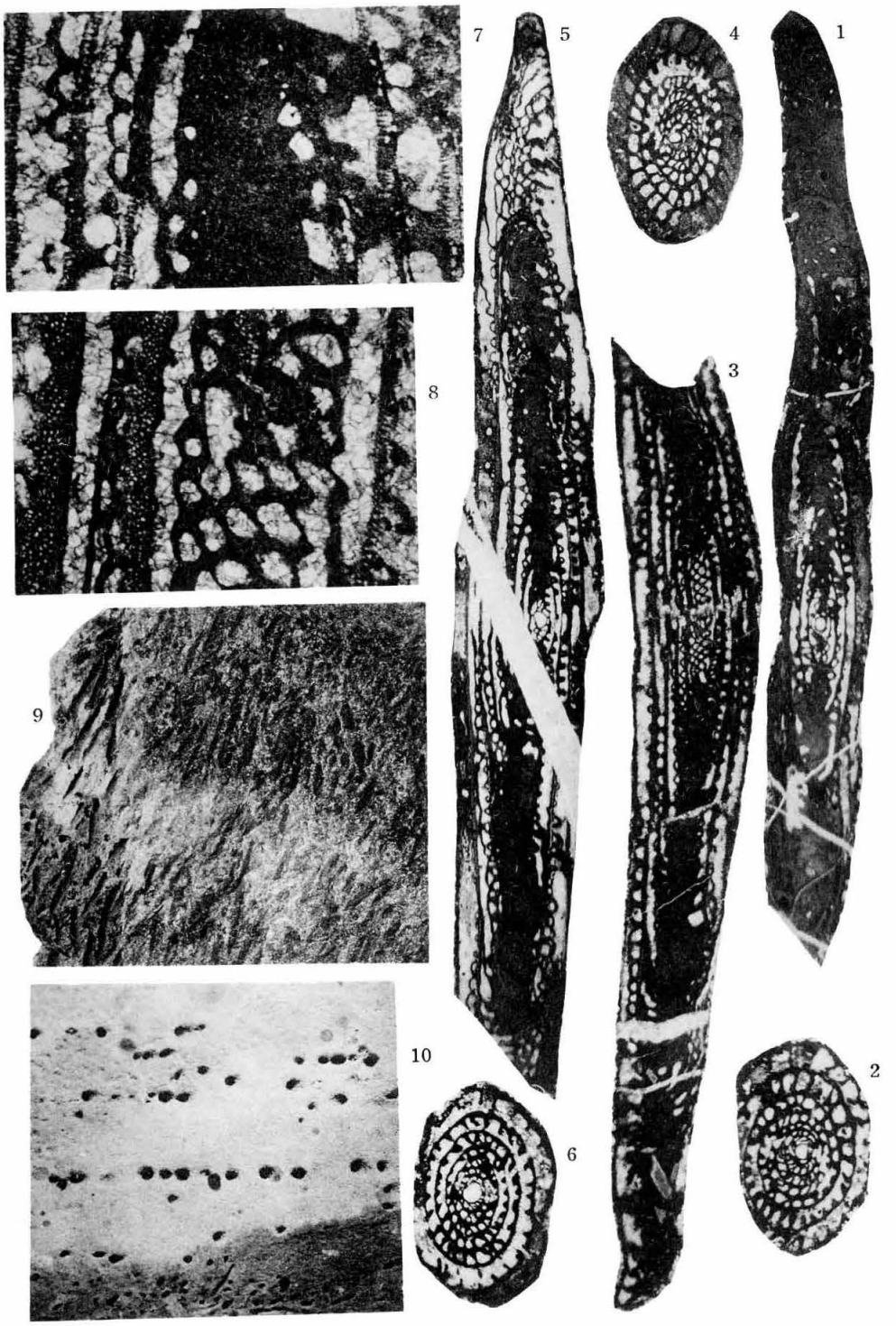
Explanation of Plate 25

Parafusulina matsubaishi FUJIMOTO, n. sp.

Fig. 1. Axial section of the paratype, ×10. Reg. No. 19496. Loc. Tsukitate.
Fig. 2. Sagittal section of the paratype, ×10. Reg. No. 19495. Loc. Ditto.
Fig. 3. Axial section of the paratype, ×10. Reg. No. 19456. Loc. Omotematukawa.
Fig. 4. Sagittal section of the paratype, ×10. Reg. No. 19421. Loc. Ditto.
Fig. 5. Axial section of the holotype, ×10. Reg. No. 19495, Loc. Tsukitate.
Fig. 6. Sagittal section of the paratype, ×10. Reg. No. 19495, Loc. Ditto.
Fig. 7. Enlarged part of an axial section of the paratype, showing the structure of the spirotheca ×40. Reg. No. 20002. Loc. Omotematsukawa.
Fig. 8. Enlarged part of a tangential section of the paratype, showing the structure of the spirotheca, ×40. Reg. No. 19498. Loc. Omotematsukawa.
Fig. 9. Sample of sandstone with abundant specimens of this species, note their parallel arrangement against the bedding plane, natural size. Loc. Omotematsukawa.
Fig. 10. Sample of sandstone with abundant specimens of this species, at right angles to the bedding plane, natural size. Loc. Omotematsukawa.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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 21, pp. 161—167, Pl. 26, Apr. 15, 1956

284. MIOCENE MOLLUSCA FROM NOTO PENINSULA, JAPAN. PART 1, (II)*

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能登半島の中新世軟体動物；その 1. (II)： 先に掲げた二枚貝 4 種と巻貝 1 種の記載に続いて．本編では巻貝 8 種の記載を掲げた。 増田孝一郎

Family Potamididae

Genus *Vicaryella* YABE and HATAI, 1938

Vicaryella notoensis MASUDA, n. sp.

Pl. 26, figs. 2-4.

Shell rather large, highly turreted, with 15 whorls preserved; apical angle about 20°. Whorls with straight sides, gradually growing, separated from one another by a distinct, flat-topped, smooth and elevated sutural band; surface sculptured by one strongly beaded and two smaller beaded, elevated spiral cords on all except for younger whorls; beaded spiral cords become strong, and secondary spiral cords appear in their interspaces with growth towards the older whorls; these spiral cords are nearly equally spaced. Last whorl sculptured with one strongly beaded upper spiral cord consisting of about 24 tubercles to a whorl, two smaller beaded lower spiral cords separated by a beaded spiral cord between them, and three fine smooth, occasionally undulated subsutural spiral cords; base of whorl with about 12 unequal, nearly equally spaced spiral threads among which the 3rd from sutural band is most distinct, and provided with several, more or less distinct costa and fine incremental threads near the outer lip. Aperture squarely oblique in shape, extending to above lowest sutural band of ultimate whorl, posteriorly grooved; inner lip distinct, furnished with very large and thick callus; outer lip thick above and thin below, and undulatory. Columella short, slightly bent, furnished with one strong significant fold; canal short and bent. Dimensions (in mm.):—Height 60, diameter 20 (holotype).

Occurrence:—Abundant.

Depository:—DGS, Reg. No. 1410 (holotype).

Remarks:—This new species is characterized by its highly turreted and large shell, about 15 whorls, apical angle of about 20°, spiral sculpture, and columella. As a rule, of the preserved whorls the younger ones are sculptured with three beaded spiral cords, consisting of a strongly beaded spiral cord above and two less elevated and beaded ones; at the 9th whorl a primary spiral cord appears between the lower and middle spiral cords; at the 7th whorl a secondary

* Read June 28, 1955; received July 20, 1955

spiral cord appears between the upper spiral cord and the sutural band; at the 6th whorl a third spiral cord appears between the upper and middle spiral cords; at the 4th whorl a fourth spiral cord appears between the lower spiral cord and sutural band of next whorl; at the 3rd whorl the primary spiral cord tends to become beaded.

This species resembles *Vicaryella ishiiana* (YOKOYAMA) (YOKOYAMA, 1926, p. 218, pl. 28, figs. 11, 12), but it is distinguishable therefrom by the less number of spiral cords, less number of tubercles on the spiral cords, and more simple sculpture.

Genus *Cerithidea* SWAINSON, 1840

Cerithidea tokunariensis MASUDA, n. sp.

Pl. 26, figs. 6-7.

Shell small in size, rather thin, turreted, consisting of about 9 whorls, younger whorls lost; apical angle about 30°. Whorls slightly convex, gradually growing, separated from each other by a more or less distinct fine sutural band. Surface ornamented by distinct longitudinal ribs and spiral cords; ribs subvertical, numbering about 18 on body whorl, separated by much broader interspaces except for varix, about 16 on penultimate whorl among which one is varix; diminishing their number towards the upper whorls and without trace of varix; interspaces between ribs much wider than ribs themselves; spiral cords rather distinct, much narrower than their interspaces, numbering about 6 on body whorl, and diminishing their number towards the upper. Base of whorl with 2 faint sutural bands and fine incremental lines. Aperture subovate, with shallowly notched anterior canal, roundly angulated at periphery, and convex above near base; outer lip notched posteriorly and thickend by terminal ribs; inner lip smooth with narrowly spread thick callus. Dimensions (in mm):—Height 9.6, diameter 4.2(holotype).

Occurrence:—Common.

Depository:—DGS, Reg. No. 1536 (holotype).

Remarks:—This species resembles *Cerithidea tokunagai* OTUKA (OTUKA, 1938, p. 39, pl. 3, fig. 29) from the Miocene Shôbara formation developed at Shôbara-machi, Higa-gun, Hiroshima Prefecture, but it is distinguishable therefrom by the larger shell, smaller apical angle (about 18°), and narrower interspaces between the spiral cords. Another related species is *Cerithidea ozakii* NOMURA (NOMURA, 1935, p. 229, pl. 17, fig. 22) from the Chiganoura formation at Shiogama-shi, Miyagi Prefecture, but that species has distinctly impressed sutures.

Family Naticidae

Genus *Polinices* MONTFORT, 1810

Polinices (Euspira) otukai MASUDA, n. sp.

Pl. 26, figs. 9a-b.

1938. *Natica (Euspira)* aff. *maisensis*(MAKIYAMA), OTUKA, *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2, Vol. 5, pt. 2*, p. 37, figs.25,28.

Shell rather small in size, rather thick, obliquely globose; about 4 whorls, ventricose; nuclear whorl very small, but distinct; body whorl very large, base rounded; surface sculptured with fine, close-set, subequal incremental lines. Suture rather distinct, and slightly channelled on early whorls. Aperture oblique, having broad, rounded anterior side and narrow posterior side. Outer lip simple and sharp; inner lip nearly straight but slightly concave near the base. Umbili-

cus small and elongated; callus rudimental. Dimensions (in mm.):—Height 17.6, width 9.0, maximum diameter of aperture 9.8 (holotype).
Occurrence:—Rare.
Depository:—DGS, Reg. No. 1408 (Holotype).
Remarks:—This species is characterized by its obliquely globose shell, aperture with broad anterior side and narrow posterior side, small and elongated umbilicus, and rudimental callus.

Polinices (*Euspira*) *meisensis* MAKIYAMA (MAKIYAMA, 1926, p. 150, pl. 12, figs. 7, 8) is related to the present species, but *P. otukai* is distinguishable therefrom by the obliquely globose shell, small umbilicus, and by the aperture being anteiorly broad and posteriorly narrow.

Family Muricidae

Genus *Chicoreus* MONTFORT, 1810

Chicoreus asanoi MASUDA, n. sp.

Pl. 26, figs. 10-11.

1950. *Chicoreus* (*Rhizophorimurex*) *tiganouranus* (NOMURA), OYAMA, *Geol. Surv. Japan, Rep. No. 132*, p. 11, Pl. 1, figs. 5a-b, 6a-b.

Shell moderate in size, thick, ovate, provided with 7 whorls; apical angle about 60°. Whorls rapidly enlarging, shoulders rounded, separated from each other by more or less indistinct sutures, sculptured with longitudinal ribs, faint incremental lines and spiral threads; longitudinal ribs prominent, subvertical, numbering about 11 on body whorl and diminishing their number towards the upper whorls, separated by interspaces nearly equal or slightly wider than ribs themselves; spiral threads numerous, distinct, fine, separated by wider interspaces, with very fine subordinate spiral threads between the main spiral threads, rapidly diminishing their number towards the upper whorls; body whorl large, roundly shouldered above and rather abruptly narrowed towards base. Basal fasciole defined with a shallow groove. Aperture narrowly ovate or near-shaped; outer lip thick and denticulated within; inner lip smooth, with thin callus; canal long, curved and open. Dimensions (in mm.):—Height 23.8, diameter 12.7 (holotype).
Occurrence:—Abundant.
Depository:—DGS, Reg. No. 2500 (Holotype).
Remarks:—This species resembles *Murex tiganourana* NOMURA (NOMURA, 1935, p. 225, pl. 17, fig. 18) described from the Miocene Chiganoura formation, at Chiganoura, Shiogama-shi, Miyagi Prefecture, but it differs therefrom by the less number of whorls, and more prominent spiral threads.

This species is named in honor of Dr. Kiyoshi ASANO who assisted the writer in his field work.

Chicoreus notoensis MASUDA, n. sp.

Pl. 26, figs. 12a-c.

Shell moderate in size, thick, ovate, provided with 5 whorls, younger whorls lost; apical angle about 70°. Body whorl very large, contracted below. Whorls rapidly enlarging, angularly shouldered, separated from each other by indistinct sutures; surface sculptured with distinct, subvertical longitudinal ribs, fine incremental lines and numerous, distinct, fine spiral threads with fine subordinate spiral threads; body whorl sculptured with 5 prominent longitudinal ribs and two conspicuous revolving ridges, 4 weaker longitudinal ribs with no ridge, incre-

mental lines and spiral threads; interspaces between longitudinal ribs much broader than ribs themselves on the body whorl, spiral threads separated by wider interspaces; younger whorls sculptured with longitudinal ribs separated by interspaces nearly equal in breadth and spiral threads. Basal fasciole distinctly defined with a deep groove. Aperture nearly ovate outer lip thick, denticulated within; inner lip smooth with rather thick callus; canal curved, more or less long and open. Dimensions (in mm.):—Height 33.2, diameter ca. 20.5(holotype).

Occurrence:—Few.

Depository:—DGS, Reg. No. 2503(Holotype).

Remarks:—This species is characterized by the few number of prominet longitudinal rids and by the two conspicuous ridges. This species is distinguishable from *Chicoreus asanoi* described in this article by the larger shell, the less number of longitudinal ribs, and the two conspicuous ridges.

Family Nassariidae

Genus *Nassarius* DUMÉRILL, 1806

Nassarius notoensis MASUDA, n. sp.

Pl. 26, figs. 13-14.

Shell small in size, rather thick, globose, stout, consisting of about 7 whorls; apical angle about 40°. Whorls moderately inflated, separated from each other by distinctly impressed sutures; ornamented with smooth longitudinal ribs and numerous faint fine spiral threads; ribs suboblique, numbering about 13 on body whorl, diminishing their number towards upper whorls, and separated by interspaces much wider than ribs themselves; interspaces between ribs sculptured with fine incremental lines and spiral threads. Body whorl large, convex, contracted below; basal fasciole distinct. Aperture roundly ovate, oblique, with deeply notched anterior canal, posterior angle acute; outer lip thick, smooth within; inner lip smooth with narrowly spread rather thick callus. Dimensions (in mm.):—Height 6.5, diameter 3.7(holotype), height 8.3, diameter 5.0, height 6.4, diameter 3.4, height 6.6, diameter 3.6 (paratypes).

Occurrence:—Abundant.

Depository:—DGS, Reg. No. 1538 (Holotype).

Remarks:—This species resembles *Nassarius* (*Hinia*) *perdominulus* NOMURA and ZINBO (NOMURA and ZINBO, 1935, p. 177, pl. 15, figs. 16, 17) described from the Miocene Yanagawa formation at Yanagawa-machi, Fukushima Prefecture, but it is distinguishable therefrom by the less number of longitudinal ribs, rather distinct spiral threads, almost equal width of interspaces, and more stumpy shell. Another related species is *Nassarius* (*Hinia*) *hemipolitus* NOMURA and ZINBO (NOMURA and ZINBO, 1935, p. 177, pl. 15, figs. 19, 20), but it differs therefrom in having a less number of ribs which are about equal to or slightly narrower than their interspaces in breadth, and larger aperture.

Family Pyramidellidae

Genus *Pyramidella* LAMARCK, 1799

Pyramidella hataii MASUDA, n. sp.

Pl. 26, figs. 15a-b.

Shell small in size, thin, slightly umbilicated, regularly turreted, with 8 whorls, youngest whorl lost; apical angle about 25°. Whorls flattish, gradually growing, separated from each other by moderately channelled, smooth bottomed

sutures. Sculpture consists of faint incremental lines. Body whorl about 1/3 of shell length; flattened above, rounded at periphery, slightly convex at base. Columella straight, with three unequal folds, the upper two larger and stronger, and the lowest less strongly developed. Aperture ovate, moderate in size, with acute posterior angle, rounded anteriorly; outer lip thin, simple, and inner lip more or less distinct. Dimensions (in mm.):—Height 9.3, diameter 3.7 (holotype).

Occurrence:—Rare.

Depository:—DGS, Reg. No. 1540 (Holotype).

Remarks:—This is the first record of the genus *Pyramidella* from the Miocene formations of Japan.

This species resembles *Pyramidella mexicana* DALL and BARTSCH (DALL and BARTSCH, 1909, p. 23, pl. 1, fig. 12), but the latter has no umbilicus, and has a much stronger upper fold in the columella, a little larger apical angle and a larger shell.

This species is named in honor of Dr. Kotora HATAI.

Family Triclidae

Genus *Acteocina* GRAY, 1847

Acteocina hamadai MASUDA, n. sp.

Pl. 26, figs. 16a–b.

Shell very small in size, thin, smooth, cylindrical in form, truncated above, rounded below; consisting of about 4 flat, cylindrical whorls separated from each other by more or less distinct, channelled sutures. Body whorl very large, occupying the greater part of shell, with microscopic incremental lines, which are rather distinct at upper and lower parts. Spire very low and nearly flat above. Aperture long, narrow, linear in upper half, and gradually dilated downwards; outer lip thin; inner lip with thin callus. Dimensions (in. mm.):—Height 3.4, diameter 1.6 (holotype).

Occurrence:—Rare.

Depository:—DGS, Reg. No. 1654 (Holotype).

Remarks:—This may be the first discovery of the genus from the Tertiary strata of Japan.

This species resembles *Acteocina dulcis* (YOKOYAMA) (YOKOYAMA, 1927, p. 449, pl. 51, fig. 2), but it differs therefrom in having deeply and broadly channelled sutures, many distinct incised spiral lines, and a weak oblique fold.

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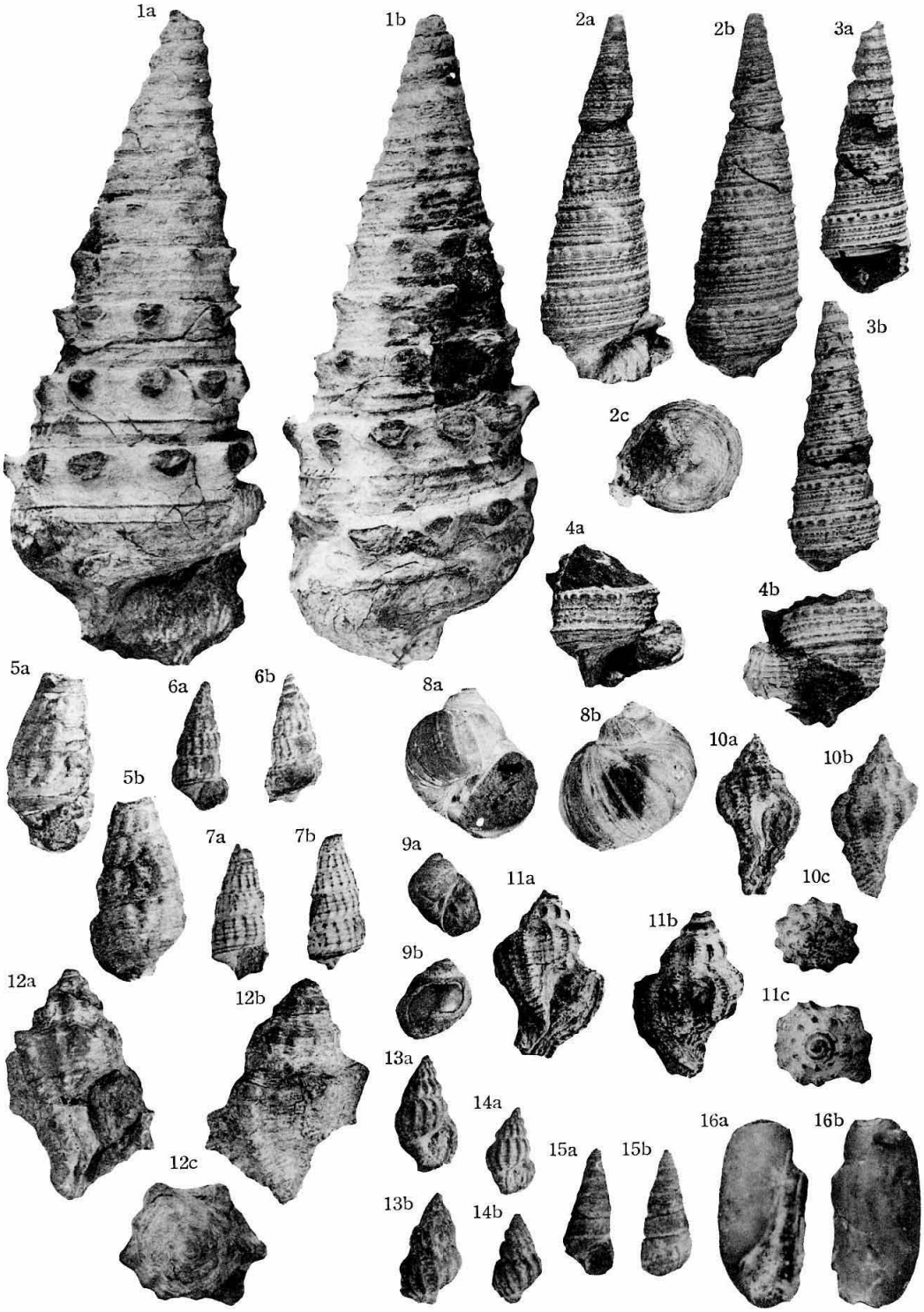

K. KUMAGAI photo.

Explanation of Plate 26

Figs. 1a-b. *Vicarya callosa japonica* YABE and HATAI, IGPS,* coll. cat. no. 74449. a, Apertural view, x 1. b, Dorsal view, x 1. Loc. Tokunari, Machino-machi, Fugeshi-gun, Ishikawa Prefecture.

Figs. 2a-c. *Vicaryella notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 1410. a, Apertural view, x 1. b, Dorsal view, x 1. c, Umbilical view, x 1. Loc. Same as above.

Figs. 3a-b. *Vicaryella notoensis* MASUDA, n. sp. Paratype, DGS, Reg. No. 1410. a, Apertural view, x 1. b, Dorsal view, x 1. Loc. Same as above.

Figs. 4a-b. *Vicaryella notoensis* MASUDA, n. sp. Paratype, DGS, Reg. No. 1410. a, Apertural view, x 1. b, Dorsal view, x 1. Loc. Same as above.

Figs. 5a-b. *Cerithidea kanpokuensis* MAKIYAMA, DGS, Reg. No. 1533. a, Apertural view, x 1. b, Dorsal view, x 1. Loc. Same as above.

Figs. 6a-b. *Cerithidea tokunariensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 1536. a, Apertural view, x 3. b, Dorsal view, x 3. Loc. Same as above.

Figs. 7a-b. *Cerithidea tokunariensis* MASUDA, n. sp. Paratype, DGS, Reg. No. 1536. a, Apertural view, x 3. b. Dorsal view, x 3. Loc. Same as above.

Figs. 8a-b. *Polinices (Euspira) meisensis* MAKIYAMA, DGS, Reg. No. 1407. a, Aertural view, x 1. b, Dorsal view, x 1. Loc. Same as above.

Figs. 9a-b. *Polinices (Euspira) otukai* MASUDA, n. sp. Holotype, DGS, Reg. No. 1408. a, Apertural view, x 1. b, Dorsal view, x 1. Loc. Same as above.

Figs. 10a-c. *Chicoreus asanoi* MASUDA, n. sp. Holotype, DGS, Reg. No. 2500. a, Apertural view, x 1. b, Dorsal view, x 1. c, Apical view, x 1. Loc. Same as above.

Figs. 11a-c. *Chicoreus asanoi* MASUDA, n. sp. Paratype, DGS, Reg. No. 2500, a. Apertural view, x 1. b, Dorsal view, x 1. c. Apical view, x 1. Loc. Same as above.

Figs. 12a-c. *Chicoreus notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 2503. a, Apertural view, x 1. b, Dorsal view, x 1. c, Apical view, x 1. Loc. Same as above.

Figs. 13a-b. *Nassarius notoensis* MASUDA, n. sp. Holotype, DGS, Reg. No. 1538. a, Apertural view, x 3. b, Dorsal view, x 3. Loc. Same as above.

Figs. 14a-b. *Nassarius notoensis* MASUDA, n. sp. Paratype, DGS, Reg. No. 1538. a, Apertural view, x 3. b, Dorsal view, x 3. Loc. Same as above.

Figs. 15a-b. *Pyramidella hataii* MASUDA, n. sp. Holotype, DGS, Reg. No. 1540. a, Apertural view, x 3. b, Dorsal view, x 3. Loc. Same as above.

Figs. 16a-b. *Acteocina hamadai* MASUDA, n. sp. Holotype, DGS, Reg. No. 1654. a, Apertural view, x 8. b, Dorsal view, x 8. Loc. Same as above.

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* IGPS=abbreviation for Institute of Geology and Paleontology, Sendai.

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

「日本古生物学会第62回例会」1955年10月29日東京教育大学理学部地質学鉱物学教室に於いて開催した（参会者36名）。講演者並びに講演題目は次の通りである。

ジュラ紀日本の古気候の一考察（代読）...前田四郎
A New Foraminiferal Genus from Katase Beach, Kanagawa Pref. .....Hiroshi UZIIE
On Some Species of *Elphidium*.....
..... Yukinori FUJITA
北海道釧路国支庁釧路郡昆布森村字アチョロ別附近舌羊層の有孔虫化石について（代読）吉田三郎
On a New type of Fusulinids Wall structure
.....Hisayoshi IGO
Neoschwageninae from the Shima Peninsula, Japan (代読).....Nobuo YAMAGIWA
愛媛県板取川層群の *Fusulina* 属について（代読）
..... 石井健一
Fusulinids from Onagata, Kamiyoshida-mura, Chichibu-gun, Saitama Prefecture, North-eastern Part of Kanto mountainland, Central Japan .....Rokuro MORIKAWA
Several minor Fusulinids from the Shomaru Pass, eastern Part of Kanto mountainland
.....Rokuro MORIKAWA
Parafusulina nakamigawai n. sp. from Adoyama formation in the vicinity of Kuzū city, Tochigi Prefecture .....
..... Rokuro MORIKAWA and Mankichi HORIGUCHI
A New Species of *Parafusulina* from the Kitakami Massif, Japan .....
..... Haruyoshi FUJIMOTO
Some Corals from Tateishi Formation (Lower Carboniferous) in the North-eastern Abukuma Massif, Japan .....Toshihiko SATO
Halysites Kitakamiensis SUGIYAMA from the Gotlandian formation in the Kuraoka district, Kyushu, Japan ...Takashi HAMADA
福井県九頭竜川上流芦谷コトランド紀（代読）...
..... 前田四郎
北上山地叶倉統産の腕足類 Orthotetinae 亜科の4種（代読） .....湊正雄・中村耕二
A New Species of *Lingula* from Hokkaido, Japan.....Ichiro HAYASAKA and Kotora HATAI
On Some Problems of the Thanatocoenosis in the Tokyo Bay.....Masae ÔMORI
Fossil and Recent Species of the Cultellid Mollusca from Japan .....Saburô KANNO
Notes on *Macoma optiva* (YOKOYAMA) .....
.....Shigeru AOKI
Stratigraphic Relations between the so-called Kadonosawa and Suenomatsuyama Faunas
.....Shigeru AOKI
Additional Fossil Mollusca from the Miocene Kabeya Formation, Jôban Coal-Field (代読)
..... Katsumi HIRAYAMA and Shigeru AOKI
On some Species of Lucinids from Japan, with Descriptions of New Species (Notes on Japanese Lucinids Mollusca Part 4) (代読).....Katsumi HIRAYAMA
Additional Fossil Mollusca from the Miocene Arakawa Group, Tochigi Prefecture Japan (代読) .....Katsumi HIRARAMA
仙台付近中新統産 Pectinidae その8 *Pecten* (*Pachinopecten*) *kimurai matumoriensis* NAKAMURA に就いて .....増田孝一郎
仙台付近中新統産 Pectinidae その9 *Pecten* (*Chlamys*) *miyatokoensis* NOMURA and HATAI に就いて .....増田孝一郎
Note on a species of the Early Triassic "*Bakevellia*" in the Sanchu Graben, Kwanto Massif, Japan.....Yukio YABE
Les Ammonites recueillies dans le Groupe de Kuruma, Nord du Japon Central.....
..... Tadashi SATO
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